

CANADA  
DEPARTMENT OF MINES AND RESOURCES  
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MINES AND GEOLOGY BRANCH  
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BUREAU OF GEOLOGY AND TOPOGRAPHY  
F. C. C. LYNCH, CHIEF

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GEOLOGICAL SURVEY

MEMOIR 204

GOLD-BEARING DEPOSITS ON THE WEST  
COAST OF VANCOUVER ISLAND BETWEEN  
ESPERANZA INLET AND  
ALBERNI CANAL

BY  
M. F. Bancroft

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OTTAWA  
J. O. PATENAUDE, I.S.O.  
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# Gold-bearing Deposits on the West Coast of Vancouver Island between Esperanza Inlet and Alberni Canal

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## INTRODUCTION

The field season of 1935 was spent in examining gold-bearing deposits on the west side of Vancouver island, British Columbia, from south of latitude 49 to north of latitude 50, principally between, and including, Alberni canal on the south and Esperanza inlet on the north. There in the Clayoquot and Alberni mining divisions are extensive areas geologically similar to the Coast Range country of the mainland, consisting mainly of granodiorite, but containing many remnants of the pre-existing formations.

Vancouver island has an estimated area of 12,156 square miles and the area to which attention was directed extends over 3,500 square miles in the central western part of the island.

The focal points of recent gold mining interest include: (1) Zeballos River valley, north of Ceepeecee; (2) Muchalat arm east of Nootka; (3) The head of Herbert arm in from Ahousat; and (4) Alberni canal. Small shipments of high-grade ores are reaching the smelters at Trail and Tacoma from prospects in these four localities.

The primary object of this survey was to discover what formations and structures were proving of special interest in the places where prospecting was in progress, and to obtain information that might promote systematic prospecting in the extensive areas yet undeveloped.

Hugh L. Hamersley and Robert M. Mather ably carried out their duties as student assistants. A 55-foot boat served for the season as a main camp and base of supplies. Local guides were employed at a few places and the writer acknowledges the willing co-operation of property owners, prospectors, and "old timers" on the coast.

Haycock and Webster worked along sections of the west coast of Vancouver island in 1902 when the region was regarded as essentially a district for copper, though magnetite iron ores and gold deposits were also receiving attention. Haycock expressed in his report the opinion that "any immediate or early advance in wealth and industry on the West Coast of the island is dependant on its mineral resources."<sup>1</sup>

In 1920 V. Dolmage<sup>2</sup> completed the shore-line mapping of the geology between Quatsino and Barkley sounds and gathered information on gold, copper, iron, marble, mercury, and manganese deposits. W. L. Uglow<sup>3</sup> and G. A. Young examined iron deposits on the coast in 1924.

<sup>1</sup> Haycock, Ernest: Geol. Surv., Canada, Ann. Rept., vol. XV (1902).

<sup>2</sup> Geol. Surv., Canada, Sum. Rept. 1920, pt. A.

<sup>3</sup> Geol. Surv., Canada, Ec. Geol. Series No. 3 (1926).



H. C. Gunning in 1930 carried on field work in Buttle Lake map-area, Strathcona park; the western boundary of the park reaching to within 5 miles of the west coast in Burman River valley off the south end of Muchalat arm. In 1932 Gunning<sup>1</sup> reported on the Zeballos area off Esperanza inlet.

The Annual Reports of the Minister of Mines of British Columbia show that the west coast of Vancouver island, especially in the vicinity of Alberni canal, Barkley sound, and Clayoquot, has been of mining interest from the early days of settlement.

Very little underground development has been done on any of the gold properties, and very little machinery has been brought in to aid mining or to concentrate the low-grade gold ores. Production tonnage has been small as the ores shipped from the lode deposits to the smelters must of necessity be high grade.

Stream and beach gravels yielded an important production of placer gold in the past under primitive methods. The possibilities for expansion in this field are still inconclusively known, as little systematic testing of ground has been attempted in recent years. The mild marine climate favours all-year operation.

## GENERAL CHARACTER OF THE DISTRICT

Vancouver island is the largest of the islands in the submerged section of the north Pacific. Physiographically and structurally it is considered as an island range, part of the mountain system that embraces Vancouver and Queen Charlotte islands. It shares a geological history similar to that of much of southern British Columbia.

The Vancouver range constitutes virtually the entire island, which is 285 miles long, with width varying from 9 to 86 miles. It trends north 55 degrees west. The island is separated from the ranges of the mainland by Haro, Georgia, Johnstone, and Broughton straits, and Queen Charlotte sound; and from the Olympic mountains, which lie to the south, by the strait of Juan de Fuca. The inside passage between Vancouver island and the main coast has a maximum width of 50 miles and has many islands.

The west coast with its fiord-like indentations from cape Beale northwestwards, in detail is most irregular, but its general outline is a broad and regular curve, convex toward the Pacific. Haycock in 1902 observed this and further pointed out that the elevations of the surface of the island from south to north form a profile even more conspicuously symmetrical than that of the coast-line. The hills gradually increase in elevation from a few hundred feet to above 3,000 feet, as Barkley sound is approached; northwest of Barkley sound the elevation increases, reaching a maximum in the snowy ranges behind Clayoquot and Nootka sounds, where peaks up to 7,000 feet occur. Thence northwesterly the peaks become less lofty, seldom reaching 3,000 feet beyond Kyuquot except in Cape Cook peninsula. Towards cape Scott the surface becomes rolling and hilly and in general resembles that of the southeastern extremity of the island.

<sup>1</sup> Geol. Surv., Canada, Sum. Rept. 1930, pt. A; 1932, pt. A II.

Great diversity of relief is the outstanding feature. In the interior of the island the summits have been cut back by glaciation and by long-continued stream erosion. The interstream divides are topped by sharp, knife-like, thin, sinuous ridges making their last stand, but below altitude 3,000 feet giving way in a most irregular manner to form rounded ridges of varying continuity. The stage of erosion is one of advanced youth. Very irregularly distributed, isolated mountain peaks and clusters of peaks are characteristic. Some may be of the nature of residual peaks inherited from a late or middle Tertiary erosion cycle. The modern stream pattern closely resembles in general the pre-glacial drainage which has been modified by crustal movements and glacial erosion. Beano creek on the south side of Nootka island displays a fine example of entrenched curves and meanders. Drowned valleys such as Tasis canal, Tlupana arm, and Muchalat arm show the routes once followed by valley glaciers in exit to the sea. Valleys following the trend of the mountain axes are prominent as well as transverse valleys.

What glaciation accomplished for this region in the modifying of the land surface is best seen below altitude 3,500 feet. Abrupt slopes and numerous cliffs mark the transition from upland to valley flat or to the rim of deep, post-glacial gorges. The lower stretches of valleys may be occupied by lakes or by the sea. Nitinat lake is a good example of the former and Alberni canal of the latter. Deltas and tidal estuaries are present at the heads of the many fiords, and the shores in general are bold and rocky. Marked unevenness of surface persists to the outermost islands. Flores island on Clayoquot sound presents a cluster of twenty-six or more cone-like peaks, the majority of them carved from diorite and approaching altitudes of 3,000 feet.

Post-glacial erosion has been intense, lines of weakness in glaciated rock surfaces have been etched out. A quartz vein that stands out in relief may be exposing only its hardest and barren parts, the mineralized, softer parts having given way to form horse-stall like gullies and water-course depressions. The annual precipitation is such that oxidized zones are so rinsed that they fail to become conspicuous. To trace mineralized veins and shears in the field calls for a close scrutiny of the land surface, rock formations, and fracture systems.

The region presents a multitude of geological contrasts, from deeply "pot-holed" river gorges in hard granodiorite to low-lying tracts of land developed on younger and softer formations. The west coast of Vancouver island has very little coastal plain in contrast with the east coast. Estevan peninsula and portions of Nootka and Flores island are remnants of a coastal plain.

### GENERAL GEOLOGY

The essential features of the geology of the central part of Vancouver island have been indicated through the continued work of the Geological Survey. The following table of formations applies directly to the geology of the west side of Vancouver island.

Table of Formations

| Era          | Period                  | Epoch                                | Formation  | Lithology   |  |
|--------------|-------------------------|--------------------------------------|--|---|--|
| Cenozoic     | Modern                  | Recent                               | Stream and beach deposits  | Sand, gravel, clay                                      |  |
|              |                         | Pleistocene                          | Wreck Bay continental and marine beds  | Glacial and interglacial gravel, silt, boulder clay     |  |
|              | Tertiary                | Unconformity                         |  |   |  |
|              |                         | Lower Miocene<br>Lower Oligocene     | Carmanah<br>Sooke gabbro, Metchosin  | Conglomerate, sandstone, anorthosite, basalts, and tuff |  |
|              |                         | Oligocene (?)                        | Escalante  | Conglomerate, sandstone, shale                          |  |
| Unconformity |                         |                                      |  |   |  |
| Mesozoic     | Cretaceous              | Upper Cretaceous<br>Lower Cretaceous | Cowichan<br>(One Tree island)  | Sandstone, shale, conglomerate, and coal                |  |
|              |                         | Unconformity                         |  |   |  |
|              | Jurassic                | Upper Jurassic (?)                   | Coast Range intrusives   | { Zeballos granodiorite<br>Beale diorite                |  |
|              |                         | Intrusive contact                    |  |   |  |
| Triassic     | Upper Triassic          | Bonanza                              | Flows, tuff, breccia, argillite, and limestone                                   |   |  |
|              |                         | Quatsino                             | Crystalline limestone with interbedded volcanics                                 |   |  |
|              |                         | Karmutsen                            | Flows, breccia, minor interbeds of limestone                                     |   |  |
| Palaeozoic   | Permian and pre-Permian | Vancouver Group                      |  |   |  |
|              |                         |                                      | Crystalline limestone, volcanics, and minor sedimentary beds of Buttle Lake area |   |  |

## PALÆOZOIC COMPLEX

"A Palæozoic complex was discovered in the Buttle Lake map-area in 1930, through finding fossils of Permian age in a limestone horizon about the headwaters of Marble creek. The Palæozoic rocks are cut off by a large body of granodiorite southwesterly at the head of Burman river and are likely cut off to the southeast in a somewhat ragged manner by the granodiorite at the head of Bedwell river. These Permian and possibly earlier formations can occupy only a small area at best, though their presence on the eastern border of the area traversed in 1935 is important, stratigraphically and structurally.

"They consist of a thick series of volcanic rocks including andesitic to basaltic flows, tuffs, and coarse volcanic breccias with at least two or probably three interbedded horizons of white, grey, or pink, crystalline limestone and minor amounts of argillite and quartzite. The Palæozoic volcanic rocks are intruded by a vast number of dykes and irregular bodies of rock varying in composition from fairly basic porphyries to quartz and feldspar porphyries and aplites. Included in the complex are normal volcanic rocks, dykes, and sills connected with the Palæozoic or early Mesozoic vulcanism and also many dykes belonging to the Coast Range period of intrusion."<sup>1</sup>

The uppermost Permian limestone has been taken as the upper limit of the Palæozoic rocks and it appears that there may quite probably be a conformable succession of volcanic and sedimentary rocks from the late Palæozoic well up into the Mesozoic. The maximum observed thickness of the uppermost Permian limestone is about 500 feet, the minimum probably about 100 feet, as exposed in Buttle Lake area.

