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GEOLOGICAL EXAMINATION OF THE COUNTRY BETWEEN THE KING RIVER & KING WILLIAM RANGE.

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REPORT BY MR. L. K. WARD, ASSISTANT GOVERNMENT GEOLOGIST.

Launceston, 15th June, 1908.

SIR,

I HAVE the honour to present the following report upon the results of my examination of the country along the Linda Track, lying between the King River and the King William Range:—

I.—INTRODUCTION.

In accordance with instructions received, I left Launceston on 18th February, and having been recalled, returned thereto on 9th April.

In the field work I was assisted by M. Donoghue and W. Stewart, two experienced prospectors with a good knowledge of the West Coast.

The examination of the western section of the railway route was commenced at Gormanston, and the party moved eastward, examining the country on the way. It was originally intended that a junction should be effected with Mr. Twelvetrees' party, which was moving towards the King William Range from the Tyenna end of the route. The time allotted proved insufficient for this junction to be made, and a small central strip of the Great Western Railway route remains thus far unexamined by the Geological Survey Department. There is, however, good reason to believe that there occur in this unexamined strip no essential variations from the geological features of the country which came under observation by either Mr. Twelvetrees or myself at the furthest points reached by us.

The western portion of the proposed railway route follows, for the most part, the course of the Linda Track, and our investigation of the country was therefore made from this track.

The methods of the investigation of the area were especially chosen with a view to the prospecting of the country for mineral contents. This investigation on either side of the Linda Track took our party over a fair area of country, and the general geological features were noted, and are recorded on the geological map which is attached to this report.

The bearing of the general geology of the district on the question of the possible occurrence of mineral wealth is indicated, as far as possible, in the following pages.

One area was met with—at the source of the Collingwood River—which afforded indications of the possibility of the discovery of metallic ores. We were unsuccessful in our prospecting of this area. However, the time which could be given to this particular strip was quite insufficient for a thorough investigation, and the flooded condition of the rivers during the whole time of our stay at this spot seriously hampered the work of prospecting. And it must not be supposed that such prospecting work as was possible during so brief an exploration constitutes a conclusive test of the country examined.

It was, however, sufficient to give an idea of the geological conditions existing in the area, and to enable general conclusions to be drawn as to which areas may most reasonably be expected to carry metallic ores in payable quantities. The facts thus noted should serve as a basis upon which prospectors can conduct operations in the future. An indication is given, where possible, of the types of ore deposit most likely to be met with in the areas which do carry metallic minerals, or minerals such as tourmaline, which are commonly associated with the ores of some metals.

Since, in proceeding eastward from Gormanston, a mineralized area of notable wealth was the starting-point of the expedition, it will be appropriate to give a brief summary of the outstanding geological features of the Mt. Lyell area; for it might well have been expected that the mineralized zone of the West Coast Range would extend towards the east.

The abrupt alteration in the geological features at the King River is most marked; and, in the search for metallic ores in the area lying to the east of this river, it is necessary to form some general idea of the relation of the ores of the Mt. Lyell to the general geology of that district, the conditions limiting the ore-bearing part of the district, and the relation of the ore-bearing portion to the neighbouring area.

II.—GEOLOGY.

The Mt. Lyell District.

The following brief statement of the geological features of the Mt. Lyell district is merely an outline. The outstanding features only are mentioned, for the reason that no detailed investigation has yet been possible, and a full accurate account cannot be given without an exhaustive examination of the area.

The principal rock formations which constitute the ore-bearing portion of the district are two in number:

(*a*) *The Mt. Lyell Schists*, which constitute the outer schistose mantle of a belt of porphyritic igneous rocks which appear in an uncrushed state further to the west. These rocks are very variable in appearance, but the writer would unhesitatingly classify them as described, for they are exact counterparts of rocks which he has examined in detail at Mt. Farrell.

The age of these igneous schists has not yet been quite definitely determined. They belong, approximately, to the middle or lower portion of the Silurian system.

(*b*) *The West Coast Conglomerate*, which forms the main part of the capping of the higher portions of the range near Queenstown.

This conglomerate is essentially a quartzose one, and contains pebbles of all varieties of quartz, quartzite, and quartzite schist. The latter pebbles are undoubtedly derived from the quartz schists lying to the eastward, and described below.*

The relation of this conglomerate to the igneous schists of Mt. Lyell has not been worked out. If they do prove to have been formed subsequently to the solidification of the igneous rocks, the fact that pebbles of the latter are absent from the mass of the conglomerate is indeed remarkable. This characteristic was found by the writer to be a feature of the same conglomerate in the Mt. Farrell field, to the northward.

The age of the conglomerate is thus far undetermined. It has been recorded† that in the Zeehan field the Upper Silurian rocks lie upon the conglomerate, but there is so far no evidence collected to prove the exact lower limit of age. This is, of course, an important point to be decided, in order that an opinion may be formed as to the likelihood of obtaining valuable mineral deposits enclosed within walls of the conglomerate. Thus far we may say only that the conglomerate had already been built up before the principal period of ore-deposition in the West Coast region. It is, therefore, apparently possible that lodes may be contained within it, if the other necessary conditions are fulfilled. The conglomerate body is at least worthy of the attention of prospectors, who have hitherto regarded it as quite unfavourable.

There is a necessity for a detailed examination of the contact between the igneous schists and the conglomerate. There is a tendency to look upon the sedimentary rocks as a stratified series laid down upon the schists. This matter, however, requires further careful investigation before it can be accepted.

To the west of Mt. Lyell undoubted Silurian rocks occur. These are a series of shales, sandstones, and limestones, of which the only economic application thus far made is as fluxing material for the smelting of the copper ores.

On the eastern fall of the ridge between Mt. Lyell and Mt. Owen there is a vast mass of morainic material gathered together at the head of the Linda Valley.

In addition to this formation, there are some fragments of former sedimentary deposits, the greater portion of which has been denuded away by the action of the Linda Rivulet. These are unimportant commercially.

The principal ore-bodies of Mt. Lyell are situated in very close proximity to the junction between the schists and conglomerate, and are popularly termed "contact deposits." The objections that may be raised against the use of this term cannot here be fully discussed. The ores are situated at the junction of the schists and conglomerate—not because they are derived from either of these formations, but because the channels filled with the metallic ores have (for reasons thus far undetermined) followed a direction which closely coincides with the boundary between the two formations.

The ore-bearing channel is marked out at the surface by the occurrence of hematite.

The whole region is traversed by a very complicated series of faults, and the relations of the ore-bodies to the various fracture-systems have yet to be worked out.

The mode of origin of the ores does not seem likely to prove different in essential particulars from that of the majority of other West Coast ores.

Of the latter, those which have been carefully studied appear to have been introduced from below in solution.

The ores themselves in the Mt. Lyell District are of somewhat varying types. The Mt. Lyell ore is a dense pyritic one; that of the North Lyell Mine is a siliceous bornite ore; the Lyell Blocks Co. has mined cupriferous clays, and, besides these, there are many zones of schist irregularly impregnated with metallic minerals.

It will be seen from the foregoing account of the salient geological features of the Mt. Lyell District that there are many vital questions to be solved before any statements can be made with regard to the possible extension of these ore-bodies. The need for the solution of these problems is urgent, for the sake of recording information that can be employed by those engaged in the exploitation of the neighbouring properties, not so fully prospected as those of Mt. Lyell.

The brief examination which was made of the Mt. Lyell geology for the purposes of noting its general features and their possible connection with those of the country lying to the eastward showed the following facts:—

(1) The trend of the main geological formations in this district is meridional, or nearly so.

(2) The main axis of the mineralized zone seems to trend in a direction very nearly north and south, at the principal centre of mining operations.

(3) The mineral-bearing country at this point has not yet been proved to extend further eastwards than the western boundary of the West Coast conglomerate.

The topography of this portion of the West Coast Range is rather striking. The bold bare masses of conglomerate form the bulk of the higher portions of the range, viz., Mt. Owen, Mt. Lyell, and Mt. Sedgwick. These ridges are deeply dissected by the processes of general degradation; and, as has been noted, glacial action has left its marks upon the Linda Valley.

The mountain streams are still actively corroding their channels downwards.

