GEOLOGICAL FIELD TRIP

VICTORIA - EAST SOOKE AREA

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Victoria and Saanich municipalities are underlain by a complex assemblage of gneissic rocks which have been mapped as two separate units, Wark gneiss and Colquitz gneiss. The Wark gneisses are massive, generally mafic, metamorphosed basalt, gabbro, or diorite with frequent marble lenses. The Colquitz gneiss is a more felsic quartz-feldspar gneiss. The origin and age of these gneisses, and the relationship between the two types, is poorly understood. They have locally been intruded by small stocks and dykes of granodiorite.

The Leech River Fault is a major crustal break which cuts across southern Vancouver Island through Loss Creek, Bear Creek Reservoir, Glen Lake, and Esquimalt Lagoon. South of the fault, the rocks are all Tertiary in age and are genetically more related to the rocks of the Olympic Peninsula in Washington State than to the older rocks north of the Leech River Fault. They are now believed to represent a slab of oceanic crust which has been obducted (thrust) onto the southern tip of Vancouver Island since mid-Tertiary time.

Most of this Tertiary terrane consists of the Metchosin volcanics, mainly pillowed or massive basaltic flows with minor tuff and breccia units. They are identical in form and composition to volcanic piles presently developing in oceanic areas like Hawaii and Iceland. Their age is believed to be early Eocene (50-57 million years) based on very limited fossil evidence. The Metchosin volcanics are intruded by masses of Sooke gabbro and Catface quartz diorite. Radiometric ages on these intrusive rocks are all mid to late Eocene (39-45 million years). Scattered remnants of Sooke Formation sandstones and conglomerates unconformably overlie the volcanics and plutonic rocks. They contain fossil evidence of an Oligocene-Miocene age (approximatley 26 million years).

The only significant bedrock mineral resources known in the area south of the Leech River Fault, and the only deposits accessible on this trip, are the copper deposits at Jordan River and on East Sooke Peninsula. They occur in hornblendized shear zones in Sooke gabbro and are probably related to late hydrothermal solutions emanating from the parent magma of the gabbro bodies.

The advance and retreat of continental glaciers during the Pleistocene epoch has polished and grooved most bedrock outcrops in the Victoria area. Pleistocene glacial till and outwash sands and gravels are widespread throughout the area and were deposited on top of the bedrock mainly during the retreat of the last great ice-sheet about 10,000 to 15,000 years ago.

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STOP 1 Confederation Garden (NO HAMMERS PLEASE!)

A grooved and striated glacial pavement has been carved on a large outcropping of metagabbro, part of the Wark metamorphic complex. The gabbro is cut by numerous dykes of basalt, aplite, and pegmatite as well as quartz veins. Frequent small offsets, ptygmatic folding, and pull-apart structure (boudinage) in the dykes and veins, indicate considerable deformation of the rock, although the gabbro itself shows little evidence of it.

STOP 2 Finlayson Point

Till overlies a glaciated pavement with well developed grooves and striations. Numerous roches moutonees, with rounded northern terminations and plucked southern ends, reflect southward-flowing glacier ice. In the bedrock, metavolcanics are intruded by a small body of granodiorite with extensive related development of contact breccia and granitic dykes.

STOP 3 Harling Point

The predominant rocks underlying the Chinese cemetery are sericite - chlorite schist, locally with well-developed shear folding. They are probably derived from felsic to intermediate volcanics. At the shore line, a north-dipping fault separates these rocks from a different assemblage of sheared and crushed rocks which have recently been re-classified as a new "terrane" which has fused itself onto the south tip of the island in early Tertiary time.

STOP 4 Cattle Point

These well glaciated outcrops consist of thin-banded Colquitz gneiss. The dark layers are rich in hornblende and the lighter layers are mainly feldspar and quartz. The gneiss may have been an iron-rich sedimentary rock, or possibly a felsic or intermediate layered volcanic rock, which was subjected to intense metamorphism at considerable depth in the crust. Metamorphism resulted in recrystallization, segregation of the light and dark minerals into bands, and possibly partial melting.

