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FIELD WORK, 1959

by

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INTRODUCTION

The following notes describe briefly, by provinces, field projects undertaken by the Geological Survey of Canada during 1959, indicate progress made, and briefly summarize some of the results. The main purpose of most Geological Survey field work is to obtain basic data concerning the geology of Canada. These data, when assembled, interpreted, and published as appropriate maps and reports, guide those engaged in the search for and development of metallic and non-metallic mineral deposits, fuels, and construction materials. From time to time, however, as an incidental product of the field work, geological features or mineral occurrences are noted that might be of immediate or direct economic interest. Data concerning some of these warrant prompt release, in advance of the Survey's more formal Preliminary Series reports. Facts concerning a few such items are included in the following notes, but the mention of such items does not necessarily imply economic merit beyond what is obvious from the facts stated.

The field projects described involve the study and mapping of bedrock geology, unless otherwise specified.

In most instances, and unless otherwise specified, the scale of publication of geological maps resulting from the field projects can be inferred from the size of the map-areas. Areas involving 1 degree of latitude, and 1 or 2 degrees of longitude (for instance, 32 A E½, or 32 A) are generally mapped for publication on the scale of 1 inch to 4 miles; whereas areas involving 15 minutes of latitude, and 15 or 30 minutes of longitude (for instance, 32 A/1 E½, or 32 A/1) are usually mapped for publication on the scale of 1 inch to 1 mile.

All statements concerning the results of field work are subject to confirmation by office and laboratory study, and publication by the officer concerned through Geological Survey or other media.

Map-areas are designated according to the National Topographic System in effect up to and including 1957.

Insofar as practicable or warranted preliminary maps and/or reports incorporating the results of the 1959 field work will be released during 1960. The date on which these will be released cannot, however, be forecast accurately. The release of these preliminary reports and maps, and all other Geological Survey publications is, however, announced by postcards mailed free of charge to all persons or organizations requesting this service.

Persons contemplating a visit to the Geological Survey of Canada headquarters in Ottawa will recall that all Survey staff and facilities are now housed in new quarters at 601 Booth Street.

Convenient telephone numbers are:

Director, J.M. Harrison,	CE-2-8211, Loc. 4-5817
Chief Geologist, C.S. Lord,	Loc. 4,5907
Distribution of Publications, J.L.L. Touchette,	Loc. 4-5004.

DISTRICT OF FRANKLIN

R.G. Blackadar, in 1958, commenced mapping Mingo Lake (36 A) and Macdonald Island (35 P) map-areas on the southern coast of Baffin Island. During 1959 he completed field work within most of Macdonald Island map-area, and within Mingo Lake map-area south of latitude 64°20'.

The rocks mapped are of the Grenville type, and contacts between map units are gradational in most places. The structure is locally complex, but the regional trend is northwesterly. A belt, commonly several miles wide, of limestone, quartzite, and rusty graphitic schists, extends from the centre of White Bear Bay northwesterly to the head of Keltie Inlet. Southwest of this belt, and including offshore islands, is granitic gneiss, granulite, and biotite-quartz-feldspar gneiss. Northeast of the White Bear Bay-Keltie Inlet belt is garnetiferous gneiss, locally graphitic.

Tabular bodies of amphibolite occur here and there, mainly within the granitic gneiss-granulite-biotite gneiss map-unit. These commonly contain bands of massive magnetite, the abundance of which varies greatly from place to place within any one body. The longest amphibolite body mapped extends in a sinuous course southeasterly from a point midway along the length of Keltie Inlet, to about the head of Amadjuak Bay. Some exploratory work is reported to have been done on this body immediately southeast of Keltie Inlet, by Ultra-Shawkey Mines Limited in 1958.

R. Thorsteinsson, R.L. Christie, J.G. Fyles and E.T. Tozer made a reconnaissance of the bedrock and surficial geology of Banks, Victoria, and Stefansson Islands suitable for publication on the scale of 1 inch to 8 miles. J.G. Fyles was responsible for the surficial geology.

The party comprised the above four staff geologists, two pilots, and a cook, and had full time use of two Piper Super Cubs (PA18A) supplied by Bradley Air Services of Carp, Ontario.

The aircraft were equipped with special large low-pressure tires enabling them to land with little difficulty at numerous unprepared localities. By using these aircraft for traversing, about 110,000 square miles were mapped at a cost of about $50,000 exclusive of staff salaries. The total flying time for the Piper Super Cubs was about 720 hours, including ferry time to and from Ottawa. The party arrived in the area about 21 June, and left about 14 September.

The rocks mapped range in age from Archaean to Pleistocene. The total stratigraphic section amounts to something in the order of 18,000 feet.

The oldest rocks identified, presumably of Archaean age, comprise a minor area of quartzite and granite on the west shore of Hadly Bay, Victoria Island.

A belt of Coppermine series rocks, resting unconformably on the above, extends from Minto Inlet and Prince Albert Sound on the west, to Hadly Bay on the east. This assemblage has been mapped as six units comprising, from bottom to top: sandstone, limestone, gypsum, limestone, gypsum and red sandstone and shale, and basalt flows with minor native copper. The total thickness of the Coppermine series rocks is about 7,000 feet, including 1,500 feet or more of gypsum.

Most of the remainder of Victoria Island is underlain by flat-lying mid-Ordovician to mid-Silurian dolomite. The dolomite rests unconformably on rocks of the Coppermine series and has a maximum thickness of about 2,000 feet. It is overlain, conformably, by upper Silurian limestone on Stefansson Island.

Extreme northwestern Victoria Island, and northeastern Banks Island, are underlain by gently dipping middle and upper Devonian limestones and sandstones totalling about 4,000 feet. The upper Devonian strata are mainly sandstones, but contain limestone and dolomite biostroms and biohermal reefs scattered over wide areas.

Most of the remainder of Banks Island, insofar as exposed, is underlain by lower Cretaceous to Tertiary marine and non-marine sediments totalling about 5,000 feet. Coal occurs in the non-marine beds. Throughout much of central and western Banks Island, bedrock is masked by surficial deposits including early Pleistocene gravels of the Beaufort formation.

Solifluction, particularly on Banks Island, has obscured many data required for an adequate interpretation of the surficial geology.

Banks and Victoria Islands were glaciated by ice that moved northwesterly, distributing granitoid erratics from the mainland as far as the northwest corner of Banks Island.

Post-glacial emergence in southeastern Victoria Island has been more than 550 feet. In the northwest, near Prince of Wales Strait, and in the north, on Stefansson Island, emergence has amounted to something between 100 and 200 feet. Due to the masking effects of solifluction the amount of emergence of Banks Island is not known precisely, but appears to have been slight.

DISTRICT OF MACKENZIE AND DISTRICT OF KEEWATIN

J.A. Fraser, B.G. Craig, W.L. Davison, and W.W. Heywood commenced and completed a helicopter-supported reconnaissance of the bedrock and surficial geology of about 65,000 square miles between Great Bear Lake and the Arctic Coast, for publication on a scale of 1 inch to 8 miles. The project was known as Operation Coppermine.

The boundaries of the area mapped are: the 124th meridian south from the Arctic coast at Darnley Bay to the north shore of Great Bear Lake; thence easterly along the north and east shores of the lake to the 66th parallel near Port Radium; thence east to meridian 116; thence south to parallel 65; thence east to meridian 112; thence north to the Arctic coast near the mouth of Tree River; and thence northwesterly along the coast to Darnley Bay at meridian 124.