The total destruction of the vegetable cover in this region has accentuated the sense of desolation conveyed by the great conglomerate mountains, with their rugged summits and steeply graded sides.

The Linda Valley narrows considerably on passing eastwards, through the close approach of the eastern spurs of Mts. Owen and Lyell, and the Linda Rivulet finds its outlet to the King River through a narrow gorge.

The present topographic features of the area are due, in the first place, to a complicated series of fractures and dislocations in the West Coast conglomerate and the igneous schists; and secondly, to the modification of these features by the action of ice and water; and the processes of surface-degradation have been greatly accelerated in late years by human agency, through the destruction of the vegetation.

The King River Valley.

At the King River both topographical and geological features change abruptly. The eastern spurs of the West Coast Range descend precipitously to the King River, which flows southwards at their base.

Beyond the river no sign of the conglomerate appears. The West Coast Range terminates abruptly, and on the eastern side of the King River lies a flat, marshy plain, some 2 miles in width. This plain has been so covered with "button-grass" vegetation that its floor is almost wholly concealed, in spite of the bush fires which have swept across it and charred its surface. There are, however, some low prominences of small extent which show the foundation-rock to be a soft dark slate, upon which a quartzose alluvial cover forms a thin layer.

This slate appears to extend to the foot of the West Coast Range, and may possibly dip under the conglomerate at the King River.

However, I was unable to find any evidence bearing on this matter during this expedition.

On the other hand, the extremely abrupt termination of the West Coast Range would seem to suggest a great fault-plane as the boundary between the slate and the conglomerate.

The strike of the cleavage-planes of this slate is usually a little east of north; but it varies, and is even west of north in places.

However, this strike of the cleavage-planes does not represent that of the original bedding-planes.

The bedding and cleavage-planes can both be seen together on the eastern side of this slate belt near the Princess River. At this point the original shales have been interbedded with a fine-grained sandstone. The bedding-planes strike N. 25° E., and dip to the west at 65°. The cleavage-planes cutting across these strike N. 10° E., and dip to the west at 78°. From these figures it is clear that the cleavage and bedding-planes both indicate a westerly dip.

With regard to the age and relations of this slate belt no definite statement can be made. Yet inferences can be drawn from the geology of other areas which are

* *Vide infra*: p. 14, *et seq.*

† G. A. Waller: Report on the Zeehan Silver-lead Mining Field, 1904, p. 3.

at the present time better known. In the district of Mt. Farrell, 24 miles further north, there are represented a series of very similar slates. The Mt. Farrell slates have been intruded by the felsites and porphyries, some of which have been converted into schistose types. The igneous schists and the porphyries of the Mt. Lyell area are, in my opinion, portion of the same igneous invasion.

If this be granted, and if the slate belt also corresponds to the Mt. Farrell slates, the age of these slates in the King River Valley would be greater than that of the Mt. Lyell schists. I am of the opinion that we are justified in making the provisional assumption that the general sequence has been the same at Mt. Lyell as at Mt. Farrell, until further evidence is available.

On this assumption, the slate may be expected to carry ore-bodies where the necessary conditions are fulfilled. For it is probably older than the ore-bodies of Mt. Lyell; and should there be discovered within its boundaries any fractures which extend downwards to the source of the ores, these fractures may be the *loci* of ore-deposition.

Nevertheless, in that portion of the slate belt which came under my observation, no indications whatever were seen which would point to the presence of any valuable minerals. Unfortunately, there are few outcrops available, and none are of any magnitude. The visible portions of the formation show neither metallic contents nor signs of lode-structure.

Between this slate formation and the rocks lying to the eastward is a fringe of river alluvial, where the ground begins to rise from the plain of the King River. The principal constituents of the alluvial material are boulders of diabase, some of these being of very large size.

No diabase could be found *in situ*, but all of the creeks in this locality carry pebbles of it.

The diabase has apparently at one time extended over a very much wider area than that which it now covers. On Mt. Sedgwick stands an outlier, which may be portion of the mass which forms the present capping of the Eldon Range; and the rounded pebbles and boulders are probably derived from some portion of this mass, for they become less and less numerous, and finally disappear as we pass eastwards.

The Nelson River Valley.

On leaving this old river gravel and following the Linda Track eastwards, the first consolidated formation met with is a white sandstone, containing some bands of shale interstratified with the sands. The dip seems to be always at a low angle towards the west. One excellent exposure in the bed of a small tributary of the Nelson River showed the strike at that spot to be N. 14° E., and the dip westward at an angle of 24°.

The sandstone is fossiliferous throughout, but most of the imprints are obscure. Some fairly-well preserved remains of some brachiopods were obtained in one creek which runs into the Nelson River. From these it would appear that the sandstone is of Silurian age.

Whether it lies upon the King River slate series unconformably cannot be seen for the cover of river alluvial above mentioned. The dip is notably flatter than that of the slate, and I do not think it likely that the two formations will prove to be conformable.

Moreover, the fossil-bearing sandstone shows no signs of having undergone any crushing like the slate, and the fossils are free from all signs of deformation.

The sandstone is terminated southwards by the Nelson River, but runs back in the direction of the Eldon Range.

Eastwards, this sandstone extends a little further than the ridge which forms the divide between the Nelson and Collingwood rivers.

Near the eastern extremity there are some inconsiderable outcrops of limestone, which seem to be bedded with the sandstone and to form the lower layers of the series. They do not seem important, and are largely covered by the fragments of weathered sandstone from the upper portions of the slopes.

I could see no trace of the existence of any fossils in the limestone.

The sandstone series rests upon a floor of massive quartzitic and micaceous schists.

It may be here noted that the succession of formations in this area is exactly the same as that represented in the northern portion of the Mt. Farrell District, and the sediments of the Nelson River correspond very closely to those of the White Hawk Creek.

On the southern side of the Nelson River there is no appearance of the sandstone series. On leaving the river and ascending the Raglan Range the lower slopes are covered with button-grass. Above this there is little vegetation left, except in the gullies occupied by tributaries of the Nelson. The bush fires have completely destroyed all the rest; and above the charred slopes rise rugged blocks of quartzitic schist. The whole of the Raglan Range is composed of this material which needs detailed description on account of the very large area on which it occurs.

It is difficult to give a single name to the formation, for the reason that its character is continually changing. The proportion of quartz to the micaceous ingredient is very variable, and while at times the rock appears almost wholly quartzose, it is at others a typical mica-schist.

The quartz is sometimes finely crystalline and granular, or coarse like reef-quartz, or chalcedonic, or, on rare occasions, clear and glassy. There are very occasional portions within this formation which are obviously siliceous sediments, hardly altered beyond a slight silicification, and which thus indicate the origin of the rock.

The structure varies widely also. The quartzose types are at times quite massive and non-cleavable. More usually there is a well-marked cleavage, which may attain a remarkable degree of perfection in one direction, so that the rock can be cleaved into sheets almost as thin as paper. However, although many varieties are cleavable, the cleavage surfaces are not always plane. Examples of these contorted quartz schists are to be seen in the form of pebbles in the West Coast conglomerate, together with pebbles formed of the other varieties from this formation.

The cleavages are due to the development of a sericitic mica, which is sometimes almost invisible on account of the extreme tenuity of the film. This mica increases in abundance in other varieties, till a typical mica schist is formed.

No hard and fast lines separate this type from the more quartzose ones, and it is impossible to mark out any definite boundary lines between the two.

In the more micaceous varieties the cleavages are less regular, and there are often knots and depressions on the cleavage surface, although the minerals causing the elevations or knots have not developed beyond the embryonic stage. The colour of these micaceous varieties varies from pale yellow to dark grey, with an occasional reddish tint on account of the presence of hematite.

The hard quartzose varieties—quartzite schists—are those which build up the mass of the Raglan Range. If the Silurian sandstone ever stretched southward across the Nelson River it must have been at a higher level than any portion of the formation now visible. For the Raglan Range looks over all the sandstone hills to the north of the Nelson River, and on its slopes there are no signs of the sandstone formation.

In this area there are no signs of the exact age of the quartz mica schists. The only fact discernible is that they form the basement upon which the Ordovician and Silurian sediments were deposited.

The Nelson River receives the waste of the Silurian sandstone and the quartzite schist. The grade of the river is not a steep one, and the rock-waste is therefore abundant in its bed. The result of this is that it is difficult to find a spot where there is a "bottom," upon which the gold, if any, washed down by the streams might be caught.