The structure of the Palæozoic rocks is clearly shown by the limestone beds. The rocks are folded into a broad anticline pitching to the north. The axis of the major structure trends almost due north. The westerly limb of the anticline dips from 20 to 30 degrees west and the easterly limb, on Price creek, at lower angles to the east. Faults that would be inconspicuous if it were not for the offsetting of limestone beds, cut northwesterly across this north-pitching anticline. The result is that the Palæozoic section is broken into a number of blocks by numerous faults. The horizontal displacement is such as to suggest that the southwest wall of the fault held and the northeast wall moved to the southeast, bringing in younger formations from the west limb of the fold to abut directly the older formations south of the faults.

The geographic position of the Palæozoic beds and the deformation they exhibit lend support to the physiographic evidence advanced by Haycock that this central portion of Vancouver island is a critical area from the standpoint of maximum uplift and deep erosion.

## MESOZOIC COMPLEX

The Vancouver group of presumably Triassic and possibly early Jurassic formations can best be considered by starting from Buttle Lake area where younger formations spread outward from the Palæozoic nucleus, overlying the Permian limestone, apparently conformably. "For 5,000

<sup>1</sup> Gunning, H.C.: Geol. Surv., Canada, Sum. Rept. 1930, pt. A, p. 59.

feet stratigraphically above this limestone the rocks are not known to contain any fossiliferous horizons. They include pillow lavas, breccia, andesite, and amygdaloidal basalt, very minor amounts of dacite and felsite, and all are cut by dykes of andesite and diabase, and by a few more acidic dykes. In ascending the section the first fossiliferous sediments, impure dark grey limestone and argillite, were encountered on the upper reaches of Iron river which drains into Quinsam river, heading for the east coast. These beds were placed in the Triassic by F. H. McLearn. As yet no horizon can be defined as marking a break between Palæozoic and Mesozoic and it seems probable that volcanic activity was more or less continuous, unbroken by an important erosion interval. The distribution of the sediments of the Vancouver group is of economic importance, as many of the mineral deposits of the island are found in limestone."<sup>1</sup>

Dr. G. M. Dawson found marine fossils in dark, tuffaceous argillites 6 miles east of cape Scott on the north coast of the island. In 1920 V. Dolmage found a highly fossiliferous horizon at Malksope inlet on the west coast. In 1929 H. C. Gunning found similar beds in Quatsino-Nimpkish area and in 1932, in Zeballos area, where the younger formations of the Vancouver group occupy a wide area marked by a major monoclinial structure with gentle dips to the southwest.

In 1935 younger fossiliferous beds of the Vancouver group were discovered in Herbert Arm and Moyeha River sections and the country inland from Clayoquot sound. The beds strike due west and dip 40 degrees south. They are composed of thin-bedded, black, silicified tuff, associated with prominent, grey limestone beds, in which fossils are abundant but not well preserved. These formations extend across the summit and should appear in the Shelter Arm drainage basin unless cut off by granodiorite. F. H. McLearn, of the Geological Survey, reports the presence of *Halobia* ? sp. and *Monotis* ? sp. and dates the beds as Triassic.

A great thickness of amygdaloidal basalt appears on Moyeha river west of the fossil beds, forming high, ragged summits on both sides of the valley, and such basalts are seen in the section at the head of Muchalat arm, some 20 miles northwest of Moyeha river.

Various estimates have been made of the thickness of volcanics and sediments embraced in the Vancouver group, possibly in all an accumulation of 20,000 feet. Widespread shelf seas dotted with active submarine volcanoes and volcanic islands permitted the accumulation of a vast amount of material in Triassic time. Crinoidal limestones and volcanics of this age are found as far east as Slocan area in the Selkirks.

The subdivision of the Vancouver group in the north end of the island is made possible by the persistence of the limestone in the Quatsino formation. On the western watershed of the island the limestone beds in it are 500 to 2,000 feet thick. The Quatsino formation is described by Gunning as consisting of several hundred feet of dark, fine-grained, or coarsely crystalline dark grey to white, limestone with minor intercalations of green flows and fine-grained, grey, green, or brown tuffs, the tuffs becoming particularly abundant towards the top of the formation. In

Gunning, H.C.: Geol. Surv., Canada, Sum. Rept. 1930, pt. A, p. 61.

Nimpkish area the upper beds of the Quatsino formation yielded small Triassic ammonites.

The distribution of the Quatsino formation is peculiar in that in spite of the batholithic intrusion, strike faulting, and flexure, it maintains a position approximately 20 miles from the west coast paralleling it from the vicinity of Tlupana arm, Nootka sound, to Quatsino sound, a distance of 72 miles.

Throughout the batholithic area southeast from Tlupana arm numerous limestone horizons are found. The Moyeha fossil locality previously mentioned is 20 miles from the western coast of Flores island. Limestone is prominent in the Summit section above the You property on the south side of Bedwell valley, and again in the canyon 8 miles up Kennedy river from Kennedy lake. It seems fairly certain that this thick limestone horizon continues through the Mackenzie range to appear on Barkley sound not far from the entrance to Alberni canal. Haycock<sup>1</sup> in 1902 noted poorly preserved fossils in limestones of this locality.

Conformably beneath the Quatsino formation is a great assemblage of volcanic rocks named<sup>2</sup> the Karmutsen volcanics, ". . . predominately andesitic to basaltic flows, but containing considerable quantities of coarse, volcanic breccias and some tuffs. The flows are dark green to almost black and include a large proportion of amygdaloid and pillow lava. The fragmentals (breccias and tuffs) are green, grey, and reddish. Interbedded with these volcanics are minor amounts of fairly pure white to impure dark grey limestone in the form, generally, of limited lenticular beds. The contact between the Quatsino limestone and the underlying Karmutsen volcanics is always sharp and frequently exhibits evidence of faulting along it.

"The Bonanza group overlies the Quatsino limestone conformably and consists of a great variety of volcanic flows and fragmental rocks with interbedded sediments. The distinctive pillow lavas and the amygdaloids of the Karmutsen volcanics are absent, and their place is taken by green and grey, andesitic and more acidic, light-coloured types with a minor proportion of black, basaltic rocks and very few fine-grained amygdaloids. Fragmentals including green, purplish to red, and grey breccias, and the corresponding finer grained tuffs or beds of consolidated volcanic ash, are very abundant. Crystal tuffs, resembling porphyries, are widely developed and there are a few coarse-grained, porphyritic flows. Interbedded with all these, but most abundant near the base of the group, are sediments. These include well-bedded, pure to impure limestone in thin beds, and argillites and quartzites. Green to grey dykes, believed to be part of the volcanic series, are quite abundantly developed in all the rocks of the Vancouver group." Gunning regards the lower part of the Bonanza group as definitely upper Triassic in age.

#### COAST RANGE INTRUSIVES

"The Vancouver range differs from the Coast range of British Columbia in that the granitic rocks of the Vancouver range do not, as exposed, occur in one large batholith, but occur in relatively small, irregularly outlined

<sup>1</sup> Haycock, Ernest: Geol. Surv., Canada, Ann. Rept., vol. XV, pt. A, p. 83 (1902).

<sup>2</sup> Gunning, H.C.: Geol. Surv., Canada, Sum. Rept. 1932, pt. II A, p. 33.

batholiths.”<sup>1</sup> The distribution of batholiths on the western watershed of Vancouver island would favour the hypothesis that the “Vancouver range may be composed of a large Coast range like batholith not yet largely unroofed, of which the exposed batholiths are mere protuberances or cupolas.”<sup>2</sup> Although few of the batholith areas have been fully mapped in Clayoquot and Alberni areas plutonic rocks outcrop widely and share not less than half the surface area with the rocks they invade. According to Gunning,<sup>3</sup> field relations indicate that these plutonics, varying from gabbro to quartz monzonite in composition, were formed during a single extended period of intrusion during upper Jurassic and possibly early Cretaceous. Differentiation proceeded within the magma so that a variety of rock types were formed, beginning with the early gabbro and diorite, and ending with the much lighter, more acidic, granodiorite, quartz monzonite, and associated dyke rocks. Dykes are numerous around the peripheries of the major intrusions, and are also common in the central parts of many of the granodiorite areas, suggesting that the upper mineralized portion of the batholiths still exists intact.

## CRETACEOUS

Dolmage<sup>4</sup> collected fossils from One Tree island, just off the entrance to Kyuquot sound, from sandstones and shales of Lower Cretaceous age.

The Cowichan group, some of it Upper Cretaceous, is represented in the section near the head of Alberni canal. Thus far, coal is the chief item of economic importance in the Cretaceous sediments of Vancouver island, particularly in Nanaimo district.

## TERTIARY SEDIMENTS

The youngest consolidated strata on the west coast of Vancouver island are the marine formations of Tertiary age. These are observed on the shore along Juan de Fuca strait, which probably originated as a down-fold or a depressed area at the time of the Laramide revolution. Vancouver island was outlined about that time as a mountainous region, for there is no evidence that the Tertiary marine beds extend inland over the underlying crystalline rocks.

The oldest Tertiary sediments thus far found on Vancouver island underlie the Nootka coastal plain. Coarse conglomerates with rounded pebbles of crystalline rocks of the Vancouver group outcrop at the shore at Escalante point; stratigraphically upward these give place to finer conglomerates, sandstone, calcareous sandstones, and shales containing an abundance of plant remains, shells, and rounded pebbles of jet. Southeast from Escalante point a prominent escarpment extends inland toward Hesquiat harbour, and marks the contact between the Tertiary and pre-Tertiary formations. The Tertiary beds have been folded and faulted; they strike north 45 to 60 degrees west and dip to the southwest or seaward from 10 to 25 degrees.

<sup>1</sup> Clapp, Charles H.: Geol. Surv., Canada, Mem. 13, p. 113.

<sup>2</sup> Loc. cit.

<sup>3</sup> Gunning, H.C.: Geol. Surv., Canada, Sum. Rept. 1932, pt. A II, p. 35.

<sup>4</sup> Dolmage, V.: Geol. Surv., Canada, Sum. Rept. 1920, pt. A, p. 17.

Dr. R. B. Stewart, of the U.S. Geological Survey, reported as follows on a set of fossils obtained by the writer in 1935 from beds outcropping at the shore between Escalante point and the ranch owned by G. J. Smith:

"A gasteropod faunule:

*Epitoneum* (s.l.) sp.

*Galeodea* sp.

*Naticoid*, not determined

*Siphonalia* sp.

"*Turris*" cf. *T. packardi* Weaver

*Turris* ? sp.

The six species of gasteropods are not sufficiently well preserved to be identified with certainty, but they belong to an Oligocene fauna, that is, near the Lincoln horizon of western Washington. The *Galeodea* may be related to *Galeodea dalli* Dickerson, from the Greise (Greece) Ranch fauna of Washington (Oligocene), and "*Turris*" *packardi* Weaver is probably from the Lincoln horizon. The *Siphonalia* is larger but comparable with *S. oregonensis* (Dall)—described as *Strepsidura*—and the *Epitoneum* may be *E. condoni* Dall. Both of Dall's species are from the Oligocene of Oregon. If the correlation with the Oligocene is correct the fauna is probably earlier than the Sooke fauna, which although erroneously called Oligocene seems better referred to the Miocene."