STOP 5 Big O Tire

Alongside the restaurant parking lot a thick limestone bed strikes northerly and dips steeply west. It grades westward into a mixed limestone-basalt assemblage. Although mapped as part of the Wark gneiss, these rocks strongly resemble the upper part of the Triassic Karmutsen volcanic sequence and the overlying Quatsino limestone. If this is true, the westerly dip indicates that the beds are overturned.

At the east end of the outcrop, the limestone is in contact with a sheared igneous rock, probably a dyke. The contact is offset by an easterly-striking fault.

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STOP 6 Hydro Towers, Malahat Hwy.

The hydro towers sit on a prominent outcrop of east-striking ribbon chert. The beds of white-weathering chert are separated by graphitic films and contain drag folds which are interpreted as soft-sediment slump folds.

STOP 7 Goldstream Park Campground (NO HAMMERS PLEASE!)

In the creek below the bridge at the park entrance, scattered outcrops of dark grey slate are mapped as part of the Leech River complex. The strong slaty foliation has been deformed into small-scale secondary folds.

STOP 8 Centre Mountain, Happy Valley Road

These bluffs on the west side of Happy Valley Road have recently been cut back and scaled producing an outstanding exposure of pillows in Metchosin basalt. Several subhorizontal pillowed flows and at least one thin, magnetic, unpillowed flow can be examined. The basalt is a fine-grained rock composed mainly of labradorite (feldspar) and augite (pyroxene) with traces of magnetite, pyrite, and chalcopyrite. The presence of pillow structure indicates that the basalt lava was extruded and solidified in a submarine setting. Amygdules (filled gas-holes) are abundant in the pillows and are filled mainly with quartz and minor epidote or zeolite.

STOP 9 Becher Bay

Large exposure of massive Metchosin basalt. The outcrop is cut by irregular altered dyke-like zones, with epidote and feldspars; epidote is also concentrated on several fracture surfaces. Note that the basalt is unusually magnetic throughout and locally contains anastomosing thin black magnetite-hornblende seams.

STOP 10 Aylard Farm

Outcrops on the beach immediately to the left and right of the picnic shelter are of massive, unpillowed Metchosin basalt. Southward along the beach, part way around the large cove, is a small outcrop of massive Sooke gabbro composed of interlocking coarse crystals of plagioclase, augite, and olivine. Alteration, including development of green hornblende, can be seen along incipient fractures in the gabbro.

From the gabbro outcrop to the next small point, the cut bank consists of poorly consolidated yellow sandstone of the Sooke Formation. It is locally crossbedded and contains occasional gabbro and basalt pebbles and fragments of carbonized wood. On both sides of the point, the sandstone is overlain by a spectacular boulder conglomerate containing rounded cobbles and large boulders of basalt and gabbro.

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Continuing southward along the beach, the boulder conglomerate is, in turn, seen to be overlain by another bed of mixed sandstone and pebble conglomerate with numerous thin clay seams. Although richly fossiliferous elsewhere (e.g. Muir Creek), the Sooke Formation at Aylard Farm contains few or no fossils, except wood fragments.

The next headland to the south consists of massive Sooke gabbro. The unconformable contact between gabbro and sediments is not clearly exposed and may, in fact, be downfaulted below present sea level.

STOP 11 Willow Grouse Mine (Cooke Zone)

The Willow Grouse mine workings are exposed at the west end of Andover Road on the north edge of East Sooke Park. They have been partly buried by recent road-building. Again, copper mineralization is concentrated where cross faults have intersected a major hornblendite-altered northeast-trending shear zone. Very good specimens of coarse, dark green hornblende can be collected from the walls of the old stope and in nearby road cuts.