The main creeks and the tributaries right along the Nelson River Valley were tried without any reward whatever.

The only metallic minerals which were met with in any part of this area were enclosed within the quartzite schist.

In one place, on the top of the Raglan Range, some specular iron ore and micaceous hematite were met with.

Near the head of the Nelson River the quartzite schist is to be seen on the northern side of the river. One portion of this schist—here somewhat greenish in colour—carries a little pyrites and arsenical pyrites. The mineralized area is a very small one, though the gossanous cap would seem to indicate a larger proportion of the metallic minerals. A little work has been done here, and a trench cut for a few feet in the mineral-bearing rock.

However, nothing more than the one patch of rock showing the pyritic impregnation is to be seen, and no mineral of value is associated with it at this point.

There is no sign at this place of any regular lode-structure. The channel whereby the pyrites has been introduced is not now apparent. A few other similar impregnations of the quartzite schist have been observed, both in the district now being described and further north on the flanks of Mt. Swallow, near Granite Tor.

In all cases the mode of occurrence appears to be the same, and there are no indications of any continuous or regular systems of fissuring.

These deposits, therefore, offer no inducement to prospectors, in spite of the presence of the pyritic minerals which are frequently the associates of the valuable minerals in other types of ore-deposits.

The Collingwood River Valley.

On approaching Bubb's Hill both banks of the Nelson River are thickly timbered, but once past the divide there are some miles of open country along the strip lying between the Collingwood River and the foot of the Raglan Range.

There are a few low hills rising above the general level of the country, which is here constituted mainly of the mica schist, with which are associated only bands of the harder quartzite schist.

To the northward, across the Collingwood River, the country is very densely timbered as far eastwards as the valley of the Inkerman River.

Here and there, lying upon the mica schist of the floor of the low country north of the Raglan Range we met with numerous fragments of silica veins, in which needles of black tourmaline occur.

The veins from which these fragments were shed were found in the mica schist, and proved to be very irregular in form and of small horizontal extent. There was no metallic mineral associated with those veins which I examined. Nevertheless, the presence of the tourmaline is by no means to be overlooked, on account of the remarkable character of this mineral.

Tourmaline is a mineral found usually in veins, and formed by the chemical action of boric vapours upon the wall-rocks of the veins during the processes of vein-filling.

Its presence in the vein-matter usually means that certain definite types of mineral veins are represented, and that the locality in which these veins occur is at no great distance from a granitic mass.

The principal types of mineral veins with which tourmaline is a characteristic associate are two in number :—

(1) *The tin ore v ins*, represented in several different localities in Tasmania, *e.g.*, Heemskirk, Stanley River, Mt. Bischoff, Poimena, &c.

(2) *The cupriferous gold-quartz veins*, of which the Mt. Black deposits form a Tasmanian example.*

The future prospecting of this district should therefore be directed by this knowledge of the most common mineral associates of the tourmaline.

The Cardigan and Collingwood Rivers were tried in vain on the occasion of this exploration of the area. But our search for stream deposits was very greatly impeded by the swollen condition of these rivers during the time of our examination.

The more permanent minerals,—*i.e.*, those most likely to survive the chemical processes of weathering and the grinding action in the river beds, and to be concentrated in the sands and gravels on account of their specific gravity—which are associated with these types of veins are cassiterite, wolframite, gold and iron pyrites. None of these were recognised in the gravels which we examined.

It has been mentioned that tourmaline is usually associated with a granitic magma. In the examination of this district our search for a rock with granitic relationships was rewarded.

This discovery is one of more than purely scientific interest, since the greater part of the ore deposits of Tasmania are visibly associated with rocks which are either granites or the less deeply seated equivalents of the granitoid type.

And in the cases cited above, where either tin ores or cupriferous gold quartz ores are found in Tasmania, there are rocks derived from granitic magmas invariably present.

The rock type found in the Collingwood River Valley is that which is known as "pegmatite." The term "pegmatite" is applied to the coarse-textured varieties of deep-seated igneous rocks, which are found cutting through the rock of normal texture, and sometimes protruding into the adjacent rocks. The typical pegmatite is notable for the way in which its constituents, especially quartz and felspar, become mutually intergrown during the solidification of the rock. These peculiar modifications are derived from the same mass as the normal types, but differ from them in being usually the final products of consolidation, and consequently, for reasons which cannot be here discussed, more siliceous in composition.

On the southern bank of the Collingwood River, and 15 chains eastwards from its junction with the Cardigan River, there are some small lenticular veins of the pegmatite. The quartz and felspar are intergrown, as in typical examples, and the mica is coarse-grained and of a pale silvery colour.

These veinlets are only 4 inches in width where they are exposed to sight, and they only extend for a couple of feet in length. They are enclosed within the folia of the mica schist, and conform to the foliations, so that they appear to partake of the schistosity of their host.

The strike of these veins at this point is W. 20° N., but these figures must be used with caution; for the foliation-planes of the schist are ever varying in strike throughout the district, and the intrusions of pegmatite have followed the directions which would admit of their introduction with the least expenditure of energy.

The discovery of this occurrence adds considerably to our knowledge of the distribution in Tasmania of the granite with which so many of our ore-deposits appear to be genetically associated.

It is certainly a slight assumption to attribute this pegmatite to the Devonian granite, rather than to the older granitic masses which occur on Mt. Darwin and at Mt. Farrell. However, these latter granitoid types are associated with the older porphyritic intrusives and effusives (many of which have been rendered schistose), and are not known to have been accompanied by acidic excretions. On the other hand, the Devonian granite shows a marked tendency towards the development of these pegmatitic modifications.

The locality at the Collingwood River is, in my opinion, a sure proof of the proximity of the granite which has been exposed at the surface by the denudation of its original cover—at Granite Tor, on the north: and at Cox's Bight, on the south. Other intermediate localities may yet be found as the examination of the western portion of the island proceeds.

Our prospecting of the river beds below this occurrence resulted in the discovery of a little pyrites, but no mineral of any value.

Beyond this last occurrence there is no variation from the mica schist for half-a-mile to the eastward. Then there is a notable alteration in the mineral composition of the mica schist, which is found to carry garnets in some of the darker-coloured bands.

And on following the bed of the Collingwood River where the bed-rock is laid bare it was found that the mica schist is intersected by an amphibolite of a remarkable type.

The mica schist at the contact varies from its normal composition through the development of a felspathic mineral; consequently, the schist near the amphibolite resembles a muscovite gneiss.

I was unable to satisfactorily determine the relation of the amphibolite to the schist, although I have little doubt that the former is intrusive into the schist. The only outcrops available for examination were situated in the river bed, and the river was in flood.

However, the specimens collected show that there is a coarse-grained amphibolite, of which some varieties are free from garnets and are not noticeably schistose. Other varieties show abundant garnets and zoisite crystals, the latter with a general parallelism of arrangement. These types in turn give place to zoisitic schists, in which garnets occur scattered here and there, or are confined to definite bands, and the amphibole is segregated into short lenses.

In some of the garnetiferous varieties there is a considerable amount of pyrites, which shows on every fresh fracture-surface, and with it now and then is a little copper pyrites.

It seemed to me that the massive amphibolite formed the central portion of this complex, with the garnetiferous zoisitic schists on either side.

The various types all weather to a rock, of which the garnet seems to constitute the greater part; but although there are bands in the schistose types which are almost wholly composed of garnet, the proportion of the other constituents is greater than weathered surfaces indicate.

The exact dimensions and orientation of the mass could not be determined.

The amphibolite probably represents a basic intrusive rock, altered by dynamical metamorphism.

On following the river eastwards two other entirely similar zones of amphibolites, carrying zoisite and abundant garnet, were met with. They are probably closely connected with the first in origin, as they are in mineral composition. All three occurrences of the amphibolite lie between the intersections of the Balaclava and Cardigan rivers with the Collingwood.

Immediately to the east of the garnetiferous amphibolite, and within 5 chains of the point where the Balaclava River joins the Collingwood, there is a dark-grey argillaceous schist, which is very densely impregnated with iron pyrites. Here, too, a little copper pyrites was discernible in the impregnated zone, which extends for a width of 16 feet, measured along the river bank.