Most of the area was traversed by parallel helicopter flights east or west, spaced at intervals of about 6 or 7 miles. Minor, mainly irregular, areas were traversed by radial helicopter flights.

The northwest boundary of the Canadian Shield, except for scattered inliers, lies along a line from Coppermine to the head of Dease Arm and convex towards the northwest. This information radically modifies the Geological Map of Canada.[1]

Strata north and west of the above boundary are mainly of upper Ordovician to mid Silurian age, although drift covered areas adjacent to Great Bear Lake may be underlain by Cretaceous rocks.

Substantial areas of Yellowknife volcanic and sedimentary rocks, and their metamorphic equivalents, were mapped in that part of the Shield lying south of the 66th parallel. Granite and granite-gneiss underlie about a quarter of the Shield area, and are younger than the Yellowknife formations. The remainder of the Shield area is underlain

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[1] Geological Survey of Canada: Geological Map of Canada, Map 1045A (1955)

by extensive areas of each of the following post-granite units: Epworth group, mainly quartzite, dolomite, slate, and greywacke; Hornby Bay group, mainly sandstone, quartzite, conglomerate, and dolomite; Lower Coppermine River series, mainly basalt; and Upper Coppermine River series, mainly sandstone, shale, and dolomite, here and there with a little gypsum.

Near the mouth of Tree River, in the northeast corner of the mapped area, marine shells indicate an emergence of at least 495 feet. This emergence apparently decreases along the coast to the west; and west of the mouth of Croker River, no evidence was found for a significant marine emergence. Similarly, beaches at Hornby Bay, at the east end of Great Bear Lake, indicate that the former maximum water-level stood 480 feet above the lake. This maximum decreases towards the west, and, at meridian 124 on the north shore of the lake, no evidence was found to indicate that the lake formerly stood significantly higher than at present. Furthermore, no evidence was found that would indicate that marine waters had entered Great Bear Lake basin.

Two of several Pingos mapped are known to involve bedrock in their structure. In one of these, the rock involved is a shale, possibly of Cretaceous age. In the other, the disturbed rock is dolomite, probably of Ordovician or Silurian age.

G.D. Jackson completed the geological study and mapping of Belcher Islands, Bakers Dozen Islands, and King George Islands (33 M, and 34 D, E). Project resulted in the mapping of about 20,000 feet of Proterozoic sedimentary and volcanic rocks, including two volcanic units and 250-400 feet of iron formation. The formations occupy north-northeasterly trending tight folds, and plunge up to 20° N-NE and S-SW. The strata are less tightly folded on the extreme west of Belcher Islands, and presumably likewise less tightly folded immediately east of the islands beneath Hudson Bay.

J.C. McGlynn was transferred from the Yellowknife office to Ottawa in mid-July, thus completing a tour of duty as Resident Geologist which he had commenced in the early summer of 1953. He returned to Yellowknife for a few weeks during September to brief his successor, W.R.A. Baragar, on duties of the office and related matters.

P.J.M.J. Sartenaer, a post-doctorate fellow from Belgium, continued his research program with the Geological Survey of Canada by studying the palaeontology and stratigraphy of Upper Devonian (Feminian) strata at various localities in the Mackenzie River basin, Northwest Territories, and in the vicinity of Banff, Alberta.

C.H. Smith commenced, as part of his continuing study of ultrabasic rocks of Canada, a detailed investigation of the

Muskox complex (parts of 86 J/2, 6, 11, 14; 86 O/3) in the Big Bend of the Coppermine River, Northwest Territories. Part of the body, lying north of Coppermine River, has been under exploration by Canadian Nickel Company. Hans Kapp, a post-doctorate research fellow from Switzerland, is participating in laboratory petrological studies now being undertaken in Ottawa.

The complex is a northerly trending differentiated basic intrusion that crosses the Coppermine River and is known to extend from latitude 66°20' at longitude 114°50' to latitude 67°10' at longitude 115°10'. A 30-mile length of the intrusion was mapped on a scale of 1 inch to 1,000 feet. At its southern end, south of Coppermine River, the body is dyke-like, vertical, about 400 feet wide, and composed of norite on the walls with feldspathic ultrabasic rocks (picrite) in the centre. North of Coppermine River the complex widens to 4 miles and the contacts dip inward at angles ranging from about 25° to 50°. Nearly flat layers of dunite, olivine pyroxenite, and gabbro occur within the intrusion. Granophyres are found at the north end. Pyrrhotite, chalcopyrite, and pentlandite occur along the margins of the complex. At several localities small lenses of galena, up to about a foot in length, were noted in the gneissic rock bordering the intrusion.

The rocks of the complex were not found in contact with the nearby dolomites and basalts of the Coppermine River series and the age of the complex relative to the latter is, therefore, unknown.

DISTRICT OF MACKENZIE AND YUKON

J.A. Jeletzky continued from 1955 and 1958, and concluded, his field study of the stratigraphy and palaeontology of Cretaceous and uppermost Jurassic strata of northern Richardson Mountains and vicinity. During the 1959 field season he examined Cretaceous strata, or reported Cretaceous strata, and associated rocks, in the following areas: Peel River between Fort McPherson and mouth of Road River, Northwest Territories and Yukon; Road, Vittrekwa, and Stony Rivers, Northwest Territories and Yukon; Upper Rat River, Northwest Territories; Bell River, Yukon; Porcupine River from Bell River to a point 10 miles upstream from Driftwood River, Yukon; Bonny Lake-headwaters of Blow River-headwaters of Fish Creek, Yukon; and Inuvik, Northwest Territories.

A line lying slightly east of Peel River in Northwest Territories, and extending northerly to a point a few miles west of Inuvik, is believed to mark the eastern boundary of the Jurassic and Cretaceous rocks of Richardson Mountains; and the southern limit of the strata, except those of late lower Cretaceous age, probably lies between Vittrekwa River and Road River.

Correlations based on palaeontological evidence have demonstrated pronounced facies changes, and significant changes in porosity due to metamorphism, within the upper Jurassic and Cretaceous strata from place to place within the region examined. The distribution of these various rock types was outlined in a reconnaissance manner.

Although previous work by McConnell[1] indicated Cretaceous strata on Porcupine River between the mouth of Bell River and a point 10 miles upstream from the mouth of Driftwood River, a re-examination in 1959 identified only Permian and Jurassic strata.

A breccia of sedimentary rocks and diabase in a gypsum or anhydrite matrix outcrops for a length of about ¼ mile on Lower Donna River north of Mount Gifford (approx. latitude 68°12', longitude 135°27'). This rock is interpreted as a Cretaceous or Tertiary piercement breccia exposed in the core of a piercement dome or other structure.

On the south shore of Rat River about 1 mile below the mouth of Barrier River small lumps of asphaltum-like bitumen were observed in the upper part of the upper shale-siltstone division[2] as small blebs and as fillings of fossil shells. It has been identified by the Mines Branch as gilsonite, rather than weathered petroleum. Its occurrence here suggests that equivalent strata elsewhere in the area may be source beds of petroleum and natural gas.

YUKON

E.B. Owen, on behalf of the Department of Northern Affairs and National Resources, commenced a project involving a preliminary examination of the engineering geology of more than 26 dam sites in Yukon River basin. Thirteen sites were examined, two on Teslin River, and eight on Yukon River.