On the south side of the road close to where the vehicles are parked, is an outcrop of plagioclase-rich gabbro called anorthosite. This rock contains the same basic minerals as seen in the olivine gabbro but, here, plagioclase comprises more than 80 per cent of the rock and is present as stubby crystals surrounded by augite or secondary hornblende (called ophitic texture). Anorthosite has been mapped as irregular patches or dykes cutting olivine gabbro in a few places around Mount Maguire.

STOP 12 Merryth Zone - Iron Mine Bay

In the vicinity of East Sooke park, a number of northerly-trending shear zones, mineralized with iron and copper, cut the Sooke gabbro. At the Merryth zone the augite gabbro was fractured at a late stage of crystallization and the fractures were filled and altered by an amphibole (Na-hornblende or glaucophane) which carries pyrrhotite, pyrite, magnetite, and chalcopyrite. The amphibole alteration is intense in the main zone and can be seen projecting out into small fractures along the flanks of the main zone.

The Merryth zone has been explored and tested on numerous occasions since the start of the century, the most recent work being in 1971, but no ore production has taken place. The trenches and open-cutting seen in the shoreline exposures were for sampling and testing purposes only. The most complete description of all the East Sooke mineral zones can be found in the 1948 Annual Report of the B.C. Minister of Mines, an extract of which is attached.