* G. A. Waller: Report on the Ore Deposits, other than those of tin, of North Dundas, 1902.

No gold was obtained from our pannings at any of these occurrences of sulphides. Nevertheless, the presence of the metallic minerals in this area is an indication of the former operation of mineralizing agencies; and the observed points of outcrop are worthy of the attention of prospectors.

The information to be gathered at this point concerning the strike of the formations must be treated with considerable caution. For it is highly probable that the foliation-planes of the mica schist will exert a controlling influence upon the direction of both the dip and the strike of any mineralised zone contained within it, and the mica schist at times shows marked variations in the strike of its foliation-planes from point to point.

From the Balaclava River eastwards no occurrence of any igneous rock was noted until the diabase which caps the eastward mountains—Mt. Gell and the King William and Lodden Ranges—was reached.

The greater part of the area is composed solely of the quartzite schist and mica schist. The several varieties are all represented in the valleys, but the high country is constituted solely of the more quartzose types; and the physiography of the district is that of a region long elevated, but still one in which, owing to comparatively recent readjustments of level, the river systems are actively engaged in the work of degradation. The several rivers are all marked by the presence of small falls and rapids, and here and there traces of former river deposits are to be seen forming the banks of the present rivers. For instance, at the Wire Bridge the Collingwood cuts through its former bed, which is now left high above water-level.

The most prominent constituents of the gravel of these river deposits are the pebbles of diabase, which have been derived from the high country on the eastern side of the Alma River, viz., Mt. Gell and Mt. Hugel. Some boulders of the abovementioned amphibolite were also observed, and a few rounded fragments of fossiliferous sandstone, which seem to have come from the Permo-Carboniferous coal measures.

The Alma River is the only one which carries these pebbles of diabase and sandstone. The other rivers flowing into the Collingwood from the north carry pebbles of the quartzite schist and mica schist only; so no other formation of any size can be expected to be met with inside the area drained by these rivers.

Between the Balaclava and the Franklin rivers the softer mica schists of the Collingwood River Valley carry some irregular veinlets or lenses of quartz, which either conform to the planes of foliation or cut across these at varying angles; in fact, in no case was it possible to determine any persistent system of fracturing, since the strike and dip vary even in one and the same vein.

Some of the quartz veins carry a small amount of iron pyrites, but no gold was found associated with any such occurrences.

These veins of quartz appear to me to be only one of the results of the general siliceous impregnation of the district, the more obvious effect of which is the conversion of the quartzose sediments into quartzites.

All along the route these quartzites are constantly recurring; and in the Collingwood River Valley, about 2 miles north-west of the Wire Bridge, many cases occur showing the old sedimentary rocks but little altered from their original condition.

They would seem to have been originally sandstones and shales, and a few of the quartzitic bands appear to have been, in their unaltered condition, conglomerates.

The Collingwood and Franklin Rivers unite and flow westward round the base of the Frenchman's Cap and between this mountain and the Raglan Range; and the steeply-sided gorge of the Franklin is cut through the quartzite schist.

The Raglan Range, the Collingwood Range, Junction Peak, Mt. Mullens, and the huge mountain mass I have called Mt. Hardy, lying between Mt. Gell and the junction of the Collingwood and Franklin Rivers, are the most prominent elevations in the immediate vicinity of the railway route.

Southwards, the higher country, as for instance the great mountain known as the Frenchman's Cap, and the summit of the distant Prince of Wales Range, are gleaming white, and have every appearance of being mainly constituted of these same quartzite schists.

No change was found towards the east between the Collingwood River and Mt. Arrowsmith. The same mica schist alternates with the quartzitic variety, and sporadic veins and lenses of quartz occur, which carry pyrite or hematite.

It is somewhat noticeable that the strike of the planes of foliation of the schistose rocks varies through wide angles from point to point.

On the Raglan Range, south of the Nelson River, the strike is generally a few degrees west of north, and the dip westward. At the Wire Bridge the strike is north-west and south-east, and the dip is to the south-west. On the southern slopes of Mt. Hardy the strike line runs east and west, while the dip is to the south.

Yet the mention of these directions of strike and dip by themselves is apt to convey a false impression; for the strike lines of the foliation-planes are contorted lines, which vary greatly in direction within short distances.

They leave a general impression that the prevailing direction of the strike is to the east of north and the dip north of west. The angle of dip of these foliation-planes is also very variable, and perhaps most often between 50° and 60°.

The Central Plateau and Mountain Ranges.

On the north-western portion of the summit of Mt. Arrowsmith, and 1600 feet above the Franklin River Bridge, there is left undenuded portion of a sedimentary basin, the full extent of which is not now clear. The strata consist of bedded shales, sandstones, and fine-grained conglomerate, which dip at an angle of 5° to the west. The sandstone contains some imperfectly preserved impressions of brachiopods, which are probably of Silurian age.

This series of sedimentary rocks would therefore appear to have at one time been continuous with the Silurian rocks of the area situated on the northern side of the Nelson River.

At this place the area covered by the sediments is very small, and fills a hollow in the hard quartzitic schist, to the endurance of which it owes its preservation.

The rest of the summit of Mt. Arrowsmith is wholly of the white foliated quartz schist. This same formation extends across the Franklin River and runs far up the sides of Mt. Gell. However, I was unable to ascend the latter mountain, and cannot say whether the quartzitic schist continues right up to the diabase which forms the capping, or whether any of the sedimentary series of Silurian or Permo-Carboniferous age take a share in building up the mass of the mountain.

Mt. Arrowsmith forms the western escarpment of the central plateau. Passing eastwards, the Linda Track reaches a maximum elevation of 3050 feet above sea-level on Mt. Arowsmith, and there is a fall of only 500 feet in the next 5 miles, when the King William Plains are reached.

Once over the crest of this escarpment the white quartzitic schist gives place to a green mica schist, which is only to be seen where the button-grass cover has been stripped in track-cutting. On both the north and south sides of this green schist the quartzitic facies again appears, and I have no doubt that the green schist belongs to the same formation.

After crossing this belt of green schist a sudden alteration of the country-rock is found.

A low hill on the northern side of the Linda Track proved to be composed of a medium-grained reddish quartzite. There are numerous short lenticular veins of white quartz, and here and there a tendency towards a replacement of the silica by hematite. In all respects this quartzite resembles very closely the reddish quartzite which is associated with the West Coast conglomerate. The dip is north-westerly, at an angle of 40°.

This formation rests upon a floor of the quartzite schist which runs northward to Lake Dixon, and forms the basement of the south-western slope of Mt. Rufus.

South and east of the reddish quartzite the schistose series gives place to diabase, which continues without interruption on the lower-level country to the King William Plains.

It is not, I think, a portion of the same mass of diabase which forms the upper portions of Mts. Gell, Rufus, and King William; for on ascending Mt. King William a great thickness of Permo-Carboniferous sandstone was found to intervene between the diabase at the foot and that which forms the whole summit of the range.

The diabase, therefore, forms two great sills, of which the upper one extends further to the west than the lower. For the Loddon Range, between the King William Range and the Loddon River, is capped with diabase, which may possibly have once formed a continuous sheet across the present site of the Surprise River Valley and Mt. Arrowsmith to Mt. Gell on the north. In fact, there may have been some connection between this mass and that which caps the Eldon Range and forms a peak on Mt. Sedgwick

Diabase is a rock which has not consolidated at the surface. It probably forced its way in a horizontal direction below a considerable cover of sediments of younger age than any of those met with at the present time in this area.

The present mountain ranges are typically such as are created by the agencies of denudation. So the diabase which now caps the ranges occupies that position on account of the superior hardness of the rock and the inequalities produced by a long period of elevation in a region of considerable rainfall.

The diabase on the eastern slopes of the Loddon Range seems to rest upon quartzite, so that the Permo-Carboniferous sandstone cannot have continued far towards the east.

The Permo-Carboniferous sandstone, where it was observed on the north-eastern slopes of Mt. King William I. was dipping at an angle of 4° or 5° to the east. It is fossiliferous at this place on one horizon, and showed good impressions of *fenestella* associated with some obscure casts of a spirifer.