Dr. Roland W. Brown, palæobotanist on the U.S. Geological Survey, identified some pieces of fossil coniferous wood that was almost destroyed by borings of a ship-worm or teredo. This material was quite abundant in the Escalante section.

At Nootka, the writer learned from Rev. Anthony Terhaar, parish priest, that the supposed vertebra of a whale had been exposed for two years or more in the rocks beaten by the surf in front of the ranch of Mr. G. J. Smith. Mr. Smith kindly consented to have the fossil quarried out and sent to Ottawa, where it was referred to Mr. L. S. Russell who submitted the specimen to Remington Kellogg of the U.S. National Museum for study. The report by Mr. Kellogg is as follows:

"*Specimen.* An imperfectly preserved anterior lumbar vertebra. Cat. No. 8748, Geological Survey, Department of Mines, Ottawa, Canada; collector M. F. Bancroft; July 26, 1935. The vertebra collected by M. F. Bancroft one and a half miles southeast of Escalante point, Nootka sound, in rocks exposed at low tide off shore fronting ranch belonging to G. J. Smith, is a very interesting occurrence and turns out to be an archæocete. The ventral orifices of the dorso-ventral vascular canals are nearly obliterated, but the dorsal ones are open. This condition is not unusual among archæocete vertebra. It is also of interest that these foramina misled Dr. Harlan into believing that he had a reptile when he described *Basilosaurus*.

"In the light of our present information this vertebra belongs to a form that is related most closely to an undetermined species that occurs in the Ocala limestone (upper Jackson formation), of Georgia. It would be risky to assert that the same form is represented, particularly in view of the inadequacy of the material. I am inclined to believe that an upper Eocene or at most a lower Oligocene age is indicated.



"It was a great surprise to me to find this specimen was actually an archæocete. There are some 10,000 feet of Eocene sediments in California. These deposits have been searched repeatedly by oil geologists and invertebrate palæontologists. Thus far, not a single trace of bone has been found. I had supposed that the archæocetes did not reach the Pacific ocean until late in the Oligocene or early in the Miocene. A form has been described from New Zealand under the name *Kekenodon onomata* from the Ototaran stage. Some of the New Zealand geologists refer this stage to late Oligocene and others to the lower Miocene. I do not think that *Kekenodon* is related to the Vancouver form.

"The specimen consists of an imperfectly preserved anterior lumbar vertebra, maximum vertical diameter, tip of neural spine to ventral surface of centrum, 315 mm.; transverse diameter of centrum, anteriorly, 166 mm.; vertical diameter of centrum, anteriorly, 131 mm.; transverse diameter of centrum, posteriorly, 180 mm.; and vertical diameter of centrum, posteriorly, 120 mm."

Rounded jet pebbles occur in the fossil beds at Escalante. At Tofino while road work was in progress a cut was made through a clay bank and V. Evans of Tofino found similar jet pebbles, possessing a fine polish, which had been drilled through in one or two directions to form bulky but very light beads.

### TERTIARY IGNEOUS ACTIVITY

No igneous intrusions were seen cutting Tertiary strata; the marine beds of the Escalante formation might, however, contain considerable pyroclastic material that had been worked over by the waves, as many of the sandstone beds of late Eocene or early Oligocene age give a decidedly olive-green appearance to the sandy beaches derived from them.

The question of late Tertiary igneous activity on Vancouver island is dealt with by Dolmage,<sup>1</sup> and is based on two lines of evidence. He points out that a large belt of basalts and gabbros of late Tertiary age occurs in the southern portion of Vancouver island and the other line of evidence has to do with the type of hot spring seen at Sharp point in the vicinity of Flores island.

The spring at Sharp point is of the sodium chloride type and "unless igneous activity has taken place more recently than late Jurassic the existence of a spring such as this is difficult to explain."<sup>2</sup> The most conspicuous spring at Sharp point issues from a crevice in granodiorite; the temperature is close to boiling at the point of exit. The water flows along a rocky channel on the surface to a pool about 100 feet distant at the immediate shore-line. On July 29, 1935, the temperature at the pool was 110°F. A mile from Sharp point on the west side of Mate island, hot water issues through beach gravels, its temperature is 86°F.

<sup>1</sup> Dolmage, V.: Geol. Surv., Canada, Sum. Rept. 1919, pt. B, p. 19.

<sup>2</sup> Loc. cit.

## PLEISTOCENE AND LATER SEDIMENTS

The Wreck Bay<sup>1</sup> formation prominent on the upraised marine platform south of Clayoquot sound may have been deposited during an interglacial period. Glacial deposits are not conspicuous at the coast, but there is ample evidence of glacial grooving and scour of the rock formations along the fiords and main valleys.

Recent river gravels are seen along the streams. Valley gravels have been found to yield placer gold; China creek on Alberni canal, Bedwell river off of Bedwell sound, Gold river at Muchalat arm, and Zeballos river on Esperanza inlet, are examples of streams that have proved productive.

## STRUCTURAL GEOLOGY

The structural geology of the area lying between Barkley sound and Esperanza inlet would be simple if it were not for the inroads of plutonic rocks. The major monoclinical structure noted in the Zeballos mineral area is the key structure to the distribution of the pre-batholithic formations throughout the area examined in 1935. Minor anticlines and synclines are developed along it, trending northwesterly, and some of these folds are overturned. The attitude of the beds exposed on Meares island, Bedwell sound, and Herbert arm varies in places, but in general the strike is north 35 to 65 degrees west and the dip 38 to 85 degrees east. This direction of dip is opposite to that prevailing in the Zeballos mineral area where the dips are to the southwest.

Whether these minor folds on reaching the granodiorite area southeast from Tlupana arm prove shallow or deep is an interesting question. If synclines inset and surrounded by acid plutonic rocks are favourable localities for gold mining on the Canadian Shield it seems reasonable to suppose that such structures would be considered seriously when located elsewhere. The area has not been mapped in detail, but at the head of Herbert arm there appears to be one of these minor synclines, the central part of which is occupied by amygdaloidal basalt, underlain by andesitic volcanics, below which are limestone beds, outcropping on the north side and about the nose of the fold at the head of Cotter creek. This structure is cut off to the southwest by granodiorite and becomes irregularly engulfed in granodiorite northwesterly.

Pre-mineral faulting and fracturing cut the folded rocks and their included batholiths in such a way as to develop major shears along northwest-southeast lines and minor shears counter to the regional trend. The majority of known gold-bearing veins on Vancouver island strike northeast and southwest, and such veins are particularly well defined in the granodiorite of the Zeballos mineral area. The veins show pronounced ribbon structure, due to fracture planes.

The fact that shears occur in the granodiorite indicate that regional forces were in operation after a considerable part of the batholithic bodies had consolidated to some extent, been fractured, and become host to minor

<sup>1</sup> Dolmage, V.: Geol. Surv., Canada, Sum. Rept. 1919, pt. B, p. 16.  
28728-34

intrusion. The dykes, cutting through the granodiorite, exhibit a similar joint pattern on a finer scale than that shown in the more massive granodiorite. All the dykes seen in the field were pre-mineral in age.

## ECONOMIC GEOLOGY

Gold, silver, copper, iron, zinc, lead, mercury, molybdenum, marble, and manganese occur in the area. There is a certain amount of gold and silver associated with the heavy sulphide ores. Chalcopyrite is the principal copper ore, but some high-grade ores contain bornite. Magnetite iron ores of good quality occur in considerable quantities at various points. Some of the replacement deposits in limestone contain bodies of zinc blende. Galena is present and banded with the zinc blende, but no important lead deposits have yet been found in the area examined this season. The mercury, molybdenum, and manganese deposits are of doubtful value at present. Marble has been produced and dark to black shades of marble could no doubt be quarried in places.

The gold veins of the west coast of Vancouver island also carry silver, particularly if tetrahedrite is present. The black sands along the streams in some places assay high in both gold and silver. Vancouver island presumably contains different types of gold deposits, from high-temperature, deep-seated deposits to low-temperature deposits some distance removed from igneous contacts. In the Zeballos area pyrrhotite, arsenopyrite, pyrite, chalcopyrite, and galena may all occur in a 6-inch quartz vein, either in the Vancouver volcanics or the Zeballos granodiorite. The gold ores range from extremely complex to simple quartz veins carrying native gold and auriferous pyrite.

The gold deposits thus far developed fall into three general classes:

- (1) Quartz veins in fissures.
- (2) Quartz veins in shear zones.
- (3) Placer deposits.

The quartz veins in the fissures vary much in texture, from open, vuggy quartz to compact quartz fractured parallel to the walls of the fissure or fractured irregularly and cemented to form coarse-textured quartz veins. The gold-bearing veins may be frozen to the walls in part, or free with gouge developed along the walls. This type of vein has two well-defined walls, which may exhibit a very slight amount of hydrothermal alteration.

In the shear zone type of vein the mineral deposits may be confined to the foot-wall or the hanging-wall side of the main fracture. Pyritized country rock may be abundantly supplied with small quartz stringers. Shear zones may be seen adjacent to dykes or sills or other competent members in the rock formations.

There have been no systematic attempts to outline ore shoots in the veins as yet, and it is impossible to determine how the ore shoots pitch in the veins. In certain cases where transportation facilities and grade of ore permit, a narrow vein is mined and shipped to the smelter with very little attempt at hand sorting. Development work is meagre.

As early as 1895 Wm. J. Sutton called attention to a large intrusive boss on Corrigan (Granite) creek, in the Alberni Canal section, containing

many quartz veins—"a remarkable mineralized mass that will justify a thorough prospecting." In 1899 Carmichael, Provincial Assayer, examined mineral deposits in the Alberni division and summed up the situation thus: "Quartz veins traverse the igneous rocks, not necessarily adjacent to or having any relation to any contacts with other rocks—some of these quartz veins can be traced over the surface for long distances. The values in these veins are almost entirely in gold, with a little silver, and occur in iron sulphides scattered through the matrix."

The above comments centred about the W.W.W. mine, which has been worked intermittently. The best ore taken from this property in 1899 gave \$32 in gold, 2.6 ounces silver, and no copper. Smelter returns on five tons shipped in February 1935 averaged \$150 a ton for the Franklin River Gold Mines, Limited, the present owners of the mine.

In the little prospecting that has been done on Vancouver island the granodiorite areas have in general been avoided. Numerous claims had been staked in Zeballos area, but it was not until 1933 that gold was found in the granodiorite of that area, through following up to its source gold float found in the bed of Spud creek, a tributary of Zeballos river.

The Abco Mines, Limited, operating at the head of Herbert arm, was the only mining company on the west coast of the island furnishing continuous employment during the season of 1935, prospecting being carried on within an area of volcanic rocks of the Vancouver group.

## DESCRIPTION OF PROPERTIES

### Zeballos Mineral Area

The Zeballos mineral area is reached by Canadian Pacific Railway steamer from Victoria to Ceepeecee and from there by launch to the head of Zeballos arm, a distance of 12 miles. The discoveries in this area are still largely of the nature of prospects, but enough work has been done to show that the quartz-sulphide veins in volcanic rocks and persistent, narrow veins in granodiorite are rich in gold.