J.A. Roddick, L.H. Green, and J.O. Wheeler during June, commenced a helicopter-supported geological study and mapping of Wolf Lake North Half (105 B N½), Quiet Lake (105 F), Finlayson Lake (105 G), Sheldon Lake (105 J), and Tay River (105 K) map-areas, a project known as Operation Pelly. Full-time use of a Beaver aircraft and a Bell G-2 helicopter enabled them to complete field work within Wolf Lake North Half (105 B N½), Quiet Lake (105 F), and Finlayson Lake (105 G) map-areas in detail appropriate to publication on a scale of

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[1] McConnell, R.G.: Report on Exploration in the Yukon and Mackenzie Basins, N.W.T.; Geol. Surv., Canada, Ann. Rept., vol. IV, 1888-89, Pt. D (1890)

[2] Jeletzky, J.A.: Uppermost Jurassic and Cretaceous Rocks of Aklavik Range, Northeastern Richardson Mountains, N.W.T.; Geol. Surv., Canada, Paper 58-2

1 inch to 4 miles.

In addition, a 2-day aerial reconnaissance of Frances Lake (105 H) map-area was made with a Beaver aircraft. This map-area was not a part of the Operation Pelly area as originally defined, but field work required to complete this map-area, together with that required for Tay River and Sheldon Lake map-areas still outstanding from Operation Pelly, would just about serve to keep the Operation Pelly organization fully occupied for another field season.

Topography and geology are interrupted by the northwest trending Tintina Valley, a major structural feature that connects, through a zone of complex en-echelon faults, with the northern end of the Rocky Mountain Trench near the southeastern corner of the mapped area. The major geological units approximately parallel the Tintina Valley.

The southwest half of Quiet Lake map-area is underlain mainly by granodiorite and metamorphic rocks ("Yukon Group"). The latter comprise mainly micaceous gneisses and schists, but considerable crystalline limestone is also present, especially northeast of Quiet Lake. A few crinoid fragments have been found in the limestone indicating that some of the metamorphic rocks are of Palaeozoic age.

Northeast of the above rocks, and between them and the Tintina Valley or Rocky Mountain Trench, are Palaeozoic strata. These have been intruded, in the southern half of the north half of Wolf Lake map-area, by granodioritic intrusions of the Cassiar batholith and associated bodies. The Palaeozoic strata consist chiefly of black shale, limestone, quartzite, dolomite, volcanic rocks, and phyllites. They range from Cambrian to Upper Devonian or Mississippian age. Highly sheared phyllites commonly separate the relatively unaltered Palaeozoic rocks from the Tintina Valley, thought to mark a fault zone.

Northeast of Tintina Valley and Rocky Mountain Trench are granodiorite and metamorphic rocks ("Yukon Group") throughout the southern half of Finlayson map-area; and Palaeozoic strata in the extreme northeast corner of Finlayson map-area. Both units are broadly similar to their counterparts southwest of the Tintina Valley and Rocky Mountain Trench.

Volcanic rocks of probable Palaeozoic age are common in the outcrop-poor northwest parts of Finlayson Lake and Wolf Lake map-areas.

Ultrabasic bodies were found to be scattered throughout the mapped area, but none are known to contain significant amounts of asbestos fibre.

BRITISH COLUMBIA

H. H. Bostock, a post-graduate geology student now at the University of Wisconsin, continued, with a small party, the geological study and mapping of Squamish (92 G W½) map-area. The field work was under the direct supervision of J. E. Armstrong. Most field work to date has been along shore lines, or inland from Britannia Beach. The work has not progressed far enough to warrant publication of a preliminary map.

R. B. Campbell commenced mapping Quesnel Lake West Half (93 A W½) map-area, and completed field work within most of the south half.

Much of the west border of the mapped area is underlain by Cache Creek rocks, comprising limestone, locally fossiliferous, and chert, argillite, and greenstone. These strata trend southeasterly to pass beneath Tertiary plateau-type basalts. East of the Cache Creek rocks, and likewise trending southeasterly, is a conformable succession of Mesozoic volcanic rocks, mainly fragmental, dipping northeasterly in most places. Here and there they are interlayered with sedimentary strata. Scattered small serpentinized ultrabasic intrusions occur within the Cache Creek rocks, and contain rare minor occurrences of asbestos. A few minor granitic intrusions were noted within both the Cache Creek and Mesozoic rocks. The southwest quarter of the mapped area is underlain mainly by Tertiary, plateau-type, basaltic flows. Furthermore, these are suspected to underlie much of the unmapped southeast quarter of the south half of the project area.

H. Gabrielse continued, from 1957 and 1958, the geological study and mapping of Kechika (94 L) and Rabbit River (94 M) map-areas for publication on the scale of 1 inch to 4 miles. The work to date has been preparatory to anticipated future helicopter-assisted field work. The 1959 field season was confined to Kechika map-area. Mapping of that area is now nearly completed southwest of a line joining latitude 58°15' at longitude 126°00' to latitude 59°00' at longitude 127°15', including the northwesterly trending Rocky Mountain Trench (Kechika River).

That part of the map-area lying northeast of the Dall Lake-Ludwig Creek valley and including the Rocky Mountain Trench and Rocky Mountains - i.e., about two-thirds of the map-area - is underlain by stratified sedimentary rocks of Precambrian and early Palaeozoic age. Infolded sedimentary rocks of Devonian and Mississippian age underlie relatively small areas near Turnagain River, and volcanic rocks of possible Mississippian age outcrop on Gataga Mountain east of Kechika River.

Sedimentary and volcanic rocks of Mesozoic age outcrop in the extreme southwest corner of the map-area.

Rocks southwest of the valley trending southeasterly from Dall Lake to Ludwig Creek, except the above mentioned Mesozoic rocks, are mainly granitic and metamorphic rocks, the latter forming a belt as much as 8 miles wide immediately southwest of the valley. The granitic rocks are a part of the Cassiar batholith, probably of Jurassic and/or Cretaceous age, and include a little greenstone of Permian(?) age. The metamorphic rocks that lie between the granitic intrusions and the Dall Lake - Ludwig Creek valley may be of Cambro-Ordovician and/or earlier age, and include phyllite, quartzite, granitic gneiss, gneissic quartzite, and crystalline limestone. This metamorphic terrain is probably not related directly in origin to the emplacement of the Cassiar batholith inasmuch as bands of rocks representing different grades and conditions of metamorphism are truncated by the batholith.

Two small bodies of glassy, pisolitic, probably Tertiary rhyolite outcrop north of Turnagain River west of the mouth of Dall River.

Structures southwest and northeast of the Rocky Mountain Trench are dominated by asymmetrical and overturned folds the axial planes of which dip southwesterly. The folds are commonly plunging and hence produce a complex distribution of map units. In the Cassiar Mountains the major map units are commonly bounded by northwesterly trending faults.

Strata and structures in the Cassiar and Rocky Mountains are truncated at acute angles by the Rocky Mountain Trench. The general trend of strata in the Rocky Mountains is more northerly than that of strata in the Cassiar Mountains.

E.C. Halstead commenced a ground-water survey of the eastern coastal lowlands of Vancouver Island between Nanaimo and Campbell River, and completed field work between Nanaimo and Courtenay, including Denman and Hornby Islands. Remarkable variations in rainfall, particularly summer droughts, complicate the problem of maintaining adequate ground-water supplies in this area. Reserves of ground water are contained in recent alluvial deposits, terraced fluvial and deltaic deposits, glacial fluvial deposits, and in permeable sands and gravels underlying the glacial drift (Vachon till). Some ground water is recovered from bedrock.