The exact thickness of sandstone is very difficult to ascertain on account of the dense cover of vegetation and the fragments of diabase which have descended from the summit. It is, on the north-eastern spur of Mt. King William I. at least several hundred feet in thickness; but I was unable to ascertain on this journey whether it appears on the western slopes of the mountain.

On the top of the King William Range there is nothing whatever but diabase showing. The surface is rugged, and only stunted shrubs are to be found filling the hollows and growing in the crevices between the angular blocks of diabase. The jointed character of the diabase assists largely towards its rapid disintegration, and the action of frost must play a very considerable part in the process of weathering.

The peaks at the northern extremity are fringed at the base by a talus breccia of great blocks of the diabase.

There are numerous lakes on the summit of the mountain, the principal ones having an outlet into the Surprise River, which rises at the pass through the King William Range.

The Surprise River has cut its way down at the lower end on to the quartzite schist floor. On the eastern bank of the river under Mt. Arrowsmith there are some traces left of a former limestone basin. The limestone appears to rest upon the quartzite, and its age was not determined, for no fossils were met with, and the extent of the formation was very small.

On the southern side of the Franklin River a very brief examination showed the presence of the quartzite schists with other schists of a micaceous or argillaceous character. In one place the latter variety was graphitic, and in two or three localities veinlets of quartz carrying a few specks of pyrites were observed.

These schists are overlaid by a sandstone, of which only the north-western limits were met with. Its extent to the east and south could not be determined.

Some obscure markings were observed in this sandstone on the tongue which separates the two branches of the Loddon River. These may have been fossil imprints, but they were not of any use in the determination of the age of the formation, which is at present unknown.

No sign of any lode-formation or mineral-bearing rock (other than the short lenses of pyritiferous quartz in the schist) were found in the whole of this region.

In the strip of land between the Surprise and Franklin Rivers, at the foot of Mt. Arrowsmith, there is a shaft some 6 feet square put down for 12 feet in river wash. The work has been done a very long while ago, and no sign of the material removed now remains round the pit. I do not think any encouraging results can have been given for the work done in this place. Again, on the banks of a creek running northward along the foot of the eastern slopes of Mt. Arrowsmith, a few shafts have been put down. The object in view is not now apparent. No lode-formation is visible, and the material heaped about the collars of the shafts does not differ from the normal country-rock at that point. The shafts are full of water.

In the following table is given a summary of the various geological formations mentioned in this report. They are presented in their order of succession, as far as can be done with the knowledge at our command, and the latest formed appear at the head of the column.

The evidence weighed for the determination of the geological succession has been gathered from other districts than that described in this report.

Table of Succession.

Geological System.	Representative Formations.
RECENT.	Present-day river gravels, and remnants of older fluviatile deposits.
MESOZOIC.	Sills of diabase, forming the floor of the central plateau, and capping the higher ranges, viz., King William and Loddon Ranges, Mts. Gell, Rufus, and the Eldon Range.
PERMO-CARBONIFEROUS.	The siliceous sediments of the coal measures forming the central portion of the King William Range.
DEVONIAN.	The lenticular veins of pegmatite in the mica schist of the Collingwood River Valley.
SILURIAN.	1. The siliceous sediments (with some interbedded limestone) of the area lying to the north of the Nelson River and upon the summit of Mt. Arrowsmith. These formations are free from foliation. 2. The Queen River porphyries and Mt. Lyell schists derived from them. 3. The West Coast conglomerate and its associated quartzites, forming the main mass of Mts. Owen, Lyell, and Sedgwick.
ORDOVICIAN.	The King River slates, containing narrow bands of interbedded sandstone.
PRE-CAMBRIAN.	1. The dykes of garnet-zoisite-amphibolite intersecting the mica schists of the Collingwood River Valley. 2. The quartz-mica schists forming the basement upon which the later sediments are laid, and constituting the greater bulk of the Raglan and Collingwood Ranges, the Frenchman's Cap, Mt. Hardy, Mt. Mullens, Junction Peak, and the lower slopes of Mt. Gell and the Loddon Range.

III.—THE MEANS OF APPROACH TO THE AREA EXAMINED.

The prospectors who may decide to make a trial of any portion of the area examined will probably, it must be granted, start from the West Coast mining districts, and work eastwards.

This being so, the Linda Track will undoubtedly be the best and most accessible means of approach. It will allow of the packing of the necessary provisions on horses from the Linda Valley or Gormanston right through to the Iron Store.

The track was in very fair condition at the end of our journey. Some portions of it need to be cleared of the scrub on either side, and this could be done with a very small expenditure.

The taller trees falling across the track cause obstructions which are difficult to negotiate with horses where the slopes are steep; but the track is constantly used for the repair of the overland telegraph line, and the fallen logs are removed by the repairers.

The track had been very thoroughly cleared of the larger obstructions when we last passed over it.

This track is likely to be seriously impaired from time to time by the damage done to the minor bridges and culverts by the many floods which constantly recur, and will therefore need periodical examination and repair.

It is used at the present time by the miners who are making towards the West Coast or returning thence, for it is much the most practicable overland route between the West Coast and the more settled portions of the island.

A track has been cut to open up the country south of the Franklin River.

This track is begun on the southern side of the Franklin River, where a gap in the hills occurs. The river is broad at this place, and a considerable bridge would be necessary to make a permanent connection with the Linda Track; for the Franklin River has a steeply graded bed, and the amount of water it carries is considerable.

It would be, however, a comparatively simple matter to cut a track round to the present Franklin Bridge, which is further up stream. The Surprise River would have to be crossed, but that would not be difficult on account of the narrowness of the gorge and the abundance of large timber on the banks.

This track will admit prospectors to the country lying to the south of the Loddon Range and to the east of the

Frenchman's Cap—a district from which gold is said to have been obtained.

The Franklin River Bridge may be reached from the east with ease by the cart track which leads from the Lake Country, as far as the Iron Store. A cart cannot, however, approach any nearer to Mt. Arrowsmith than the Iron Store.

From the south-eastern districts there is a good rough foot-track cut along the railway route leading from the King William Plains through the pass in the King William Range, and down the valley of the Surprise River to the Linda Track on the slopes of Mt. Arrowsmith. This avoids the roundabout route past the Iron Store.

From the northern districts the Alma River Valley affords the best-graded passage. It can be followed from the Counsel Track at Coal Hill to the Collingwood River near Redan Hill, and the country appears open for at least the greater part of the distance. The portion near the Collingwood River certainly affords good travelling.

On the Linda Track there are three huts, which will serve prospectors as convenient stages at which to rest, and as depôts from which stores can be carried back into the less accessible places. These are known as :—

(1) The "Wooden Store," which is a galvanised iron hut, situated at the foot of the eastern slopes of Redan Hill.
(2) The "Cockatoo Hut," a log hut situated on the northern bank of the Franklin River, at the south side of the hill known as Artist's Hill.
(3) The "Iron Store," a more elaborate iron building, situated on Burns' Plains, at the foot of Mt. King William I.

At all of these places there are stables for horses. The huts themselves are in fair repair at the present time.

It is said that a certain section of the travellers who use the Linda Track have from time to time partially destroyed these buildings for firewood. These acts of vandalism are caused surely by thoughtlessness, and a notice posted in the huts informing travellers that these buildings have been erected by the Government for the benefit of those using the overland track should be sufficient to prevent any further destruction.

IV.—Recommendation for Future Operations.

In the event of there being a continuation of the prospecting operations during the following summer, I beg to recommend that the area lying to the southward of the strip here reported upon be examined as carefully as possible.

There are persistent rumours concerning the presence of gold in the area at the head of the Denison and Jane Rivers; and copper ores have been reported to occur within a few miles of the Gordon River at Pyramid Island.

This block of country could be visited and examined by a party operating from the track recently opened up by Mr. R. A. C. Thirkell, and extending from the Franklin River, near the foot of Mt. Arrowsmith, to the Gordon River at Pyramid Island.

Moreover, the information to be gathered on this proposed expedition could be correlated with that which has recently been obtained by Mr. Twelvetrees by an eastward journey as far as the Prince of Wales Range.

An examination of this portion of the island is urgently needed, and the information to be gained will be of value, not only in the prospecting of the immediate district concerned, but also in the fuller interpretation of the geology of Tasmania.