Recently the prospectors knowing that the quartz veins in the granodiorite carry visible gold, have turned with renewed interest to testing placer diggings. Three and three-quarter ounces of chunky gold was obtained from a shallow gravel bank a short distance up from the mouth of Spud creek during July and August, the men figuring that they averaged a cent a shovel of gravel fed to the sluice-boxes.

### PRIVATEER GROUP (Locality No. 3 on Index Map)

The Privateer group of eight mineral claims is a block four claims long and two claims abreast extending northeasterly along the south side of Zeballos River valley opposite the Jack of Spades cabin which is  $3\frac{1}{2}$  miles from the head of Zeballos arm up the Tagore-King Midas trail. The river is crossed at the Jack of Spades cabin to connect with the trail that extends along Spud creek to the Gold Peak cabin. Adjoining and southwest of the Privateer is the Van Isle group, and immediately to the east and southeast is the Gold Peak group of eight claims.

Alfred Bird and his associates staked the Privateer group of claims in August 1932. The original discovery is a 6-inch quartz vein in altered andesite, outcropping in the bed of Spud creek at an altitude of 400 feet above sea-level. On Spud creek, above the showing, Bird discovered gold-quartz float and this find led to the staking of the Gold Peak group of claims in October 1932. Work on the Gold Peak group occupied the attention of the owners and the ground staked as the Privateer group has remained undeveloped.

The Privateer group is crossed by the southwestern contact of the Zeballos granodiorite batholith. The granodiorite is in contact with volcanic rocks of the Vancouver group. The Privateer mineral showing is a quartz-sulphide vein averaging 6 inches in width, striking north 65 degrees east, and dipping 87 degrees northwest. The vein occurs in altered andesites in a rocky section of the Spud Creek channel and is exposed in vertical section for upwards of 20 feet in a cliff face on the northeast side of the creek before disappearing under a cover of vegetation. It persists southwesterly to the opposite side of the creek, a distance of over 60 feet, but is offset slightly by a fault in the creek bed.

A variety of sulphides are present, including pyrite, arsenopyrite, chalcopyrite, and a sparse amount of galena and sphalerite.

#### GOLD PEAK GROUP (Locality No. 4 on Index Map)

The Gold Peak group of mineral claims adjoins and lies east and southeast of the Privateer group. The mineral showings are in the vicinity of the Gold Peak cabin 5 miles from tidewater. The south boundary of the Zeballos granodiorite batholith strikes northwesterly across the group of claims, volcanic rocks lying southwest of the granitic body. The claims were staked in October 1932. Four months later a quartz vein carrying visible gold was found cutting granodiorite. Surface stripping disclosed eight or more veins in the granodiorite nearby.

On the most promising vein, known as the Donaldson, an open-cut was made into the steep hill-side at a height of 1,250 feet above sea-level. The open-cut was continued for 90 feet along the strike of the vein and in places it has a depth of 50 feet. About 50 feet below the top of the open-cut an adit has been started.

The ore from the open-cut returned 150 ounces of gold. The ore was sorted, sacked, back-packed to Zeballos river, canoed to Tagore, and back-packed again around Zeballos canyon, then taken in motor boat to Ceepeece and thence shipped by freight to Trail, B.C. The second and third shipments in 4-ton lots gave smelter returns of 23 ounces of gold and 6 ounces of silver to the ton. A shipment in June 1935 of 3,444 pounds of ore gave smelter returns of 6.26 ounces gold and 2.15 ounces silver. By the end of June 1935 approximately 15 tons of ore had been shipped to Trail from the White Star claim of the Gold Peak group.

The Zeballos batholith which trends northwest has pronounced joints striking northeasterly and curving around from north 70 degrees east to north 35 degrees east. Two fine-grained dykes with the appearance of aplite on the weathered surface, but greenish grey on fresh fracture, were noted on the White Star claim. These dykes are clearly older than the jointing of the granodiorite, since a closely spaced joint pattern was

imposed on them at the time the blocky jointing took place in the granodiorite. The granodiorite has suffered considerable faulting, movement having taken place throughout the jointed massif with varying intensity, relatively tight joints occurring along the same hill-side with parallel sheared fracture zones up to 3 feet wide.

Development work on the Gold Peak group consists of a limited amount of surface stripping, particularly along two veins to the west of the Donaldson vein and along one vein east of it higher up the slope which was discovered by Albert Bloom in February 1933, and is known as the Bloom vein. East of the Bloom vein on the summit going over into Gold creek there are three other veins exposed at an altitude of 2,000 feet above sea-level, but no work has been done on them.

The Donaldson vein follows the east side of a 6-foot dyke of dioritic feldspar porphyry for some distance, but diverges from it 70 feet from the upper end of the open-cut and continues down the slope in sheared granodiorite to a point below the dump where it splits into narrow quartz stringers. Its continuity is proved for 150 feet horizontally and for more than 100 feet in depth.

The vein strikes north 35 degrees east and dips 75 degrees southeast, its foot-wall being the 6-foot dyke. Numerous thin branches of the vein extend into joints in the hanging-wall granodiorite along lines striking north 65 degrees east. In the open-cut the vein attains a width of 15 inches, but pinches and swells, and averages somewhat over 6 inches wide. The hanging-wall rock shows marked hydrothermal alteration, the ferromagnesian minerals in the granodiorite have been completely destroyed for 4 inches back from the vein. Gouge next to the vein is white and like the altered granodiorite contains some sericite and pyrite.

In places the vein has bands of massive, mixed sulphides, along its sides, and the interior is filled with quartz growing in from both sides and forming a line of crystals in the middle. The sulphides in order of decreasing abundance are: pyrite, galena, sphalerite, arsenopyrite. Tests made on the individual minerals and also mixtures of the metallic minerals failed to show the presence of tellurium. There was considerable visible gold in the ore that was shipped.

One hundred and ten feet west of the Donaldson vein, between elevations 1,300 and 1,075 feet, a shear zone has been exposed in the granodiorite showing a quartz filling varying in width between 4 inches and 2 feet. West of the cabin is another similar quartz-filled shear in the granodiorite. The walls of this shear are impregnated with sulphide. The Bloom vein east of the Donaldson vein shows variable widths of shearing and small quartz stringers. It would require careful sampling to locate the sections of these veins where the altered country rock is barren or high in gold.

The Donaldson vein is the most promising of the showings thus far found on the Gold Peak. The presence of the 6-foot dyke on the west side of the vein may have been effective in impounding the mineral solutions and bringing about a greater concentration of gold. At any rate the best ore occurs where the vein, striking southwesterly, turns to follow the wall of the dyke for 70 feet. Other dykes in the granodiorite area should, therefore, prove of interest to the prospector.

## GOLDFIELD CLAIM (Locality No. 5 on Index Map)

The Goldfield claim, staked in June 1935 by Sam Knutsen, of Ceepee-see, is located on the summit between Spud and Gold creeks, at an altitude of 2,300 feet, about three-quarters of a mile from the Gold Peak cabin.

The Goldfield mineral showing consists of a shatter zone, 20 inches to 3 feet wide where exposed by open-cuts and natural outcrop, between well-defined walls of granodiorite. The zone contains vuggy quartz lenses and stringers of very much the same appearance as the ore on the Gold Peak. The minerals consist of pyrite, a little sphalerite, and free gold. The shatter zone strikes north 60 degrees east and dips from steeply northwest to vertical. Leaching of the granodiorite is pronounced in the brecciated material and extends for an inch or two into the walls. Samples taken by Knutsen yielded assay values varying between 5 and 16 ounces gold, and 4 and 18 ounces silver.

The deposit appears to follow a depression that crosses the crest of the ridge on the Spud Creek slope. Gold was seen in the oxidized part of the fracture zone in the depression 100 feet below the Summit open-cut on the Gold Creek side.

## RIMY GROUP AND LONE STAR CLAIMS

Sam Knutsen, Ray A. Pitre, and Alex. MacDonald have staked considerable ground, the Rimy group and Lone Star claims, yet to be prospected, adjacent to the Gold Peak group. The country rock is granodiorite of the Zeballos batholith which contains the gold-bearing veins on the Gold Peak group.

## VAN ISLE (Locality No. 6 on Index Map)

The Van Isle group includes seven mineral claims, staked by Ray A. Pitre, adjoining the Privateer group on the southwest. The property is on the southeast side of Zeballos river about  $3\frac{1}{2}$  miles from its mouth. The workings are in a small creek at altitude 600 feet, a quarter of a mile up from the river. In August 1935, preparation was being made to drive an adit along a 3-foot fissured zone in porphyritic andesite.

This fissured zone strikes north 45 degrees east and dips 80 degrees northwest. It occupies a horse-stall like gully, which makes the tracing of the fissure zone an easy matter over the surface for 1,200 feet. For 100 feet in the canyon it can be seen to contain a 1-foot quartz vein and stringers lying in crushed andesite. The quartz is fissured parallel to the walls and mineralized with fine-grained sulphides, pyrite being the most abundant, arsenopyrite next, and pyrrhotite, chalcopyrite, and galena still less abundant. The type of mineralization is similar to that noted on the Privateer. Samples are said to have assayed from \$9 in gold up to 9 $\frac{1}{2}$  ounces. A mineralized stringer 2 to 4 inches wide and almost vertical crosses the creek above and should intersect the foot-wall of the shear zone 90 feet from the creek. The property is under bond to the Nootka Gold Mining Syndicate, of Victoria, B.C.

## TAGORE (Locality No. 7 on Index Map)

The bedrock sources of gold on Zeballos river remained untouched until 1924 when the Eldorado, now known as the Tagore, group, was staked. A high-grade sample was assayed from this discovery in 1924 and ran: gold, 22.30 ounces; silver, 20 ounces; copper, 1 per cent; zinc, 8 per cent. V. Dolmage examined the ore and found that it contained native gold, galena, zinc blende, and pyrrhotite. It came from a narrow vein at the edge of Zeballos river  $1\frac{1}{2}$  miles above its mouth. A shipment of 4,500 pounds of ore from the Tagore in September 1932 gave smelter returns of 2.63 ounces gold and 2.52 ounces silver a ton. The vein is in the Vancouver group of volcanics and sediments, 2 miles south of the contact of the Zeballos granodiorite body that traverses this area.

It would appear that the gold-bearing veins in Zeballos area do not change in character, mineralogically or structurally, where they pass upward or outward from granodiorite into the rocks of the Vancouver group. The veins in both rock types strike northeast. The Tagore vein experienced only a "coyote type of mining," the productive part of the diggings having been filled in and covered. If the Tagore vein lacks lateral continuity it is in contrast with what the Van Isle vein exhibits.

## JACK OF SPADES (Locality No. 2 on Index Map)

The Jack of Spades is a copper deposit  $3\frac{1}{2}$  miles from the mouth of Zeballos river. The ore consists of irregular masses of chalcopyrite in limestone and volcanics. There has been some ore sacked. No systematic development work has been done on the property.

## KING MIDAS (Locality No. 1 on Index Map)

On the King Midas, 9 miles up Zeballos river, G. A. Clothier reported in 1933 that attention was being directed toward the development of a number of small, parallel, gold-bearing quartz veins in dense, greenish, volcanic rock. Surface stripping and open-cutting proved that the veins are small and not very long, but are very rich in gold where mineralized with zinc blende, galena, arsenopyrite, chalcopyrite, and pyrite. It is plain that gold mineralization is to be looked for in the formations both north and south of the Zeballos granodiorite body.