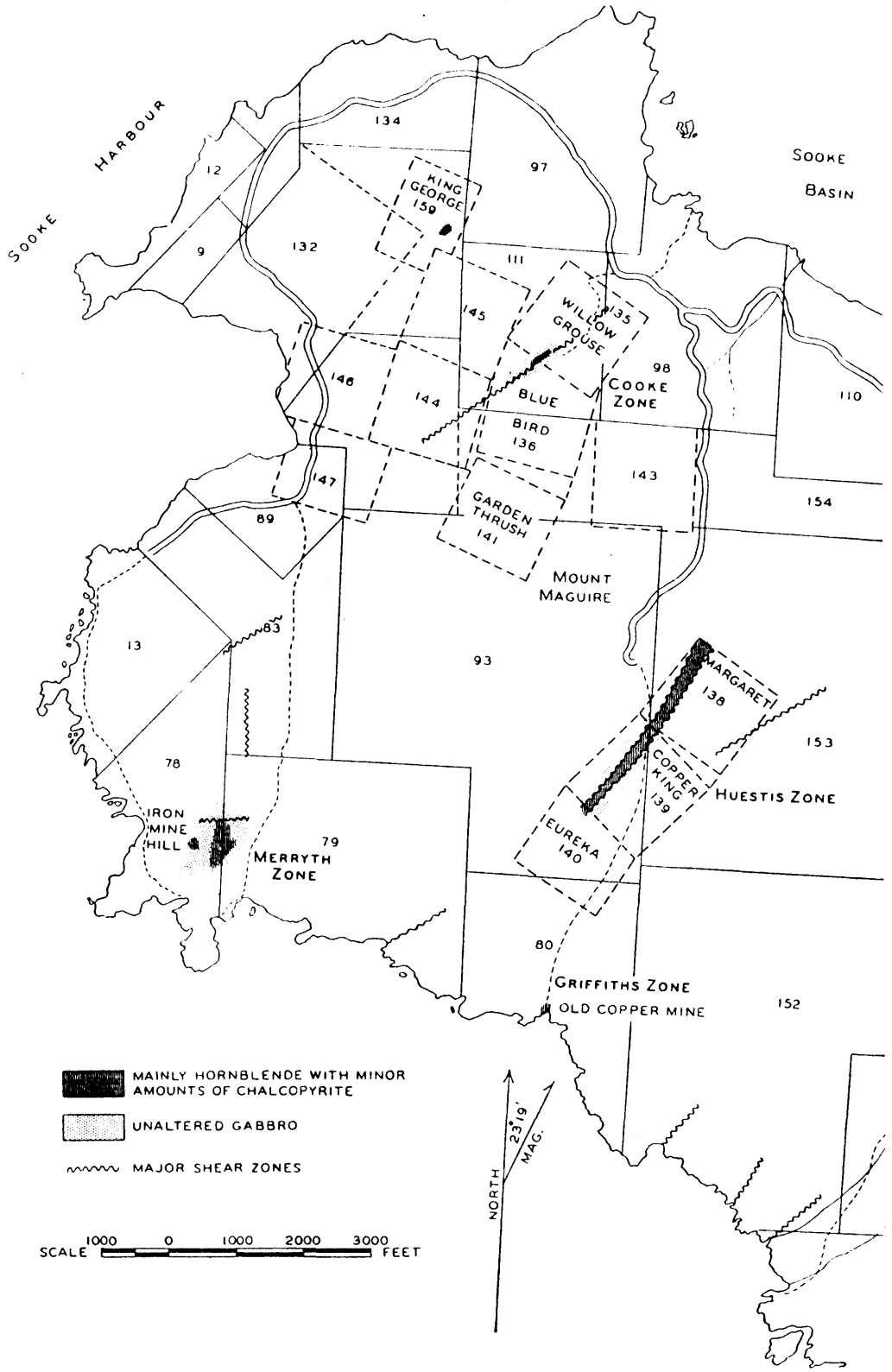

Fig. 13. Sooke Peninsula, showing location of mineralized zones.