With this report I am forwarding three plans, viz :—

(1) Topographical chart of the area examined.
(2) Geological map
(3) Two generalised sections to illustrate the relationships of the several formations.

I have the honour to be,

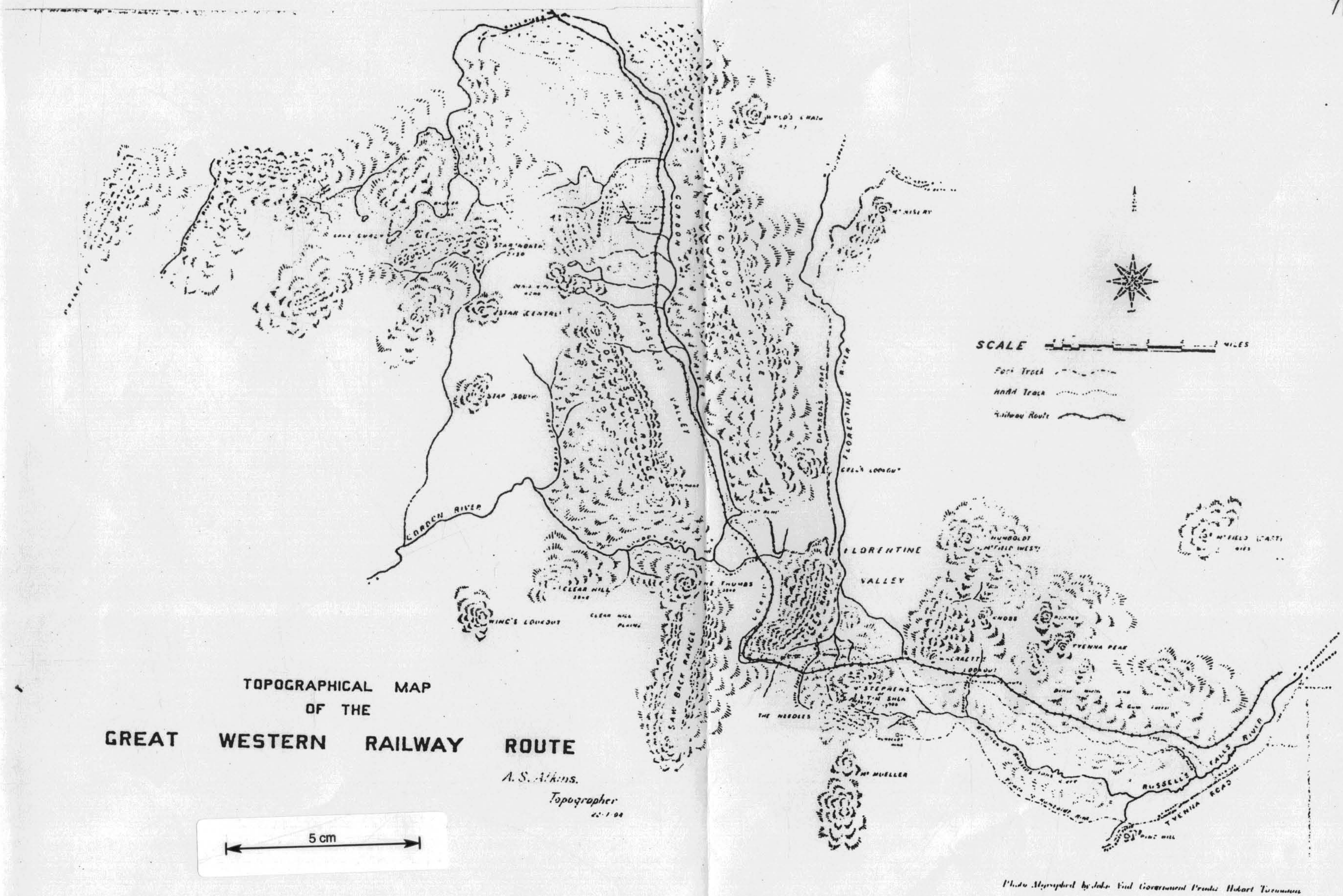
Sir,

Your obedient Servant,

L. K. WARD,
Assistant Government Geologist.

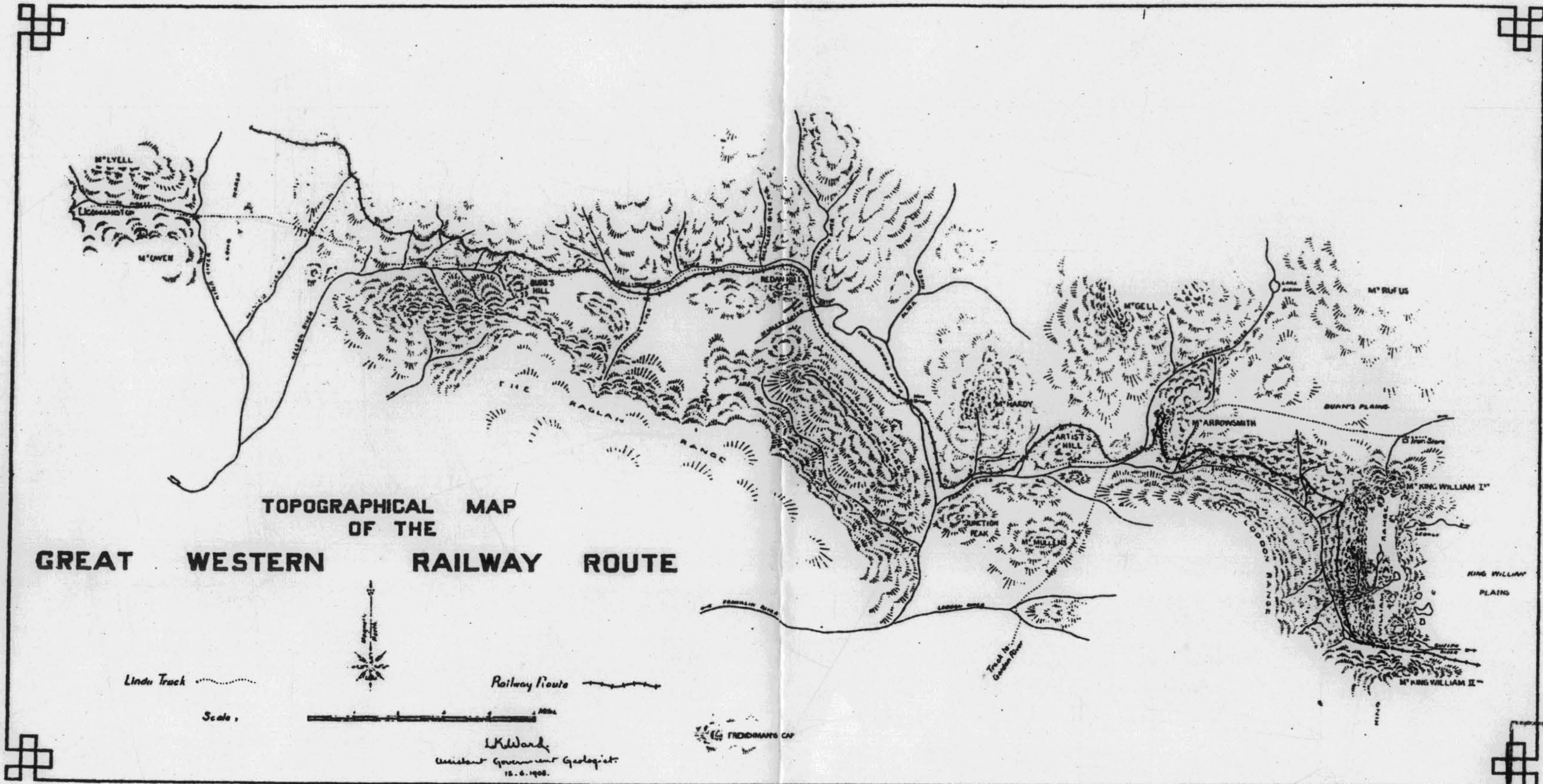
E. A. Counsel, Esq.,
Surveyor-General and Secretary for Lands.