## Nootka Sound

Nootka sound gives access to a great area of country off Tasis canal, Tlupana and Muchalat arms, over which, apart from the Baltic group of claims, the bedrock sources for gold have not been prospected. The idea prevails that considerable gold was taken out of Gold river at the head of Muchalat arm. Legend among the Indians credits the Spaniards (1789-1795) with placer mining and setting fire to the forest with the intention of prospecting for veins. Chinese in 1788 assisted Captain John Meares in building the *North West America*, the first ship built on the west coast. Just when the Chinese began placer mining on the west coast of Vancouver island is uncertain, but it is known that Gold river held the attention of stray Chinese for a number of years.



On Tlupana arm in 1934 a mining syndicate took over a gold prospect on the west shore opposite Conuma river, where quartz carrying chalcopyrite and pyrite occurs in a fissure through amygdaloidal basalt. Instead of prospecting the quartz showing, an adit site was chosen 30 feet above it and in all about 120 feet of rock work was done in tunnelling. Not a hat full of ore was produced by prospecting in this manner.

All of the few mineral properties on Nootka sound are near the shore. A mile from the head of Tlupana arm, on a creek flowing into Head bay, is a property that W. L. Uglow reported on in 1924 as a magnetite deposit approaching commercial size. In 1908 a grey marble was quarried at Deserted creek on the west side of Tlupana arm.

There is a copper property (Star of the West) at the head of Tasis canal and a zinc property, the Silverado, southwest of the Baltic group, which merit mention. They are replacements in the Vancouver volcanics marginal to igneous contacts. The mineralized zones follow shears striking northwesterly. Enough open-cutting has been done to demonstrate that these properties are worth considering when prices improve. These properties have been described by the provincial resident engineers and their assays support the idea that the gold content of such deposits is on the low side and is variable.

#### BALTIC GROUP (Locality No. 9 on Index Map)

The Baltic group of claims, owned by Danzig Mines, Incorporated, gives promise of becoming at least a small producer. By September 1935 about 40 tons of ore had been shipped, having an average value of \$78 a ton. The first  $8\frac{1}{2}$  tons shipped to Trail, B.C., gave a smelter assay: gold, 5.637 ounces, and silver, 8.8 ounces a ton.

The Baltic group of claims lies on the south side of King passage, Muchalat arm, about 12 miles easterly from Nootka cannery. The group consists of four full-sized claims and two fractions, Baltic Nos. 1, 2, 4, and 5, and Camp and Ben Hur fractions. The discovery of mineral veins on this property dates back to August 1923. Active prospecting for gold since 1933 has led to the finding of various quartz veins on the steep, wooded slopes up to altitude 400 feet. The property could not be better situated from the standpoint of transportation.

The country rock is granodiorite of the Coast Range intrusives, including small patches of the greenish volcanics of the Vancouver group. The granodiorite is light grey and fine grained, gneissic in structure with darker bands developed in it. The mineral epidote is common. Felsitic and feldspar porphyry dykes cut the granodiorite and these, the youngest intrusives, show intimate association with the mineralized quartz in several outcrops, notably vein No. 4, Perry vein, and vein No. 8.

Vein No. 1 thus far has received most attention, some of the best ore coming from an open-cut at the shore where an adit follows the vein for a distance of 137 feet. It maintains a width of 4 to 12 inches and is well defined. This vein on the surface has been traced for upwards of 1,000 feet and has been open-cut at intervals to altitude 250 feet. The vein follows a general north-northeasterly course and dips 70 degrees east. There is a definite quartz stringer linking veins Nos. 2 and 3, which are also narrow but may link with vein No. 1 in depth.

No. 1 vein shows very little development of gouge, in places it is frozen to the granodiorite walls, but where it is free the wall-rock shows marked alteration to mica, epidote, and pyrite and is mineralized with quartz, pyrite, and zinc blende. The vein quartz is variably crushed and shows minor shears.

Samples taken from the open-cut near the portal of the adit driven on vein No. 1 were sent in 1934 by Mr. Malmberg to H. C. Gunning. Some of the material was typical of the gold ore shipped from the property. A large specimen, taken from a depth of 9 feet in vein No. 1, carried pyrite, chalcopyrite, zinc blende, and a little galena and pyrrhotite, sparingly distributed in a gangue of white quartz, epidote, and a few other minerals. Microscopic examination of this ore revealed the fact that there was very little free gold present. H. C. Gunning, who examined this specimen, stated: "There are a very few tiny specks, under  $\tau, \sigma \sigma$  of an inch in diameter, and some of these may be electrum, the natural alloy of gold and silver. Scattered through the chalcopyrite, however, are a number of small specks of light to dark grey minerals. There are at least four different minerals of this kind, generally closely associated, replacing the chalcopyrite. They are too finely divided for complete identification, but they contain tellurium and silver, and probably gold. One is probably hessite, the silver telluride, and this mineral may carry gold."

A 5-pound sample of the above ore assayed by the Ore Dressing Laboratory, Mines Branch, ran: gold, 6.955 ounces a ton; silver, 7.06 ounces a ton. About one-half the gold in the vein material tested was free and the rest linked with the sulphides.

A large specimen of zinc blende taken from 16 feet down on vein No. 1 (shore open-cut) is typical of a 4-inch band in the vein. It continues for several feet, shows a little galena, and very little pyrite. The gangue is largely quartz and epidote. When assayed it ran: gold, 0.03 ounce and 3.37 ounces a ton; lead, 2.55 per cent; zinc, 21.19 per cent; and a small percentage of copper, as the zinc blende contains finely divided chalcopyrite. Plainly not of shipping grade this was piled to one side.

Vein No. 4 includes a white-weathering felsite dyke 10 inches wide that is grey to green on fresh fracture. Mineralized quartz follows both sides of the dyke which strikes north 20 degrees east and dips 85 degrees west. The quartz is 2 inches wide on the foot-wall of the dyke and numerous parallel injections of quartz pass upward to the hanging-wall side of the dyke to make junction with a much wider band of very rusty, vuggy, banded, and crushed vein quartz, which is exposed for 25 feet following the dyke at altitude 280 feet and exhibits widths of 14 to 20 inches. Epidotization is a marked feature of the granodiorite, and epidote occurs in the quartz, along with pyrite, pyrrhotite, chalcopyrite, and sphalerite.

Three narrow veins outcrop at the shore east of the powder house. The middle vein has been stripped for 40 feet, averages 6 inches in width, and contains a notable amount of smeared-out magnetite, in addition to the other minerals noted above in vein No. 4.

Vein No. 6 on Baltic No. 4 claim is a very rusty, 12-inch band of quartz exposed above the trail by two small open-cuts between altitudes

160 and 200 feet. Veins Nos. 7, 8, and 9 are quartz outcrops of uncertain merit. The Perry vein on the Ben Hur fraction is of the same order, quartz in minor amounts occurs in a feldspar porphyry dyke.

#### STAR OF THE WEST (Locality No. 8 on Index Map)

The Star of the West mineral claims at the head of Tasis canal, owned by Wm. F. Spuhl and Arthur Parks of Nootka, include three claims. The best showings are on the Hakadte claim where there is a cabin at altitude 1,400 feet. The maximum width of ore replacement measures 17 feet and consists of chalcopyrite, pyrrhotite, pyrite, arsenopyrite, and minor amounts of magnetite. The ore occurs in a shear zone traversing limestone and volcanic rocks bordering a granodiorite contact. In 1925 the late Wm. M. Brewer from a general sample obtained the following assay: gold, 0.4 ounce; silver, 0.8 ounce; copper, 7.5 per cent.

#### SILVERADO (Locality No. 10 on Index Map)

The Silverado zinc property (the old Shannon group) consists of eight claims or more located southwest of the Baltic group, Muchalat arm. The mineral showings are within a mile of the shore at altitude 400 feet. The country rock consists of volcanic rocks and limestone cut by a shear zone striking north 50 degrees west. An adit designed to crosscut the shear zone has been started in a dark feldspar porphyry that outcrops in the cliff 200 feet below the surface showing. The Silverado exhibits clean zinc blende replacements up to 7 feet in width and a varying amount of zinc and copper sulphides exposed through open-cutting for 300 feet and more. A considerable tonnage could be taken from this ledge without the hazardous experiment of tunnelling to crosscut at depth.

George Clothier, Resident Mining Engineer, described this property in 1928 as the Shannon, and from a general sample obtained the following assay: gold, trace; silver, 6.6 ounces; lead, 8 per cent; zinc, 13 per cent a ton.

#### Herbert Arm

The gold discoveries at the head of Herbert arm were first staked early in 1933. The chief interest centres around two properties where gold-bearing veins occur in rocks of the Vancouver group.

#### BIG BOY GROUP (Locality No. 14 on Index Map)

The Big Boy group of eight claims and four fractions, belonging to Herbert Arm Gold Mines, Limited, lies at the head of Herbert arm and is a gold prospect that was discovered early in 1933. The initial discovery was a quartz vein carrying visible gold located at tidewater on the east bank of Moyeha river about one-quarter mile from the head of Herbert arm.

Forty feet of surface stripping was done along the vein which strikes south 65 degrees east and dips 20 degrees southwest. Near the upper part of the open-cut an adit was driven to test the character of the vein along the strike. Thirty tons of ore shipped from this 63-foot adit yielded over

\$1,500 in gold when treated at the Tacoma smelter. The vein pinches and swells along the strike and where it narrows sharply at 40 feet in from the portal gave assays as high as 9 ounces in gold to the ton. The vein follows a shear and it is difficult to say whether bands of altered andesite occur in the vein or if the shear zone carries mineralized stringers of quartz. In addition to the free gold the quartz and sheared country rock are sparingly mineralized with pyrite, chalcopyrite, sphalerite, and galena. The ore crumbles readily and would permit the loss of free gold particles.

It is not clear just what relation a new discovery made by Robert P. Duncan during the latter part of July 1935 bears to the first vein found on the property. The finding of some quartz in place with a generous sprinkling of visible gold on the weathered surface led to the making of a few small open-cuts along a well-defined draw or gulch at an elevation of 500 feet above sea-level and 1,300 feet easterly from the river adit. The largest open-cut, about 10 feet in length and 3 feet deep, only partly laid bare the hanging-wall side of a quartz vein richly mineralized with fine-grained galena, pyrite, and chalcopyrite. Ore from this small open-cut assayed 8 ounces in gold and 8 ounces in silver. The course of the gulch is southeasterly and there are outcrops of shattered, rusty quartz at intervals along it. The largest outcrop of quartz is 10 feet wide and 20 feet long, and in it pyrite and chalcopyrite are the chief minerals other than quartz. The greenish andesite on the south side of the gulch is cut through by porphyritic granodiorite and quartz diorite dykes striking northeasterly. The quartz vein or veins follow a shear zone intersecting both the volcanic rocks and the dykes. The largest granodiorite dyke on the hanging-wall side of the shear measured 35 feet across. The vein appears to dip about 60 degrees to the southwest. The shear zone continues along the gulch for several hundred feet as indicated by quartz outcroppings and small open-cuts. Though the foot-wall is not exposed it would appear that the vein is 3 feet to 10 feet in width and persists for several hundred feet.