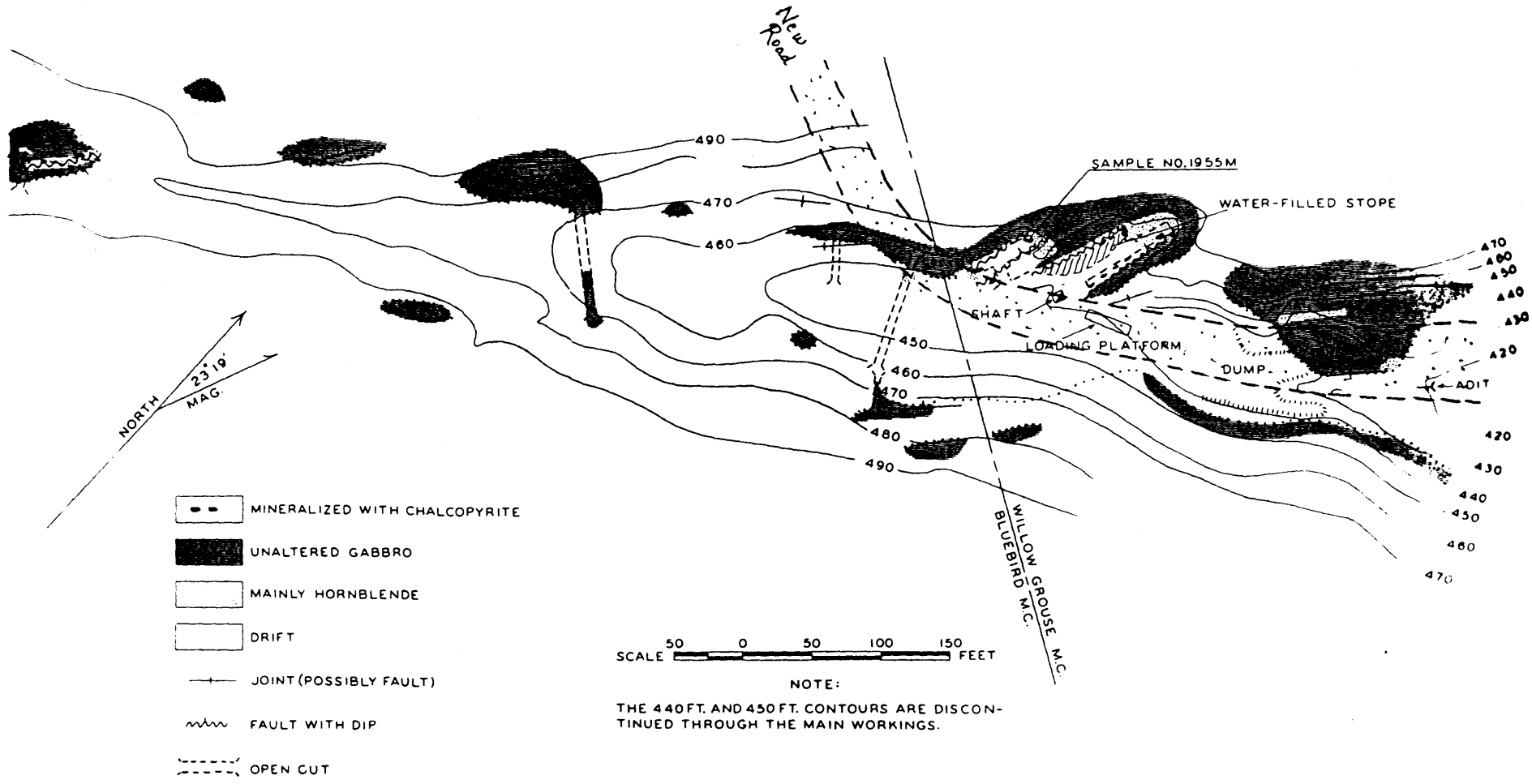

FIG 14 BLUEBIRD AND WILLOW GROUSE M.C. – GEOLOGY AND PLAN OF SURFACE WORKINGS

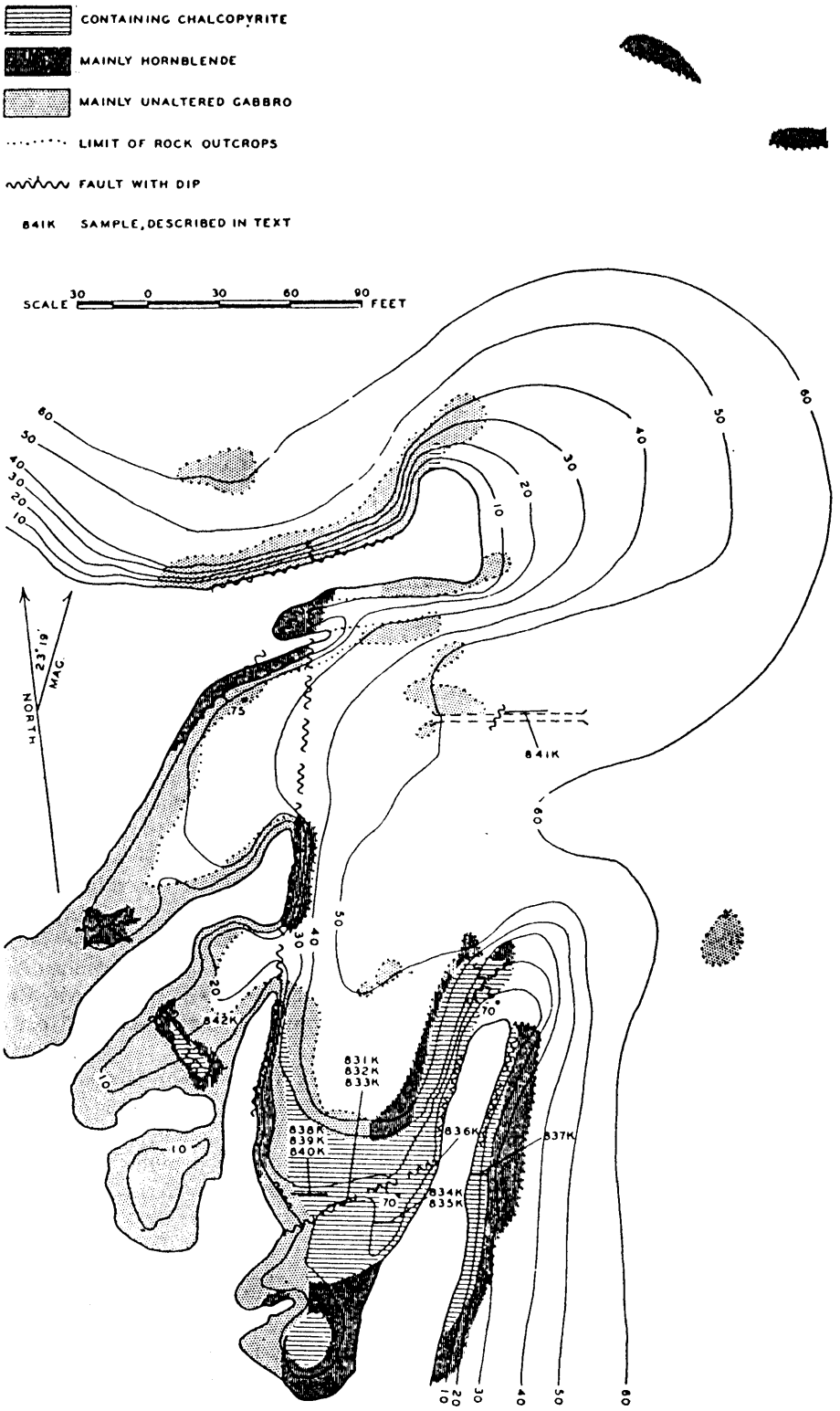

Fig. 16. Geological plan of Merryth zone.

Merryth Zone.—The Merryth zone is on the south-west shore of Sooke Peninsula due south of Iron Mine Hill (*see* Fig. 13). The main altered zone, containing hornblende and masses of unaltered gabbro, trends up the hill from the shore at about north 25 degrees east for 1,500 feet. The zone is irregular in width but averages 100 feet wide. It is not known to be continuous, as a drift-covered area separates the showings on the hill from those on the shore. Hornblendite is present not only in the main zone, but also in irregular masses several hundred feet on either side of the main zone. The Merryth zone, which is in augite gabbro, differs in this respect from the Cooke and Huestis zones, which are in olivine gabbro.

A little trenching and open-cutting has been done near the shore, and the mineralized zone is well exposed on the sea cliff (*see* Fig. 16). An area about 100 feet wide and possibly 200 to 300 feet long has been partly altered to hornblende. It is bounded on the east and west by vertical faults striking about north 20 degrees east and is cut by cross-faults, the most prominent of which strike north 60 degrees east and north 20 degrees west. The sea has cut chasms along the bounding faults, and on the west side of the mineralized zone the chasm has been filled by stratified sands and gravels. The mineralized zone contains irregular bodies