E.J.W. Irish commenced an investigation of Halfway River (94 B) map-area. Field work was confined to Peace River, which crosses the south part of the map-area from the Plains region in the extreme southeast corner to the Rocky Mountain Trench in the extreme southwest corner. Thus the Peace River section embraces the entire Foothills and Rocky Mountains.

Furthermore, as geological data are already available concerning 94 B/1[1], the 1959 work was confined mainly to that part of Peace River that traverses 94 B/2, 3, and 4.

The strata examined range in age from Cretaceous in the east to early Palaeozoic in the west, except that the Misinchinka schists in and adjacent to the Rocky Mountain Trench are of unknown age. Field work has not yet reached a stage where a preliminary report is warranted.

G.B. Leech continued, from 1956 and 1957, field work within Fernie West Half (82 G W½) map-area and confined his field work mainly to the Precambrian rocks of 82 G/3, G/4, G/5, the extreme southwest corner of G/6, and the northwest corner of G/13. Preliminary results of the 1956 and 1957 field seasons have been published.[2]

The Rocky Mountain Trench south of Cranbrook is structurally different from the part to the north. The predominant structure in it is a relatively young series of numerous longitudinal steep faults, which dip west where observed, and on which successive blocks are downstepped relative to their eastern neighbours. The oblique and transverse Moyie fault of the Purcell Mountains, and its Rocky Mountain counterpart, the Dibble Creek fault, occupy a structural zone that was active at least as early as Middle Palaeozoic time. The Palaeozoic stratigraphy south of these faults differs markedly from that to the north.

More precise correlation of Precambrian formations across the Rocky Mountain Trench near the 49th Parallel and northward to the 50th parallel was achieved. The relatively thin Phillips formation of the Rocky Mountains is now a useful marker west of the Trench near the 49th and 50th parallels. In part of the latter region it was found possible to subdivide the Dutch Creek formation into the smaller units (Gateway, Phillips, and Roosville) mapped in the south.

The age of the anomalous volcanic and sedimentary rocks in the Palaeozoic strata in the Rocky Mountains east of Wild Horse River (Unit 22 of Map 20-1958) was established as within the range mid-Silurian to mid-Devonian.

H.W. Little divided the field season between completing the revision of the geology of Kettle River West

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[1] Beach, H.H. and Spivak, J.: Dunlevy-Portage Mountain Map-Area, British Columbia; Geol. Surv., Canada, Paper 44-19

[2] Leech, G.B.: Fernie Map-Area, West Half, British Columbia; Geol. Surv., Canada, Paper 58-10

Half (82 E W½) map-area; examination of properties within, and the revision of the geology of, Kettle River East Half (82 E E½) map-area; and, with the collaboration of Hans Frebold, the revision of the geology of Salmo (82 F/3) map-area and vicinity.[1]

Field work within Kettle River West Half map-area was confined mainly to that part lying north of latitude 49°50'. A major easterly trending fault, the existence of which was suspected last year, was identified near Peachland and in Mission Creek. Other faults of unknown magnitude were found in Joe Rich Creek and in the unnamed creek south of the mouth of Belgo Creek. A few miles north of Kelowna a fault striking slightly east of north, and about 3 miles long, with the east side downthrown, is terminated at each end by easterly trending faults.

In Salmo map-area, the distribution of the Jurassic map-units was revised in accordance with recent palaeontological evidence that has demonstrated that the Elise and Beaver Mountain formations are of the same age. The structure of the Jurassic rocks was found to be much more complex than previously recognized, and several major faults were mapped.

J.E. Muller commenced the geological study and mapping of Pine Pass West Half (93 O W½) map-area. Field work involved a preliminary reconnaissance preparatory to systematic mapping for publication on the scale of 1 inch to 4 miles, and a little systematic mapping here and there. Release of a preliminary geological map is not warranted at this stage.

The map-area is bisected from southeast to northwest by the Rocky Mountain Trench. Within the map-area, northeast of the Trench, lies the entire width of the Rocky Mountains and their Foothills.

Southwest of the Trench are granitic and metamorphic rocks of the "Wolverine complex", and volcanic and sedimentary rocks of the Takla and Cache Creek groups, all with about the

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Cairnes, C.E.: Kettle River (West Half), British Columbia; Geol. Surv., Canada, Map 538A (1940)

Little, H.W.: Kettle River (East Half), British Columbia; Geol. Surv., Canada, Map 6-1957 (1957).

---------- : Salmo Map-Area, British Columbia; Geol. Surv., Canada, Paper 50-19 (1950).

distribution to be expected from information published previously.[1] The latter are probably thrust against highly disturbed, unfossiliferous, limestones and argillites, poorly exposed in the Trench west of Parsnip River in the vicinity of Nation River. The limestones and argillites are of unknown but probable Palaeozoic age.

The Rocky Mountains consist of one range, about 20 miles wide, extending from the Trench northeasterly to Clearwater River. Near the Trench, the underlying rocks are phyllitic, low-grade metamorphic schists ("Misinchinka Schists") that may be of Proterozoic, Palaeozoic, or perhaps even Mesozoic age. Near Peace River, most of the range is underlain by Devonian strata; farther south the strata are mainly of Cambrian age, perhaps accompanied by some of Ordovician age. The Devonian formations on Peace River are thrust northeasterly over Triassic rocks; and the Cambrian strata at the head of Clearwater River are thrust northeasterly over Cretaceous beds which in turn overlie Mississippian formations.

B.R. Pelletier outlined and studied Triassic rocks in the Foothills of northeastern British Columbia between Toad River and Gathto Creek. The Triassic assemblage there comprises, from oldest to youngest: Grayling formation, mostly shale and siltstone; Toad formation, mainly sandstone and siltstone; and Liard formation, mainly sandstone. Field work included the measurement and detailed description of Triassic sections totalling about 26,000 feet. These investigations were made at about 20 different localities, at each of which only a part of the complete Triassic sequence was exposed.

The Liard and Toad formations thin rapidly to the northeast in the direction of the source area as inferred from sedimentary structures and facies changes. Certain facies of the Triassic strata are believed to have been deposited as offshore bars. These trend about northwest, as inferred from measurements of current structures, thickness variations of units, and stratigraphy. Similar offshore bars in the Plains region to the east constitute reservoir rocks favourable to the accumulation of gas and oil. They, too, are now believed to trend about northwest. The offshore bars studied appear to have been deposited in front of a southwesterly migrating shore line, and at progressively higher stratigraphic positions as that migration progressed.

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1 Armstrong, J.E.: Fort St. James, British Columbia; Geol. Surv., Canada, Map 907A (1948)

-------------- : Carp Lake, Cariboo District, British Columbia; Geol. Surv., Canada, Map [illegible] (1949)

J.E. Reesor continued, from 1958, his detailed studies within and adjacent to Burton (82 F/13) and Passmore (82 F/12) map-areas[1] as part of his continuing research into the mode of emplacement, origin, and other features of granitic and associated rocks. Field work included mapping, on the scale of 2 inches to 1 mile, of approximately the east half of Burton map-area and the central half of Passmore; and involved a detailed structural and "stratigraphic" study and sampling of an elongate, westerly trending, domal structure consisting of interlayered lenses and "strata" of high grade metamorphic rocks, migmatites, agmatites, veined gneisses, and leucogranitic gneisses. The data obtained will permit appropriate office and laboratory investigation of the petrological interrelations of granites, gneisses, migmatites, and regional metamorphic rocks of high amphibolite facies. The project also involves radioactive age determinations and palaeomagnetic studies.