Surface stripping of the shear zone could be accomplished for a considerable distance along the gulch at small cost as there are no large trees or other obstacles in the way. This is necessary before it is possible to make any definite statements concerning mining widths. Effective sampling cannot be done in the present undeveloped condition of the prospect.

#### MARY MCQUILTON GROUP (Locality No. 13 on Index Map)

Abco Mines, Limited, have undertaken exploration and development of the Mary McQuilton group of claims situated near the head of Herbert arm. The company had fifteen to twenty men employed in 1935, following a program prepared by B. W. W. McDougall, M.E. Where topographic conditions would make it a very expensive matter to build pack trails, the Abco have installed an aerial tramline, constructed over a mile of road, put up comfortable quarters for their working force, and made provision for a good working unit to cope with local conditions. By the end of September ore was going forward to Tacoma smelter. A trial shipment of 23½ tons gave smelter returns of 4.08 ounces gold and 2 ounces silver a ton, valued at \$143; net returns of the shipment were \$3,000.

The finding of placer gold in the bed of a creek (Cotter creek) flowing into Herbert arm led Mr. J. Livesley to prospect the adjacent mountain side to the northwest of the creek for lodes carrying gold. This resulted in the staking of the Mary McQuilton group of twelve mineral claims in the spring of 1933. Gold-bearing veins had been found at tidewater in Moyeha valley by Mr. Robert Duncan early in 1933, which led to the staking of the Big Boy group of claims. The discovery of other gold-bearing veins on the mountain slopes to the west of Moyeha river soon followed.

The group of mineral claims is on the north side of Cotter creek which flows into the east side of Herbert arm one-half mile from the head of the arm. Mineral showings along a steep creek channel tributary to Cotter creek from the north led to a thorough search up the mountain side along the course of this creek and its branches. Mineralization can be noted along the creek channels through a considerable vertical range. The Gibson vein, for instance, is at an altitude of 1,450 feet; the Mary McQuilton lode is at an altitude of 2,525 feet, and between these two are others. Other showings have been found, but at present the most work is being done on the Mary McQuilton lode.

The Mary McQuilton lode is a shear zone containing parallel veins separated by shattered andesite which is also mineralized and carries gold. The strike of the shear zone, where opened up, is north 45 degrees east and the dip is 50 to 60 degrees northwest. The strike parallels a tongue of granodiorite extending from Bedwell River area over onto the Cotter Creek slope.

When the property was visited early in August 1935 the zone had been exposed by open-cutting over a length of more than 90 feet across a creek bottom. The shear zone has a width of at least 12 feet and may be considerably wider, for in such shear zones there are likely to be masses of relatively unshattered rock between numerous slips along which the rocks are mashed or converted to gouge. Two parallel veins are displayed along the hanging-wall. The upper vein, from 6 to 18 inches in width, is slightly mineralized with sulphides and a sample of the quartz was taken by the writer for assay. The weight of the sample was 2 pounds, 3 ounces; the assay values were: gold, 13.09 ounces; and silver, 6.20 ounces, a ton.

The second vein is much darker because of finely divided sulphides, and is 2 feet below the first. It is 6 inches to 15 inches wide. A sample weighing 1 pound, 13 ounces, taken across this vein, gave the following results: gold, 4.31 ounces, and silver, 2.53 ounces, a ton. The writer has been advised that as open-cutting continued these veins were coming closer together.

The mining width opened up was 12 to 14 feet. Narrower quartz veinlets were noted on the foot-wall side. The shattered green andesite included between the veins is pyritized and company assays indicate that it carries gold.

The Livesley lode, the third to be discovered on the property, outcrops on the east of a creek course, at an altitude of 2,360 feet. The strike is north 35 degrees east and the dip 30 degrees southeast. A quartz seam along the hanging-wall varies from about 2 to 10 inches in width. Small visible flakes of gold occur in this quartz stringer as well as small bunches

of pyrite, galena, and other finely divided sulphides. This is the widest and apparently the most persistent veinlet. Between it and the foot-wall is a series of narrower and more erratic, parallel, linking veinlets that combine to make a stockwork. The total width of the shear zone is difficult to determine as it does not appear to be fully laid bare. Assays up to 6 ounces in gold to the ton have been obtained from narrow widths and an assay across a width of 8.5 feet, including some dense andesite and a couple of quartz stringers, assayed 0.07 ounce gold to the ton.

The Walker vein outcrops at altitude 1,940 feet in the same creek course as the Gibson vein and about 500 feet away. The slope of the mountain between the two is 45 degrees. It has been exposed by shallow open-cutting at the foot of a small falls and has been partly traced along its strike for a distance of about 135 feet. The strike is about north 30 degrees west and the dip 30 degrees northeast. The mineral zone consists of several flat-lying quartz stringers separated by andesite. The hanging-wall and foot-wall stringers appear to be persistent over the length now opened up. These stringers vary from 1 to 6 inches or more in width. Between these stringers veinlets and seams form a stockwork similar to that on the Livesley showing. Company channel samples across 7 feet, the full width of the showing, gave 0.38 ounce gold to the ton and twelve assays across selected widths show gold values ranging from 0.03 ounce to 4.08 ounces gold to the ton.

The Kermode vein is exposed by a very small open-cut at an altitude of 1,910 feet and about 60 feet south of the Walker vein. This shear shows small quartz stringers well mineralized and has given assays across a width of 3 feet including stringers and andesite of 1.68 ounces gold to the ton. The Kermode shear strikes north 75 degrees east and dips 14 degrees north.

The Cotter vein is exposed in the creek course at an altitude of 1,770 feet. It is between the Gibson and the Walker vein and about 200 feet from the Walker vein where it outcrops in the creek. There is a 12-foot dyke of feldspar porphyry cut by a mineralized fissure. Rich assays have been obtained from pyrite in narrow stringers. The vein strikes north 53 degrees west and dips 78 degrees east. The dyke rock is shattered and mineralized to some extent. Faulting in a small way is indicated by a 9-foot displacement.

The Gibson vein is in the channel of a creek at altitude 1,450 feet. It strikes north 60 degrees west and dips 14 degrees northeast. The vein consists of a well-defined quartz stringer varying from a few inches to nearly a foot in width and several smaller quartz stringers lying beneath the wider one and separated by varying widths of dense andesite. The entire width of the shear zone is between 4 and 5 feet. The total length exposed is 30 feet. Free gold can be seen in the andesite and assays have been obtained up to 1.44 ounces gold to the ton from this showing. The quartz is sparingly mineralized with sulphides including pyrite, galena, and chalcopyrite.

#### MOYEHA GROUP (Locality 15 on Index Map)

Spectacular specimens of gold in snow-white quartz have been obtained from the Moyeha group of eight mineral claims staked in 1933 and 1934,

and owned by H. E. Dendoff, Wm. P. Duncan, and associates. The several showings are between altitudes 400 and 3,100 feet on the steep slopes west of Moyeha river.

The country rock consists of dense andesite into which dykes of quartz porphyry have been intruded. There are several quartz veins on the property. One vein outcrops at altitude 410 feet, strikes north 80 degrees east, and dips 40 degrees south. It varies in width from 2 to 6 inches and can be followed up the slope for 40 feet to the base of a cliff in which it rises and continues for 250 feet or more, and is accessible for a short distance by the use of ladders. Mr. Duncan had assays of 4.5 ounces gold from this vein and pointed to a narrow, rich stringer 70 feet above in the cliff, which he had sampled where it was accessible from above. The quartz filling these veins is exceedingly vuggy and some of it is coloured green with chlorite. A little chalcopryite, pyrite, and galena occur in the quartz. In places the vein is free with gouge seams along the walls, whereas in other parts it is frozen firmly to the wall-rock. The northeast striking vein is the most persistent of those seen on the property. The veins exposed along the trail leading up from the Tye group of claims strike northwesterly, dip either east or west, and none attains widths greater than 8 inches. These outcrop on Moyeha claim No. 3 in a stream channel on the south side of the claim. The veins occur either in pyritized andesite or in quartz porphyry, now more or less oxidized.

The strongest vein seen at altitude 1,100 feet is the so-called top canyon lead. The vein is exposed over a length of 75 feet. It carries coarse- and fine-grained pyrite and some chalcopryite, and varies in width from 2 to 8 inches. There has been no systematic effort to prospect the area included in the claims, the five or six scattered showings are confined to two claims, Moyeha Nos. 2 and 3.

#### TYEE GROUP (Locality No. 16 on Index Map)

The Tye group adjoins the Moyeha on the west and comprises four or more mineral claims owned by J. L. Gibson, R. W. Gridale, E. W. and R. C. Bolden. All these claims have been held by location since 1933-34. There are two mineral showings on these claims southeast from the upper group of showings on the Moyeha property.

A trail leads up from Indian Reserve No. 23 and at altitude 850 feet an open-cut shows three parallel fissures filled with quartz and pyrite and striking northwest and dipping 45 degrees southwest. The foot-wall vein is the widest, measuring 8 inches across. It cuts quartz porphyry and there is 2 to 3 inches of black gouge on the foot-wall.

A second trench is about 100 feet northwest of the first. There are five distinct stringers of quartz varying in size up to 2 inches and gouge is present on the foot-wall as in No. 1 cut.

Mr. Gibson had assays: (a) across 4 feet in No. 1 cut, giving gold, 0.34 ounce, silver, 0.30 ounce; (b) across 4 feet of No. 2 cut, gold, 0.42 ounce, silver, 0.40 ounce; (c) across 2.16 feet from foot-wall No. 2 cut, gold, 0.73 ounce; and (d) picked sample from foot-wall No. 2 cut, 2.17 ounces gold.

The quartz forming the veins and stringers is dark on account of finely divided sulphides, principally pyrite.

## DAWN MINERAL CLAIM

For  $1\frac{1}{2}$  miles up the west side of Moyeha river from the head of Herbert arm it would appear that most of the ground has been staked. At altitude 300 feet on a bluff close to the river three veins were noted on the Dawn mineral claim in a shear zone striking north 50 degrees west and dipping 27 degrees southwest. The middle vein forks, illustrating how the number of quartz stringers present may vary from one point to another in these shear zones. The veins on the Dawn claim are mineralized with pyrite, arsenopyrite, zinc blende, and a little galena, and are similar in appearance to other veins in the district carrying gold values.

**Shelter Arm**

## HIGH BOY GROUP (Locality No. 11 on Index Map)

The High Boy group consists of four claims recently located in the granodiorite on the west side of Shelter arm near its head. They were staked by C. C. Binns and associates.

There are three parallel quartz veins exposed for 50 feet along a bluff. The veins strike due north and dip 58 degrees west. The uppermost vein is 2 to 3 inches wide and shows ribboned, rusty quartz. The two lower veins are separated by 18 inches of chloritized granodiorite and have widths of 4 and 6 inches, respectively. The principal mineral is pyrite and a return of \$6.50 in gold has been obtained by sample assay.