of fine-grained relatively unaltered gabbro which increase in size away from the shore. Fine-grained magnetite, pyrrhotite, pyrite, and chalcopyrite occur in the hornblende and less commonly in the unaltered gabbro. Sulphides are relatively massive near the centre of the zone, but toward the edges they become disseminated and occur as tiny veinlets throughout the hornblende. A band of hornblende containing magnetite occurs along the east side of the main mineralized zone. On top of the sea cliff the rocks are covered by overburden, but hornblende and sulphides are less abundant in exposures there than on the shore; in a trench 300 feet from the shore very little sulphide could be found.

Samples* were cut along two lines on the face of the sea cliff. The lower line about 10 feet above high-tide mark averaged 0.83 per cent. copper across a width of 28 feet. These lower samples were taken in relatively unoxidized material from a section of the sea cliff that showed the highest-grade mineralization. The upper line of samples was taken across 16 feet of heavily oxidized material, and although the oxidized material was removed as far as possible before sampling, these samples may not be truly representative. They averaged 0.31 per cent. copper. A grab sample (No. 841K) across 20 feet of the highest-grade material in a trench about 200 feet north along the mineralized zone from the top assayed: Copper, 0.28 per cent. It appears from the assays and from field observations that the grade of the mineralization decreases upward and away from the shore.