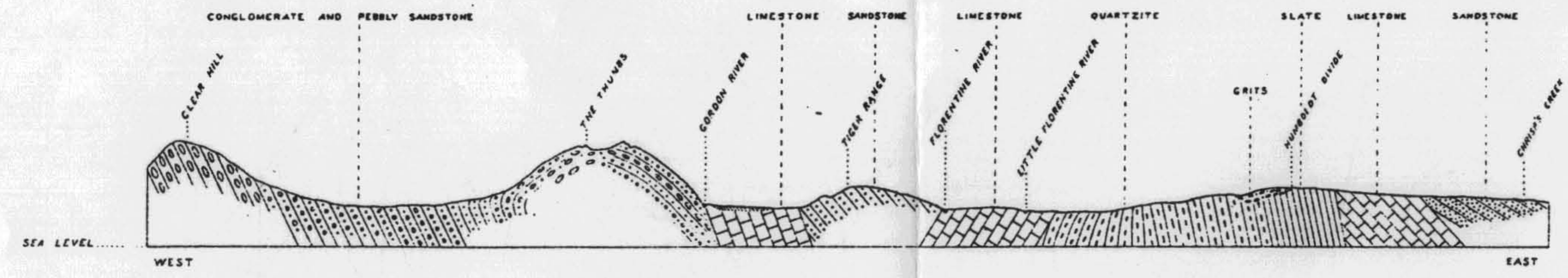
8/14



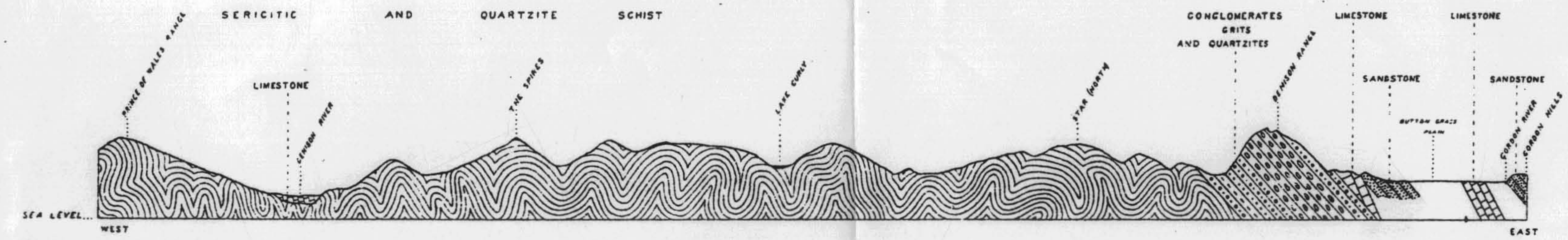
TOPOGRAPHICAL MAP
OF THE
GREAT WESTERN RAILWAY ROUTE
A. S. Aikins.
Topographer
SCALE
MILES
Foot Track
Horse Track
Railway Route
GORDON RIVER
GORDON VALLEY
FLORENTINE RIVER
FLORENTINE
VALLEY
SAW BACK RANGE
THE THUMBS
CLEAR HILL
KING'S LOOKOUT
THE NEEDLES
Mt STEPHENS
Mt MUELLER
HUMBOLDT
TYENNA PEAK
RUSSELLS FALLS RIVER
TYENNA ROAD
Photo-lithographed by John Vail Government Printer Hobart Tasmania

5 cm


TOPOGRAPHICAL MAP
OF THE
GREAT WESTERN RAILWAY ROUTE
M^T LYELL
M^T OWEN
BUSS'S HILL
RAGLAN RANGE
M^T GELL
M^T RUFUS
M^T HARDY
M^T ARROWSMITH
ARTIST'S HILL
JUNCTION PEAK
DUNN'S PLAINS
M^T KING WILLIAM I^ST
KING WILLIAM PLAINS
LODDON RANGE
M^T KING WILLIAM II^ND
FRENCHMAN'S CAP
Track to Gordon River
Lindu Track
Railway Route
Scale.
L.K.Ward
Assistant Government Geologist
15.6.1908.



CLEAR HILL TO CHRISP'S CREEK



PRINCE OF WALES RANGE TO GORDON RIVER

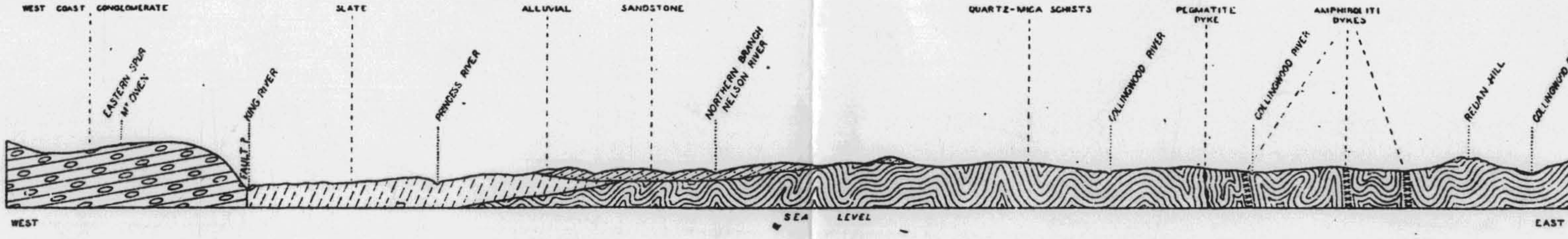
GENERALIZED SECTIONS

SCALES

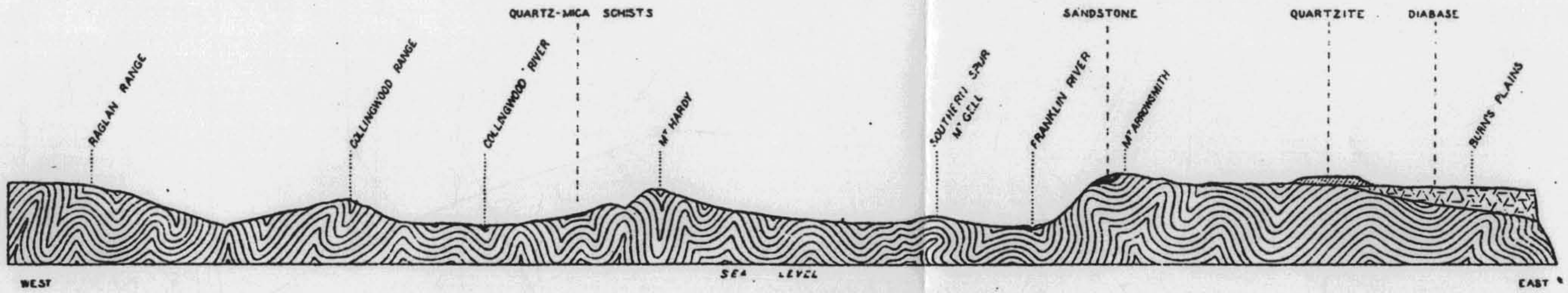
Horizontal MILES *Vertical* FEET

W. H. Twelvetrees
Government Geologist
22 7 08

Photo-lithographed by John Vail Government Printer Hobart Tasmania.