**Bedwell River Area**

Most of the properties along Bedwell river have been idle so long that little information could be secured by searching old excavations. About 6 miles up Bedwell river the old sills of cabins once occupied by Chinese placer miners are still in evidence. Going up from here to what is locally referred to as "Dry Gulch" on the west side of Bedwell river, at altitude 1,700 feet, near the contact of granodiorite below with Vancouver volcanics above is a stockwork of interlacing quartz stringers in granodiorite. The quartz contains chalcopyrite, pyrite, and pyrrotite. Molybdenite occurs on sheared surfaces in the granodiorite and in some of the quartz veins. One vein, 17 inches wide, as tested by Wm. E. Bond of Tofino, had on assay given 0.6 ounce gold. This occurrence appears to be on ground of the Crown-granted Belvedere group (Locality No. 18 on Index Map).

Bert Clayton and Joe Felber, two prospectors from the head of Herbert arm, reported late in the season the finding of a persistent lead of magnetite on the divide between Bedwell and the first important tributary of Moyeha river coming in from the east. Magnetite associated with limestone occurs on the Seattle group (Locality No. 19 on Index Map) on the east side of Bedwell river. The trail is overgrown and bridges are out. The ore noted was seen in specimens scattered on the slopes below the Seattle workings.



## YOU GROUP (Locality No. 17 on Index Map)

The You group of four mineral claims is owned by J. B. Woodworth of Vancouver. It is on Bedwell river, at altitude 1,700 feet, and is a gold-bearing vein in a 3-foot shear in granodiorite. This property is on the east side of Bedwell river where the country rock is granodiorite on the lower slopes of the valley and the Vancouver group caps the summit with a thick limestone bed, the most conspicuous member of the series.

The You group of mineral claims is first mentioned in the Minister of Mines Report for 1913, when an adit had been driven 54 feet on the vein and about 20 tons of ore was taken out and other prospecting work done.

Wm. M. Brewer, Resident Engineer, visited the You group in 1921. The following is his description of the property. "The fissure is exposed in a narrow gulch, the effects of erosion, for a vertical height of about 500 feet above the trail, where an adit is driven along the strike of the vein in a northeasterly direction. Owing to the quantity of water flowing down the gulch no close examination could be made of the vein above the adit on the trail. The fissure, with similar filling, has been traced down the mountain side a distance of 500 feet below the trail, where it has been exposed in open-cuts." Brewer makes it clear that the You vein is exposed at the surface over a vertical range of 1,000 feet. It is said that this shear zone can be followed laterally the length of four claims.

The shear zone is 3 feet wide between well-defined walls, with several inches of gouge separating each wall from the material that fills the fissure. Much of the quartz in the vein is banded and occupies widths of 6 inches to 2 feet in the roof of the adit, which has been extended so that it is now in 300 feet. The fissure strikes north 60 degrees east and is vertical.

The quartz is mineralized with pyrite, galena, zinc blende, and tetrahedrite. Some specks of free gold were noted. Much of the quartz is very friable, having been crushed to resemble granulated sugar. The downward circulation of waters from the limestone above may be responsible for the white, washed appearance of the quartz in sections of the vein. Sericite is prominent in the gouge of the vein.

Brewer's sampling of the You group in 1921 shows the persistence of gold along the tunnel driven at altitude 1,700 feet. His assays are as follows:

- No. 1. General sample from dump: gold, 2.92 ounces; silver, 2.6 ounces; copper, 0.5 per cent.
- No. 2. From across 8 inches quartz 24 feet from portal: gold, 3.56 ounces; silver, 3.4 ounces; copper, 0.2 per cent.
- No. 3. From across 8 inches quartz 36 feet from portal: gold, 0.92 ounce; silver, 0.8 ounce; copper, nil.
- No. 4. From across 4 inches quartz near face of adit 75 feet from portal: gold, trace; silver, trace; copper, nil.

Assay No. 4 indicates that there are barren places in the vein. Followed in for 225 feet farther the vein shows rich spots and lean spots.

## Tofino Inlet

STELLA (Locality No. 20 on Index Map)

The Stella mineral claim is a copper property  $1\frac{1}{2}$  miles inland from the head of Tofino inlet, at altitude 700 feet, and was recently staked by Wm. E. Bond, of Tofino. A high cliff crosses the property and much chalcopyrite ore has been sacked from the talus below the cliff. Mr. Bond has counted fourteen places where ore appears in the cliffs and high ladders have been constructed to reach some of these showings. It is typical of the replacement deposits in the limestone and volcanic formations bordering granodiorite contacts. Some of the granodiorite in the vicinity is brecciated. Brown and greenish garnet and coarse calcite occur in the gangue. Some of the ore is finely banded.

## Kennedy Lake and River Section

This part of the Clayoquot mining division was prospected to a limited extent and as early as 1899 ore from a quartz vein on the old Rose Marie group was treated in a 4-stamp mill.

The veins on which development work has been done in the Kennedy River section occur in the andesite of the Vancouver group and in close proximity to large intrusions of a very fine-grained, dark grey diorite that forms dykes in the granodiorite. Dolmage<sup>1</sup> described the gold quartz veins as probably being genetically connected with the diorite. Dykes similar to the grey feldspar porphyry that occurs in close association with the gold veins of the west coast from Zeballos river to Barkley sound were seen in the Kennedy River section in 1935. No doubt they belong "to an exceedingly late phase of the batholithic period," but they are earlier than the fissure veins.

All the veins are narrow and strike about north 45 to 80 degrees east and dip northwest 70 to 80 degrees. They consist of coarsely crystalline quartz containing vugs, and small grains of pyrite, galena, zinc blende, tetrahedrite, and gold which is sometimes visible.

ROSE MARIE GROUP (Locality No. 22 on Index Map)

The Rose Marie group, owned by Clarence Dawley and Andy Watson of Port Alberni, is situated east of Kennedy river, 3 miles above its mouth. In 1899 ore from a vein on the property was treated in a 4-stamp mill. Work was suspended in 1900 and later a rock and snow slide destroyed the concentrating mill, compressor plant, and other machinery. Wm. Brewer reporting on the district in 1925 writes of the Rose Marie as "a property that could be operated by a man with some capital and thorough knowledge of mining and milling methods and be made to pay." Mr. Brewer expresses the same opinion in his report in 1926.

The vein has been drifted on for 350 feet, the adit is at altitude 760 feet. The vein is free and follows well-defined walls in green andesite; it strikes north 70 degrees east and dips 70 degrees west. The vein pinches and swells, but averages 6 inches in width. The vein contains pyrite, chalcopyrite, and sphalerite and shows ribbon structure in places.

<sup>1</sup> Dolmage, V.: Geol. Surv., Canada, Sum. Rept. 1920, pt. A, pp. 18-19.

## LEORA GROUP (Locality No. 21 on Index Map)

The Leora group of three claims  $1\frac{1}{2}$  miles up Kennedy river was under development in 1902. In 1914 a shipment of 8 tons to Tacoma smelter brought \$880. It is estimated the Leora produced about 2,200 tons of ore that averaged gold 0.45 ounce a ton, before it was closed down in 1915.

The main vein on the Leora strikes north 79 degrees east and dips 58 degrees north. It was possible to examine its character along an adit for 106 feet. The drift apparently cut through into a creek bed and water filled the stopes. The vein in some sections was ribbon quartz averaging 8 inches in width, but maintained this width only for 75 feet southwest along the drift. Abundant pyrite, some chalcopyrite, sphalerite, and ankeritic carbonate occur in the quartz. There has been some effort to follow small branch fissures.

## JO JO (Locality No. 23 on Index Map)

The Jo Jo property is on the east side of Kennedy river less than one mile above the Rose Marie cabin. The principal showing is at an altitude of 575 feet and consists of a quartz vein. The vein appears in volcanics and sedimentary rocks for some distance, giving rise to replacements of pyrrhotite and chalcopyrite. It strikes north 65 degrees east and, entering a small granodiorite stock, maintains an average width of 2 feet and persists along the mountain side northeasterly for several hundred feet. The quartz contains blotches of pyrrhotite, pyrite, and lesser amounts of sphalerite, chalcopyrite, and traces of galena. Geo. A. Clothier describing this vein in the Minister of Mines Report for 1927 remarks that it has a very favourable appearance, but that the best samples from it on assay gave no precious metals.

## TOMMY K. GROUP (Locality No. 24 on Index Map)

On the Tommy K. group a vein called the "Hidden Treasure" strikes north 30 degrees east and dips 75 degrees northwest. The sulphides are pyrite, chalcopyrite, and pyrrhotite in a gangue of quartz. Altered quartz diabase dykes and a few aplite dykes cut the andesite breccia on this property, the light green fragments of the breccia seem much firmer than its darker matrix. The quartz stringers seen on this property yield some interesting gold assays, and may serve a useful purpose if they inspire a search for places where such stringers occur close enough together to have some commercial value. There is much higher ground in Kennedy River valley that has apparently remained unprospected.

## VANCOUVER ISLAND GOLD MINES, LIMITED (Locality No. 28 on Index Map)

The property of this company consists of ten Crown-granted mineral claims and twenty-seven claims held on location. They are situated at altitude 2,600 feet near the headwaters of Mineral creek, a tributary of China creek, 10 miles from Port Alberni, and have been fully described by A. M. Richmond in the Report of the Minister of Mines for 1934.

A trial shipment in 1934 gave smelter returns of: gold, 2.9 ounces and silver, 0.5 ounce, a ton. In September 1935 two carloads of unsorted ore shipped by the company averaged \$47 in gold a ton.

The rocks in this vicinity are sheared andesites of the Vancouver group. They are cut by acidic dykes that are sheared and pyritized and weather rusty. The deposits under development consist of quartz veins, the valuable constituents being gold and silver, associated with pyrite. The quartz is massive and occurs in varying widths up to 7 feet. The walls of the veins are free. Three principal veins have been opened to a limited extent. Excellent specimens of free gold have been obtained from several of the workings. Some of the veins distinctly show two generations of quartz, a dark quartz brecciated and surrounded by a lighter quartz, both containing native gold as a primary constituent. The veins strike northeast to north and dip from 40 to 70 degrees east to southeast.

#### W.W.W. MINE (Locality No. 27 on Index Map)

Franklin River Gold Mines, Limited, owns five Crown-granted claims on Corrigan (Granite) creek, about 10 miles southeast of Alberni canal. In February 1935 the company shipped 5 tons of ore averaging \$150 a ton.

This property was not visited. The following account is derived from a report by J. S. Stevenson in the Minister of Mines Report for 1935.

There are three veins on the property, each developed by an adit at altitudes of 1,825, 1,960, and 2,100 feet, respectively. The two upper veins strike northeasterly and dip on the average 45 degrees to the southeast. The uppermost vein varies in width from 10 inches to a narrow slip and has been drifted on for 95 feet southwesterly. The filling of the vein is chiefly ribbon quartz. Short stretches of the vein contain abundant pyrite accompanied by smaller amounts of galena and sphalerite. The vein walls are clean cut and coated with about  $\frac{1}{2}$  inch of clay gouge. The best gold values are obtained where the sulphides are heaviest.

The vein at altitude 1,960 feet has been followed in the adit for 195 feet. The next vein at altitude 1,825 feet has been followed by an adit 308 feet long. A complex of igneous rocks is exposed in the various workings. Tongues of granodiorite alternate with masses of hybrid diorite and both types have been cut by basic feldspar dykes, older than the veins.

Mr. Stevenson gives the results of a number of assays. Those of samples in which sulphides were plentiful carried gold, 6 ounces, silver, 4 ounces, a ton. Others of samples in which the sulphides are finely disseminated in the quartz ran: gold, 1.30 ounces, silver, 0.90 ounce, a ton.