C.H. Smith, in addition to his main field work in the Coppermine River area of District of Mackenzie, spent about two weeks in the Tulameen area (92 H/7 N½ and 92 H/10 S½) of southern British Columbia making a reconnaissance for an anticipated study of the Tulameen ultrabasic complex.[2] Asbestos was noted in these rocks near a granite dyke on the north bank of Britton Creek about ½ mile from its junction with Tulameen River. It occurs in parallel fractures within a zone that is exposed for a length of 100 feet and is as much as 8 feet wide within this length. Both ends of the zone are obscured by talus. The asbestos-bearing fractures are about 1/10 inch wide. One section of the zone was estimated to contain up to 10 per cent asbestos.

J.G. Souther continued, from 1958, his geological investigation of Sumdum (104 F) and Tulsequah (104 K) map-areas.[3] The field season was devoted entirely to Tulsequah map-area, and resulted in a reconnaissance of that part of the map-area east of a line joining latitude 58°00' at longitude 132°50' to latitude 59°00' at longitude 133°00'. Although additional field work is required to bring this reconnaissance up to 4-mile standard, the study is sufficiently advanced to warrant a preliminary map, now being prepared, of Tulsequah map-area insofar as mapped.

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[1] Little, H.W.: Nelson (West Half), Kootenay and Similkameen Districts, British Columbia; Geol. Surv., Canada, Map 3-1956

[2] Rice, H.M.A.: Geology and Mineral Deposits of the Princeton Map-Area, British Columbia; Geol. Surv., Canada, Mem. 243 (1947)

[3] Souther, J.G.: Chutine, Cassiar District, British Columbia; Geol. Surv., Canada, Map 7-1959

It is anticipated that this preliminary map will incorporate unpublished data obtained in 1955 by J.D. Aitken north of Inklin River.

The southern half of the mapped part of Tulsequah map-area is underlain by slightly metamorphosed Permian and Triassic(?) sedimentary rocks and by granitic rocks of the Coast Range intrusions. The intrusions are irregular, cross-cutting bodies underlying about one-quarter of the mapped area. In the north half of the mapped area, north of Tatsatua Creek, the older sedimentary rocks and some of the intrusions are overlain unconformably by a broad belt of Mesozoic sedimentary and volcanic rocks. Folds within this belt are relatively open and have a west-northwesterly trend in marked contrast to the northerly trend of tightly folded upper Palaeozoic rocks to the south. The belt of Mesozoic sediments is bounded on the north by the Nahlin ultramafic body, readily recognized from the air by its buff colour and lack of vegetation. The body has two branches that join at Nahlin Mountain and diverge toward the northwest. The southern branch, with an average width of 2½ miles, extends from Nahlin Mountain to the northwestern corner of the mapped area; and the northern branch, with an average width of 2 miles, extends from Nahlin Mountain to a point on the northern border of the map-area due north of Victoria Lake. The area north of the Nahlin body and between its two branches is underlain by Permian and older sedimentary rocks.

Moderately folded Tertiary (Eocene?) rhyolite flows and associated fragmental rocks occur as scattered remnants between the head of the Sheslay River and Trapper Lake. They are cut by major northwesterly trending faults and swarms of felsitic dykes. Flat-lying Pleistocene and late Tertiary basalt and red-weathering rhyolite underlie the Heart Peaks area east of Sheslay River.

<u>H.W. Tipper</u> spent about a month completing field work within the outstanding northeast corner of Quesnel (93 B) map-area - mainly north of latitude 52°35' and east of longitude 122°25'. A preliminary geological map of the remainder of the map-area has been published.[1]

Much of the northeast corner, as outlined above, is drift covered. It is, however, underlain mainly by Mesozoic sedimentary and volcanic strata. These are cut by a granitic body measuring about 4 miles by 16 miles that lies immediately northeast of and parallel with Quesnel River. Several faults were mapped, trending northerly to northwesterly.

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[1] Tipper, H.W.: Quesnel, Cariboo District, British Columbia; Geol. Surv., Canada, Map 12-1959

In addition to completing Quesnel map-area, Tipper commenced the geological study and mapping of Prince George (93 G) map-area. He completed field work within the southwest quarter; and within that part lying east of the southwest quarter, south of Blackwater River, and west of Fraser River.

Drift was found to be so widespread as to preclude an adequate interpretation of the stratigraphy and structure. Cache Creek rocks extend northerly from the adjacent Quesnel map-area along the west side of Fraser River; outcrop in Blackwater River between Fraser River and the Telegraph Range to the west; and also outcrop in the Telegraph Range north from Blackwater River. Middle Jurassic Hazelton sedimentary and volcanic rocks, and Jurassic and Cretaceous sedimentary strata, outcrop mainly in the extreme southwest corner of the mapped area as might be inferred from Paper 54-11[1]. Eocene sedimentary rocks equivalent to Unit 5 of Map 12-1959 extend northerly from Quesnel map-area along the west side of Fraser River to Cottonwood River. The remainder, or some two-thirds, of the mapped area is underlain in its eastern part by Tertiary volcanic rocks equivalent to Unit 6 of Map 12-1959, and in its western part by Tertiary plateau-type basalts equivalent to Unit 7 of that map. Minor bodies of granitic rocks cut the Cache Creek strata near Blackwater River where it crosses Telegraph Range.

J.O. Wheeler, after spending about the first month of the field season on Operation Pelly in Yukon, commenced the geological study and mapping of Illecillewaet (82 N W½) map-area, mainly within the Big Bend of Columbia River. The Rocky Mountain Trench (Columbia River and Trans-Canada Highway) crosses the map-area diagonally from the northwest corner to Golden on the east boundary. Mapping was confined mainly to the extreme southeast corner of the map-area, east of the Purcell Trench (Beaver River); and, to the northwest, that part of the map-area lying southwest of the Rocky Mountain Trench (Columbia River) between Swan Creek, Bachelor Creek, and the headwaters of Goldstream River. The publication of a preliminary map is not warranted at this stage.

The rocks mapped in the extreme southeast corner are members of the Proterozoic Horsethief Creek series. They trend northwesterly and are an extension of Unit 8, Map 12-1957[2].

In the Swan Creek-Bachelor Creek-Goldstream River region the sedimentary rocks mapped comprise a northwesterly trending assemblage. Some belong to the Hamill series (Lower Cambrian) and others are older, possibly including members

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[1] Tipper, H.W.: Nechako River, British Columbia; Geol. Surv., Canada, Paper 54-11

[2] Reesor, J.E.: Lardeau (East Half), Kootenay District, British Columbia; Geol. Surv., Canada, Map 12-1957

of the Horsethief Creek series or equivalent. The strata are tightly folded on northwesterly trending axes. Folds lying northeast of a northwesterly trending line passing through Mount Sir Sanford are commonly overturned towards the northeast; those lying southwest of that line are commonly overturned towards the southwest. Quartz diorite has intruded these strata and forms an elongate, westerly trending body, extending from Mount Stockmer on the east to Remillard Peak on the west. The quartz diorite contains a quartz monzonite core in the vicinity of Mount Adamant.