* All samples on the Merryth zone were taken by cutting equal chips at 1-foot intervals across the face.

The positions where samples were taken are indicated in Fig. 16, and the assays are listed in the following table:—

Sample No.	Gold.	Silver.	Copper.	Other Metals.
	Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.
831K	0.01	*Nil*	0.60	0
832K	Trace	Trace	0.39	*†
833K	Trace	*Nil*	0.79	*
834K	*Nil*	*Nil*	1.14	*
835K	Trace	Trace	1.42	*
836K	*Nil*	0.1	0.37	*
837K	*Nil*	0.1	0.17	*
838K	0.06	*Nil*	0.08	*
839K	*Nil*	*Nil*	0.53	*
840K	*Nil*	*Nil*	0.24	*
841K	*Nil*	Trace	0.28	*†
842K	*Nil*	*Nil*	0.25	*

* Spectrochemical determinations—cobalt, nickel, and molybdenum—not more than 0.05 per cent.
† Molybdenum not detected.

Cooke Zone.—The principal showings on the Cooke zone lie within the Willow Grouse and Blue Bird Mineral Claims (*see* Fig. 13).

The mineralization (*see* Fig. 14) occurs in what appears to be a major shear-zone which, near the workings, strikes about north 50 degrees east. It can be traced for more than 2,000 feet and shows on the surface as sub-parallel cliffs or scarps, 2 to 10 feet high, and as much as 100 feet long. At the main workings (Fig. 14) the zone is intersected by cross-faults, and lenses of chalcopyrite have developed along the faults and in the fractures adjacent to them. Only minor amounts of disseminated chalcopyrite were seen at other places in the shear-zone. Veins of coarse hornblende are abundant in the main workings, and hornblendite occurs at other places along the shear-zone. The zone has been explored over a length of about 1,000 feet by an adit, a shaft, and several open-cuts and trenches.

A shaft and one large open-cut lie about 100 feet north of the boundary between the Willow Grouse and Blue Bird claims. The portal of an adit is about 275 feet north 65 degrees east from the shaft. The adit is caved and the shaft is full of water, but the cross-faults and mineralization can be seen in the open-cut. Several parallel faults striking about north 15 degrees east and dipping vertically or steeply to the west are exposed. Grooves on the fault-surfaces show that the movement has been nearly horizontal. Coarsely crystalline hornblende is present near the faults, and finer hornblende occurs farther away. The coarse hornblende which has grown with the length of the crystals about at right angles to the fault-planes has itself been sheared. Grains and lenses of chalcopyrite ranging from less than an inch to a foot in length and from a fraction of an inch to 2 inches in width cut the hornblende where it has been sheared. Most of the chalcopyrite seems to have been removed from the open-cut, as only a few stringers and small amounts of disseminated chalcopyrite appear in the walls. Hornblendite grades into unaltered gabbro 15 to 20 feet north of the north end of the cut, and little hornblende is present 10 feet west of the cut. The eastern edge of the mineralized zone is covered by waste rock, and hence the size of the hornblende-bearing zone is obscure. However, it is probably less than 150 feet long and 50 feet wide. A chip sample across a width of 4 feet of what appeared to be the highest-grade material from the south end of the open-cut assayed: Copper, 0.75 per cent.; silver, 0.1 oz. per ton; nickel, 0.07; no gold and not more than 0.05 per cent. cobalt.

About 500 feet south-west along the shear-zone from the main workings an open-cut (Fig. 14) exposes a vertical fault striking north 40 degrees east. Medium-grained hornblende containing small amounts of chalcopyrite has developed along this fault.

Several trenches have been made across the strike of the main shear-zone between the main workings and this last open-cut. Only in the first trench south of the main workings was any hornblende found, and in this only minor specks of chalcopyrite can be seen. Many of the trenches are filled with overburden, but bedrock that is exposed is relatively unaltered gabbro, and it seems probable that the zone contains lenticular mineralized masses that are not continuous between the workings.