#### Barkley Sound

##### FAITH AND DORIS CLAIMS (Locality No. 25 on Index Map)

The Faith and Doris mineral claims are owned by W. E. Sagers and A. E. Jacobs of Ucluelet and were staked in 1934. They are located 2 miles southeast from the Japanese village opposite Spring cove, Ucluelet. The claims extend inland from the beach.

The mineral showings consist of abundant pyrite scattered through sedimentary strata where there has been slickensiding and slip walls

developed along a north to northwesterly direction. This condition exists across a width of 62 feet in which the rocks are altered and consist of chert, dolomitized limestone, some graphitic slate, and some rusty quartz veinlets. The strike of the shearing planes is north 10 degrees west and the dip 60 degrees east. Assays of pyrite from these shears indicate: gold, a trace to 0.22 ounce; silver, a trace. Sections of similar strata were seen elsewhere back in the mountains. Pyrite in every case is an important constituent of these beds.

#### TOQUART GROUP (Locality No. 26 on Index Map)

The Toquart group comprises four mineral claims, staked in 1933 and owned by T. Tugwell and Hillier Bros., of Ucluelet. The group is situated on the northeast side of Lucky creek, about 2½ miles up the creek from Toquart harbour on Barkley sound. Under the name of Red Rover this property received some attention in 1905 and 1906. The workings are between altitudes of 250 and 400 feet.

The country rock is andesitic greenstone cut by dykes of quartz porphyry and dense feldspar porphyry. Recent open-cutting has laid bare a quartz vein that strikes north over a total slope distance of 375 feet, the sections of the vein exposed aggregating over 100 feet. Near the south end of the vein a 30-foot adit has been driven. The vein pinches and swells and is slickensided, so that quartz sections of various widths and lengths occur along its course. Assays indicate mining widths up to 2 feet holding values up to one ounce in gold. Mr. Hillier had in his possession some excellent specimens showing free gold in the quartz. The quartz has a somewhat brownish tinge and contains small amounts of pyrite and chalcopyrite. A sample of the quartz from the vein weighing 1 pound, 1 ounce, assayed: gold, 0.27 ounce, silver, 0.07 ounce, a ton. A sample of the wall-rock associated with the quartz assayed: gold, 0.06 ounce, silver, 0.02 ounce, a ton. These assays made by the Mines Branch do not represent average samples. More open-cut work and systematic sampling of the property are desirable.

#### Placer Deposits

Many of the streams on the western watershed of Vancouver island carry placer gold and the black sands in the beaches along the coast at several places assay well for gold. It is certain that the possibilities of mining the stream gravels and beach deposits have not been tested systematically at more than a few points. Gravel banks along the streams are generally under heavy forest growth. The prospector loses interest if he finds evidence that Chinese placer miners have been ahead of him. They were operating on China creek, Alberni canal, as early as 1862 and it is estimated that prior to 1895 about \$40,000 worth of gold had been recovered from the gravels in that locality. Placer mining is still in progress.

Prospectors on Spud creek, a tributary of Zeballos river, during July and August 1935, recovered 3½ ounces of chunky gold by use of pan and sluice-box. A sample of black sand, free from visible gold, submitted to

the Geological Survey from this placer, gave: gold, 16.44 ounces, silver, 6.08 ounces, a ton. It would appear that some of the gold contains a large proportion of silver and is tarnished black. Rich float led to the discovery of the veins carrying visible gold on Spud creek and this in turn inspired sampling of the gravels for placer gold.

H. C. Gunning's report<sup>1</sup> on Zeballos area makes note of placer work on the main Zeballos river in 1908 by T. J. Marks and in 1932 by Alfred Bird. The gold-bearing material in all cases shows the presence of black sand; the coarse gold does not appear to have been transported far. Gunning concludes that the gold is derived from nearby gold-bearing quartz sulphide veins.

Black beach sands were staked early in 1899 at Wreck bay, on the western coast of the island just northwest of Ucluelet. In 1900 it is reported that the Ucluelet Placer Mining Company recovered \$9,400 from 600 cubic yards of gravel, or a little over \$15.50 a yard. The gold, though fine, was particularly clean and free and not rusty. The total recovery for 1900 from Wreck bay is given as 700 ounces, valued at \$10,639. A further recovery of \$9,950 is reported by this company for 1901 and \$100 for 1902. Mr. George Fraser of Ucluelet says this one company took out over \$23,000 worth of gold. No information is available as to the amount of gold recovered by individual prospectors at Wreck bay.

In the Geological Survey Summary Report 1919, part B (page 16), the results of assays of two samples taken from the beach sands at Wreck bay by V. Dolmage are given as 13.02 and 3.6 ounces gold a ton, respectively; the higher assay return was of a sample of black sand made up of the concentrates from three pans of sand taken from the beach at the base of a wave-cut cliff of the unconsolidated Wreck Bay formation of Pleistocene age. The lower assay was of average black sand, not panned, taken from the beach at the base of the cliff. An assay of a third sample taken from the sediments of the Wreck Bay formation showed a trace of gold. The gold in the present-day beaches is derived from this formation and has been concentrated by wave action.

From an examination of the Wreck Bay formation and of the intervening topography it seems almost certain that the gold content of the gravels in this formation originated in the quartz veins of the Kennedy Lake drainage basin, as was pointed out by Dolmage.<sup>2</sup> This area may have been low-lying ground in Tertiary time where placer gravels accumulated and were later eroded by glacial action. The quantity of gold in the Pleistocene sediments in the vicinity of Wreck bay is much too small to be extracted commercially by working them where concentration has not already been effected by wave action.

The possibilities of concentration of the gold by wave action are not, however, limited to the present strand line, as different strand lines occur in a vertical range of 40 to 50 feet above sea-level. In the Geological Survey Summary Report for 1902 (page 88) Ernest Haycock describes the Recent marine deposits and the old shore-lines along the present coast.

<sup>1</sup> Geol. Surv., Canada, Sum. Rept. 1932, pt. A II, p. 45.

<sup>2</sup> Geol. Surv., Canada, Sum. Rept. 1918, pt. B, p. 38.

Richly fossiliferous layers of strata of Oligocene age were found in 1935 fronting an ancient sea-cliff which crosses the Estevan peninsula from Escalante point southeasterly to Hesquiat harbour. Plant remains, shells, and the vertebra of a whale were found. These Oligocene strata consist of beach and shallow water deposits with conglomerates at the base containing pebbles of the Vancouver group of rocks and of vein quartz. Pleistocene and Recent, and possibly Tertiary, beach placers, might be prospected for at places along the coast where marine deposits of these ages occur.

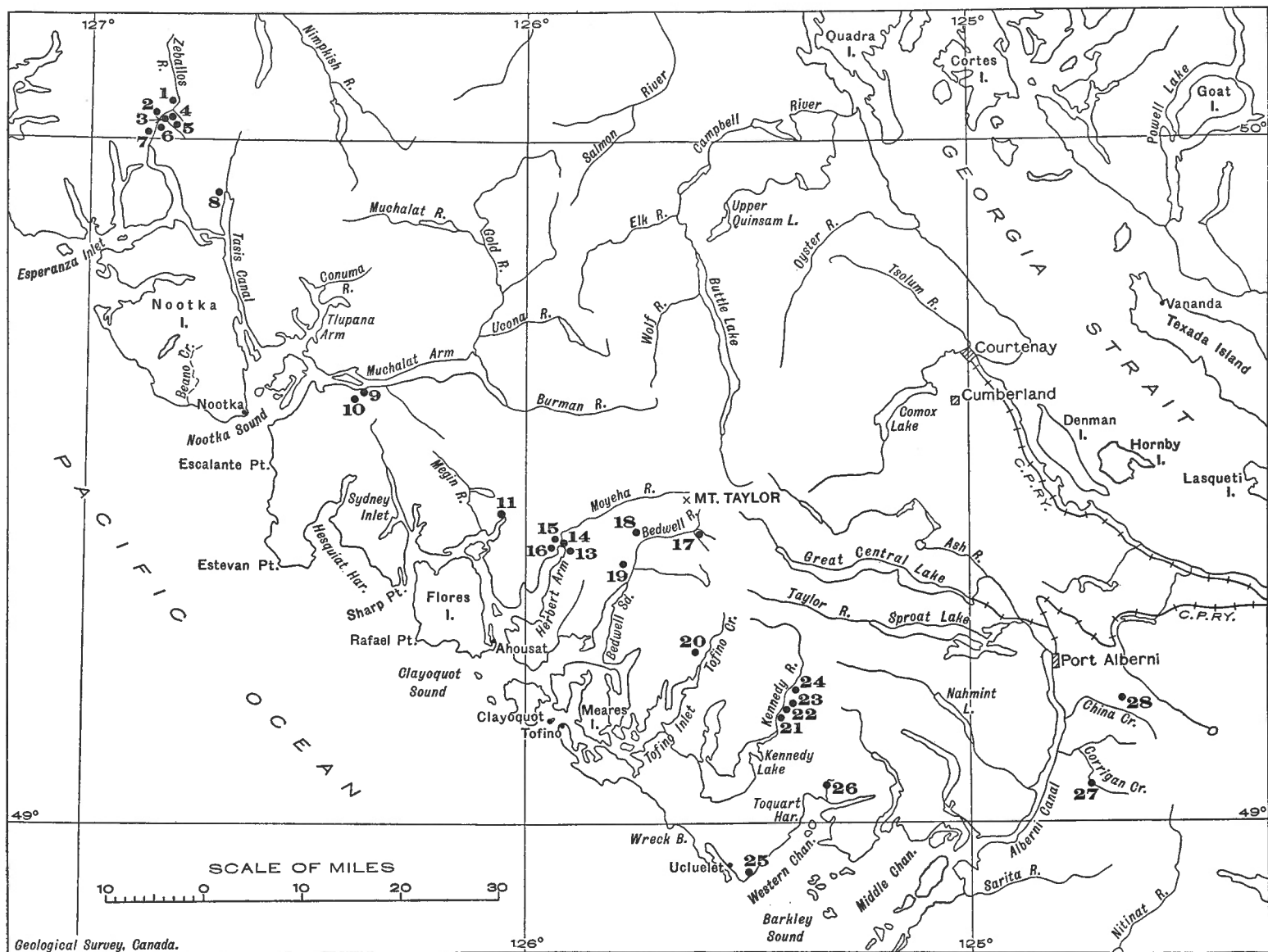


Figure 1. Index map of part of Vancouver island showing location and distribution of mineral properties. 1, King Midas; 2, Jack of Spades; 3, Privateer group; 4, Gold Peak group; 5, Goldfield; 6, Van Isle; 7, Tagore group; 8, Star of the West; 9, Baltic group; 10, Silverado; 11, High Boy group; 13, Mary McQuilton group; 14, Big Boy group; 15, Moyeha group; 16, Tye group; 17, You group; 18, Belvedere group; 19, Seattle group; 20, Stella; 21, Leora group; 22, Rose Marie group; 23, Jo Jo; 24, Tommy K. group; 25, Faith and Doris; 26, Toquart group; 27, W. W. W. mine; 28, Vancouver Island Gold Mines, Limited.



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