BRITISH COLUMBIA AND ALBERTA

H. Frebold devoted a short field season to stratigraphic and palaeontological studies of Jurassic strata within Nelson West Half (82 F W½) and Salmo (82 F/3) map-areas in British Columbia, and in the Foothills of Alberta.

Studies of Jurassic faunas and stratigraphy in Nelson West Half map-area supplemented and confirmed data contained in Bulletin 49[1]. Most of the Jurassic volcanic rocks in Nelson West Half and Salmo map-areas are now dated as middle Early Jurassic, representing part of the Sinemurian and all of the Pliensbachian stages[2]. The whole Beaver Mountain formation is the equivalent of the Toracian Elise formation, and the fossiliferous Sinemurian in Salmo map-area are probably equivalent to the upper part of the Ymir group.

The Sinemurian Nordegg member of the Fernie group was recognized on Morris Creek in the Fiddle River area of Jasper National Park, Alberta.

R.A. Price continued, from 1958, the geological investigation of Fernie East Half (82 G E½) map-area by mapping the geological features of 82 G/2 W½, 82 G/7 W½, and part of 82 G/15 in detail commensurate with publication on a scale of 1 inch to 4 miles. This work resulted in major revisions of the Precambrian stratigraphy in the Galton and MacDonald Ranges[3]. About 15,000 feet of Palaeozoic strata were measured and described, and about 3,000 feet of Mesozoic strata similarly treated. The Palaeozoic strata

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[1] Frebold, H.: Marine Jurassic Rocks in Nelson and Salmo Areas, Southern British Columbia; Geol. Surv., Canada, Bull. 49 (1959)

[2] Little, H.W.: Salmo, Kootenay District, British Columbia; Geol. Surv., Canada, Map 50-19A

----------- : Nelson West Half, British Columbia; Geol. Surv., Canada, Map 3-1956

[3] Daly, R.A.: North America Cordillera, 49th Parallel; Geol. Surv., Canada, Mem. 38 (1912)

were from three localities. A few small barite veins were noted in the western MacDonald Range, immediately east of Wigwam River, although none of these appeared to be of economic importance.

D.F. Stott, in 1958, commenced a study of the succession, lithology, and correlation of the Upper Cretaceous Smoky group and the Lower Cretaceous Fort St. John and Bullhead groups, and equivalent strata, in the Foothills of Alberta and British Columbia between Smoky River and Peace River, and completed this project as far northwest as Red Willow River. In 1959, this study was continued, and completed northwesterly from Red Willow River as far as Bullmoose Creek. It is anticipated that another field season will suffice to complete the study within the area between Bullmoose Creek and Peace River, thus completing the field phase of this project.

During both field seasons, Cretaceous strata and the structures in which they are involved were mapped in detail probably sufficient for publication on a scale of 1 inch to 4 miles. Northwesterly trending faults are prominent in the southeastern part of the mapped area, but are only a minor feature of the northwestern part. The Cadomin conglomerate was recognized and mapped throughout the length of the area investigated to date. The proportion of marine to continental strata becomes progressively greater from southeast to the northwest. The resulting facies changes, particularly within the Lower Cretaceous Luscar formation and equivalent strata, were studied and outlined.

ALBERTA

E.W. Mountjoy commenced the geological study and mapping of Mount Robson Southeast Quarter (83 E SE¼) map-area for publication on the scale of 1 inch to 4 miles. Field work was completed in the north half of 83 E/7, and in all but the southwest quarter of 83 E/8. In addition, a preliminary investigation was made of Cambrian stratigraphy in the immediate vicinity of Mount Robson, just west of the southwest corner of the map-area. The map-area is mainly in Jasper National Park and in the Rocky Mountains, although the extreme northeast corner is in the Foothills.

The strata mapped range in age from Precambrian (Hector formation) to Upper Cretaceous (Wapiabi formation). Extensive outcrops of Cambrian and older rocks occur in the southwest part of the map-area. A Devonian reef complex is well exposed along the Ancient Wall and equivalent mountain ranges to the south and southeast. Stratigraphic relationships of the northwest edge of this reef are well exposed at Glacier Pass. Another Devonian reef complex occurs about 2 miles northwest of Eagles Nest Pass.

D.K. Norris spent about a month studying the stratigraphy of Kootenay, Crowsnest, and Rocky Mountain formations in and near Blairmore (82 G/9 W½), Carbondale River (82 G/8 W½), Beehive Mountain (82 J/2 E½), and Livingstone River (82 J/1 W½) map-areas. The purpose of this field work was to obtain data required to supplement the preliminary maps already published for these map-areas in order that final reports may be prepared. Other time was spent collecting oriented samples from the Precambrian rocks of the Lewis thrust plate for palaeomagnetic studies.

This work suggested, but has not yet proved, that the middle and upper members of the Kootenay formation thicken and coarsen north and west of the Crowsnest area to become the conglomeratic members of the upper Kootenay in the Fernie and Cascade coal basins. The stratigraphic relations of the Croswnest formation were studied and data were gathered to establish a type section of the Crowsnest formation on Willoughby Ridge immediately west of Coleman. Fauna studied to date sustains the preliminary correlation[1] of lithic units in the late Palaeozoic succession of southwestern Alberta. Thus the top of the dominantly carbonate succession marks the end of Mississippian sedimentation, and the thick sandstone succession marks the end of the Pennsylvanian succession. A possible regional unconformity at the top of these sandstones separates them from chert, dolomite, and phosphatic beds which by lithic correlation appear to be Permian in age.

Remanent magnetism studies indicate tentatively that the orientation of the horizontal component of magnetic vectors within two formations of the Lewis thrust plate is the same within the Flathead and Clarke Ranges. Thus the rocks of the Lewis thrust plate in this region suffered little, if any, differential rotation in a horizontal plane during thrust faulting.

G.C. Riley commenced and completed mapping those parts of Fitzgerald (74 M) and Chipweyan (74 L) map-areas that lie east of Slave River and north of Lake Athabasca. The Palaeozoic strata west of Slave River were the subject of a stratigraphic study by A.W. Norris in 1956[2].

All rocks east of Slave River are presumably of Precambrian age. Small areas of relatively unmetamorphosed sediments (quartzite, greywacke, and arkose) outcrop in the extreme northeastern part of the map-area. Various metamorphic

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[1] Norris, D.K.: The Rocky Mountain Succession at Beehive Pass, Alberta; Jour. A.S.P.G., vol. 5, No. 10, pp. 227-231 (1957)

[2] Norris, A.W.: Devonian Stratigraphy of Northeastern Alberta and Northern Saskatchewan; Geol. Surv., Canada, Mem. 313 (in press).

equivalents of the strata occur between them and the wide-spread granitic rocks that underlie the central part of the map-area. Younger granitic rocks, intrusive into the latter, occupy the remaining western part of the map-area east of Slave River. Two outcrops of Athabasca sandstone were mapped in the bay immediately west of Fidler Point on the north shore of Lake Athabasca. Devonian strata are exposed in scattered outcrops along Slave River.

A.M. Stalker commenced studying and mapping the surficial deposits of Fernie East Half (82 G E½) map-area. This project will be confined to that part of the map-area lying east of the Continental Divide, and, within this eastern portion, confined mainly to those parts that were formerly covered by Laurentide ice. Thus the project concerns approximately the eastern half of Fernie East Half map-area. Field work within the southern 60 percent of this was completed during 1959.