MOUNT OWEN TO REDAN HILL



RAGLAN RANGE TO BURN'S PLAINS

GENERALIZED SECTIONS

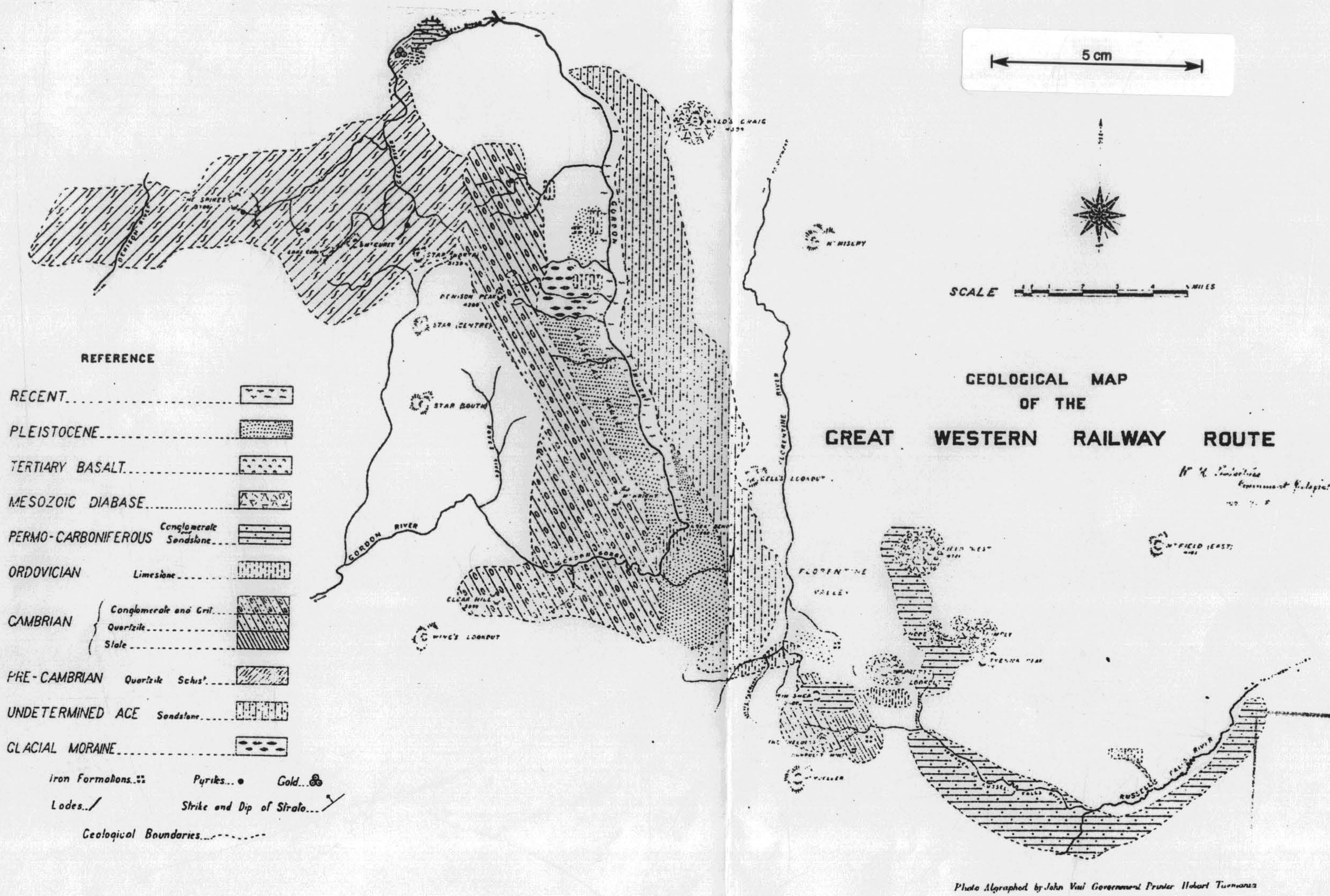
SCALES

HORIZONTAL ... MILES VERTICAL ... FEET

L.K. Ward.
Assistant Government Geologist
15. 6. 1908.

Photo Algraphed by John Vail Government Printer Hobart Tasmania

5 cm


5 cm
GEOLOGICAL MAP
OF THE
GREAT WESTERN RAILWAY ROUTE
SCALE
MILES
REFERENCE
RECENT
PLEISTOCENE
TERTIARY BASALT
MESOZOIC DIABASE
PERMO-CARBONIFEROUS Conglomerate Sandstone
ORDOVICIAN Limestone
CAMBRIAN Conglomerate and Grit Quartzite Slate
PRE-CAMBRIAN Quartzite Schist
UNDETERMINED AGE Sandstone
GLACIAL MORAINE
Iron Formations
Pyrites
Gold
Lodes
Strike and Dip of Strata
Geological Boundaries
GORDON RIVER
FLORENTINE RIVER
FLORENTINE VALLEY
STAR SOUTH
STAR (CENTRE)
DENISON PEAK
CLEAR HILL
WYLD'S CRAIG
M^T MISERY
CELL'S LOOKOUT
M^T FIELD (EAST)
RUSSELL FALLS RIVER
Photo Algraphed by John Vail Government Printer Hobart Tasmania

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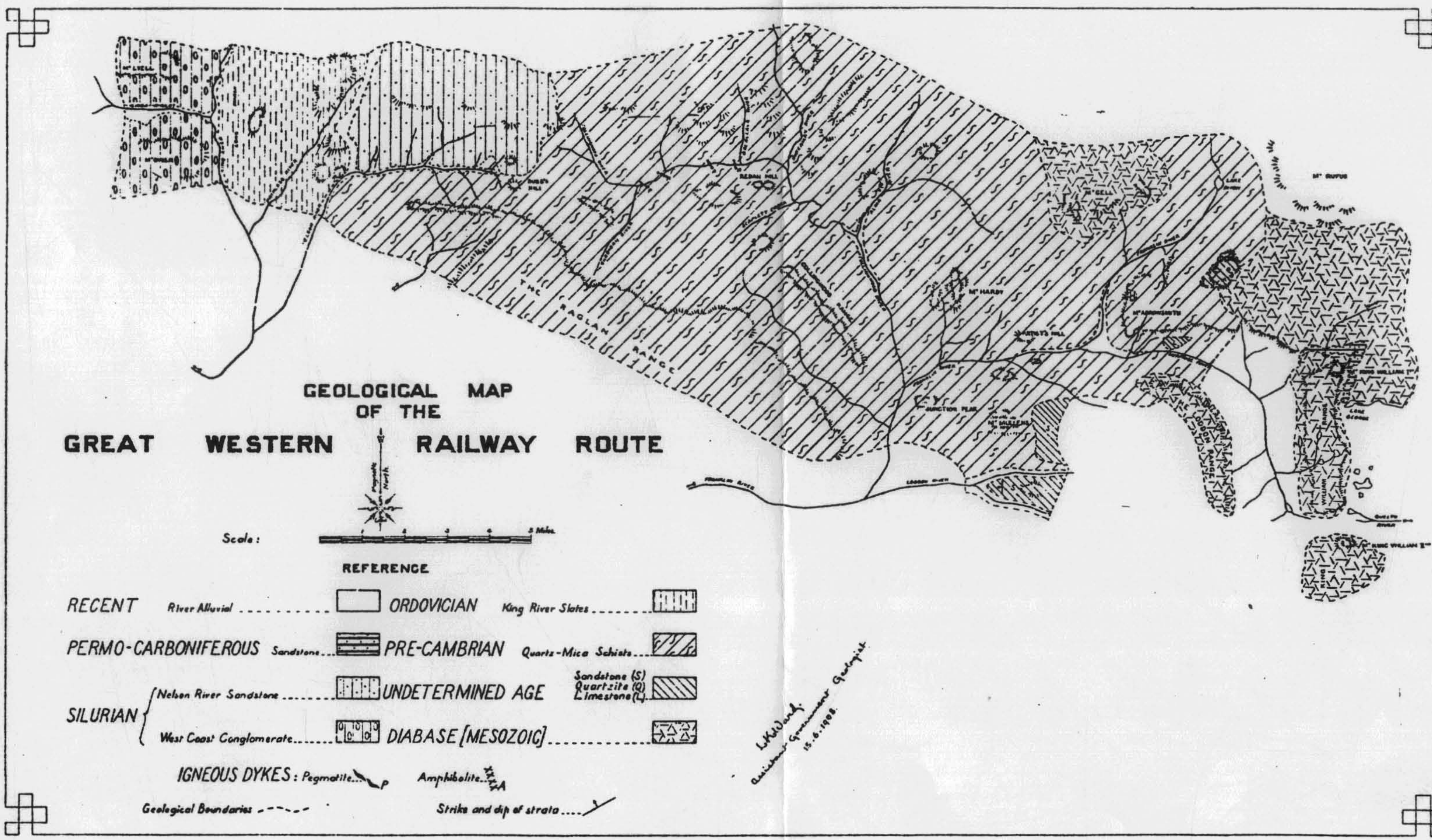

Photo Algraphed by John Vail Government Printer Hobart Tasmania

MAP OF PORTION OF TASMANIA SHOWING POSITION OF EXPLORATION TRACKS CUT AND MARKED DURING THE YEAR 1908.

SCALE 5 MILES TO AN INCH.

Map reduced by photocopying

Tracks shown thus

5 cm