Particular attention is being paid to the inter-relations of Laurentide and Cordilleran ice, for which the area is admirably suited. The extreme northeast corner of the map-area was not glaciated. The western limit of Laurentide ice was mapped precisely by determining the western limit of travel of granitic, gneissic, and other stones from the Canadian Shield. Excellent sections of surficial deposits permitted the identification of five ice advances from the east (Laurentide), and two from the west (Cordilleran). It is anticipated that further work will identify additional advances of Cordilleran ice.

In addition to the above field work, another 200 miles of buried valleys were identified as a result of a study of seismic records available through the co-operation of oil companies in Calgary. These valleys are in Beiseker (82 P W½) and Drumheller East Half (82 P E½) map-areas; and between Lethbridge and Medicine Hat, a district for which maps showing surficial geology are not yet available. The buried valleys are of interest as potential sources of ground water.

SASKATCHEWAN

E. Hall continued a reconnaissance ground-water survey, commenced by him in 1958, of that part of Saskatchewan lying within the Souris River watershed. This irregularly shaped area extends from the Manitoba-Saskatchewan boundary to about longitude 104°30', and from the International Boundary to about latitude 50°15', an area of some 11,500 square miles. The purpose of the project is to bring up-to-date, and to supplement, the Survey's 1935 ground-water inventory of that region.

Appropriate data were obtained from about 25 per cent of the wells of the Weyburn (62 E) map-area in 1958, and from a similar proportion of the wells throughout the remainder of the project area during 1959, thereby completing the inventory phase of the project. It is anticipated that a preliminary ground-water map of Weyburn map-area, now being prepared, will outline the known extent of various aquifers, and indicate their approximate depth.

The present height of the water-table, as measured in bedrock wells, is about the same as it was in 1935 when surveyed by B.R. MacKay of the Geological Survey. On the other hand, water levels in shallow wells in surficial deposits, in spite of the relatively high points attained in the early 1950's, are now as low as, and in some cases lower than, those measured in 1935. About 200 suitable wells were selected as observation wells, and appropriate initial records obtained.

Two holes, totalling about 600 feet, were drilled in order to obtain information concerning the location and ground-water content of the buried pre-Glacial Missouri River channel. The unconsolidated materials within the channel were not completely penetrated, and additional drilling is required.

J.S. Scott, a post-graduate geology student at University of Illinois, completed the geological study and mapping of the surficial deposits of Elbow (72 O/2), Haywarden (72 O/7), and Outlook (72 O/6) map-areas. The project area includes the South Saskatchewan River dam and power site. The mapping was done as for publication on the scale of 1 inch to 1 mile, except that the surficial deposits in the vicinity of the South Saskatchewan River dam site were mapped in considerably more detail.

Only one till was recognized. It appears unlikely that the filling of the reservoir created by the dam will have any great effect upon ground-water levels except in the area immediately adjacent to that reservoir. Field data indicate that recharge to isolated shallow aquifers in the till can occur due to fracture permeability.

A.M. Toth commenced a ground-water survey of Saskatoon South Half (73 B S½) map-area. He completed this survey within the Municipality of Cory, of which Saskatoon is the centre, and, in addition, obtained data from current drilling for ground water throughout the east half of the project area.

In the east half of the Municipality of Cory, lacustrine formations of clay, sand, and silt extend downwards from the surface and overlie morainal deposits. Most of the wells there are shallow, and afford water from the lacustrine strata.

Although the lacustrine deposits likewise constitute the near-surface strata in the west half of the Municipality of Cory, three principal deeper aquifers were recognized. The topmost of these is an inter-till surface at a depth of about 30 feet; the second, at a depth of about 50 feet, is an inter-till sand; and the third at a depth ranging from about 150 feet to 300 feet, is the irregular surface of bedrock. The extent of the upper two aquifers has been outlined insofar as available data permit. The highly irregular bedrock surface is suspected to enclose buried channels although these have not yet been outlined, nor has it been ascertained whether they contain available ground water.

Ground water obtained from the bedrock (Cretaceous) is saline, in general increasingly so with depth.

L.P. Tremblay commenced and completed a study of the geology of Phelps Lake (64 M) map-area. Overburden was found to obscure bedrock over wide areas, a feature that will make difficult the compilation of a completely satisfactory map on the anticipated scale of 1 inch to 4 miles.

Two bodies of ungranitized rocks were mapped. One of these, of Beaverlodge-type strata, comprises limestone, argillite, quartzite, and greywacke, and occurs as a belt about 25 miles long and up to 5 miles wide. It extends northeasterly from the west shore of Nunim Lake, past Many Islands Lake, to cross the east boundary of the map-area between latitudes 59°40' and 59°50'. The other occurs in the northwest quarter of the map-area, and comprises massive to thinly bedded dark green hornblende schist and hornblende gneiss, accompanied by a few beds of nodular quartz biotite schist. It crosses the north boundary of the map-area between longitudes 103°15' and 103°40', and extends southwesterly to the southwest end of Lichfield Lake. Most of the remainder of the map-area is underlain by fine- to coarse-grained quartz-feldspar-biotite gneiss to quartz-biotite gneiss, mainly derived from sedimentary rocks; and by massive, fairly homogeneous, biotite-hornblende metasomatic granite, which is particularly abundant in the southwest quarter of the map-area.

MANITOBA

J. Charron completed a ground-water survey of Townships 1 to 6, Ranges 1 to 5, West of Principal Meridian.

Potable ground-water resources lie in the thick surficial deposits. Ground water, if obtained from underlying bedrock, is likely to be of unacceptable quality due to dissolved sodium chloride and other salts. The surficial deposits affecting ground-water resources comprise, from surface downwards: black muck, silt with a clay content that varies from place to place, blue "Lake Aggasiz" clay, and till accompanied locally by sand and/or gravel. The eastern half of the surveyed area, due to the clay content of the silt, is in general devoid of sources of potable ground water. In the western half of the surveyed area, ground water is available locally from the silt, and/or from the sand and gravel that accompany the till underlying the blue clay. The silt is capable of affording domestic quantities in many places, but only here and there is this water potable. It is anticipated that these areas of potable water supply will be outlined in a forthcoming Water Supply Paper. In some instances the water occurring in the sand and gravel beneath the blue clay is under artesian head, and it is likewise anticipated that these artesian areas will be outlined in the Water Supply Paper.

G.W. Sinclair continued, from 1957, and concluded, his study of the stratigraphy and palaeontology of the Ordovician strata of southern Manitoba[1].

More than half the field season was devoted to outcrop studies of these strata, mainly in the vicinity of Sturgeon Bay, about midway along the western shore of Lake Winnipeg. Data obtained suggest, subject to office studies of fossils, that the Ordovician rocks between the Precambrian outlier at Lake St. Martin and the exposed margin of the Canadian Shield at Berens River on the east side of Lake Winnipeg, occupy a gentle north-northwesterly trending syncline.

The remainder of the field season was spent in Winnipeg studying subsurface data made available through the courtesy of the Manitoba Mines Branch. The data so obtained will complete and extend outcrop information concerning the Ordovician assemblage of southern Manitoba.

H. Williams, a post-graduate geology student at University of Toronto, concluded a detailed field study of an area (part of 63 K/16) including the Chisel Lake base metal deposit of Hudson Bay Mining and Smelting Company. The approximate boundaries of the map-area are: latitude 54°49' to 54°53', and longitude 100°05' to 100°10'. Field mapping was done on a scale of about 1 inch to 500 feet. It is anticipated that this project will provide data for Mr. Williams' Ph.D. thesis at University of Toronto, and an appropriate Geological Survey publication.

ONTARIO

L.S. Collett and L.W. Morley made brief experimental ground AFMAG surveys in Renfrew (31 F/7) map-area and in the vicinity of Quyon, Quebec. The object of this work was to obtain data concerning the capabilities and limitations of

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[1] Sinclair, G.W.: The Succession of Ordovician Rocks in Southern Manitoba; Geol. Surv., Canada, Paper 59-5

ground AFMAG equipment as an aid to geological mapping, particularly as a means of locating buried faults. Because of the short duration of the survey, and for other reasons, the experiment was inconclusive.

J.A. Donaldson commenced and completed the geological study and mapping of Trout Lake (52 N) map-area. In addition to providing data for a geological map on the scale of 1 inch to 4 miles, this project afforded operational and logistical data required for planning geological investigations scheduled for adjacent map-areas in 1960 and 1961 in connection with the Roads to Resources program.

About 25 per cent of the project area had been mapped previously by Ontario Department of Mines[1]. This work, around Red Lake, and in the southeast quarter of the map-area, outlined most of the sedimentary and volcanic rocks with the following exceptions.

A belt of volcanic and sedimentary rocks previously mapped by the Ontario Department of Mines at Blondin Lake was found to extend north-northwest from that lake to Whitefish River, and iron formation was noted along the eastern side of this extension. A previously unmapped belt of basic to intermediate volcanic rocks, as much as 1 mile wide, trends northerly from Mikaiami Falls on Berens River to cross the north boundary of the map-area at about longitude 93°45'. Otherwise the newly mapped parts of the map-area are underlain mostly by quartz diorite-gneiss, granodiorite-gneiss, massive granodiorite, and granite.

M.J. Frarey commenced the geological study and mapping of Wakwekobi (41 J/6) map-area, and completed field work within the northern half.

A minor area of Archaean granite underlies the extreme northwest corner of the mapped area. Otherwise, the mapped area is underlain by a gently inclined assemblage of rocks of the Proterozoic Bruce group and Cobalt group. Strata of the Bruce group (except Serpent formation) outcrop: (1) on both shores of Matinenda Lake, and south from Matinenda Lake to Chiblow Lake; and (2) immediately north and northeast of Parkinson. The remainder, or about 90 per cent of the mapped

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Bateman, J.D.: Geology and Gold Deposits of the Uchi-Slate Lakes Area; Ontario Department of Mines, vol. 48, pt. 8 (1939)

Greig, J.W.: Woman and Narrow Lakes Gold Area; Ontario Department of Mines, vol. 36, pt. 3 (1927)

Harding, W.D.: Geology of the Birch-Springpole Lakes Area; Ontario Department of Mines, vol. 45, pt. 4 (1936)

Horwood, H.C.: Geology and Mineral Deposits of the Red Lake Area; Ontario Department of Mines, vol. 49, pt. 2 (1940) area, is underlain by strata of the Gowganda formation, by sheets of gabbro, diabase, and granophyre, and by minor areas of sediments of the Lorrain formation. Strata of the Bruce group, in the vicinity of Matinenda and Chiblow Lakes, occupy a westerly plunging anticline.

R.E. Hay, a seasonal employee now studying for his Ph.D. degree at McGill University, commenced a study of Sault Ste. Marie (41 K/9) map-area. Field work was completed within the southeast quarter of the project area. The project is expected to afford data for Mr. Hay's doctorate thesis, and an appropriate map and report for publication by the Geological Survey.

G.D. Hobson commenced a reconnaissance refraction and reflection seismic survey of that part of southern Ontario underlain by Palaeozoic strata. It is anticipated that another field season will be required to complete the field phase of the project. The objectives of the project are to: (1) determine, insofar as practicable, depths to the Precambrian basement by refraction methods, particularly at localities where this information is not available from drill records, in order to permit a more accurate contouring of the buried basement surface; (2) evaluate the capabilities and limitations of refraction and reflection methods as means of interpreting geological features of the Palaeozoic assemblage, including reef structures; and (3) determine drift thicknesses by refraction.

The survey was completed within a belt, approximately 25 miles wide, extending from Havelock on the east, through Fergus, to Petrolia on the west. Observations were made at 107 evenly distributed stations within this belt. Drift thicknesses were determined at all stations. It was found that the reflection methods can be used to outline reefs once these structures have been found, as by drilling. It is suspected that, in places, refraction methods are not applicable to the determination of basement depth because of the lack of velocity contrasts between basement rocks and immediately overlying Trenton strata.

B.A. Liberty commenced a project expected to complete the geological study and mapping, for publication on the scale of 1 inch to 4 miles, of the Palaeozoic strata of southern Ontario lying south of the Canadian Shield and between longitudes 78°30' and the Frontenac axis. Field work was completed south of the Canadian Shield between longitudes 77°30' and 78°30'.

All strata mapped are of Ordovician age. All units previously mapped[1] on the western border of the map-area were traced easterly to longitude 77°30'. In addition, new units were recognized and mapped. The Cobourg formation was found to thicken greatly from west to east, particularly within the eastern part of the mapped area. Several units within the Gull River formation were found to become more impure towards the east.

E. Mirynech, a graduate geology student at University of Toronto, completed the geological study and mapping of the surficial deposits of Trenton (31 C/4) and Presqu'ile (30 N/13) map-areas. The project is expected to provide data for Mr. Mirynech's doctorate thesis, and an appropriate map and report for publication by the Geological Survey. Strand lines formed within former glacial Lake Frontenac were recognized. Specific evidence of the existence of that lake had not previously been recognized in or in the the vicinity of the project area.

J. Terasmae commenced and completed an investigation of the surficial deposits of Cornwall (31 G/2) map-area required for the publication of a report and map on the scale of 1 inch to 1 mile. Two ice advances were recognized. The ice first moved from the northeast; later from the north-northwest. The resulting two tills are in places separated by sand; elsewhere they are in direct contact. The tills are overlain by Champlain Sea deposits comprising, from oldest to youngest, clay, sand, and beach gravels and near-shore bar sands. The beach gravels commonly contain material suitable for construction purposes. They form ridges, occur mainly in the west half of the map-area, and will be outlined on a preliminary map now being prepared for publication.

ONTARIO AND QUEBEC

L.V. Brandon attended, during the summer, an instruction course conducted by the United States Geological Survey on methods of surveying and evaluating ground-water resources. A ground-water survey of the Ottawa-Hull district was commenced in October and it is anticipated that the field phase of this project will be completed prior to the 1960 field season.

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1 Liberty, B.A.: Fenelon Falls Map-Area, Ontario; Geol. Surv., Canada, Paper 52-31

-------------: Lindsay Map-Area, Ontario; Geol. Surv., Canada, Paper 52-33

-------------: Oshawa Map-Area, Ontario; Geol. Surv., Canada, Paper 53-18

-------------: Scugog Map-Area, Ontario; Geol. Surv., Canada, Paper 53-19

A.S. MacLaren studied the geology of various anomalous areas as indicated by Geological Survey aeromagnetic maps of the Grenville region between Thurso, Quebec, and Georgian Bay, Ontario. This work is part of a continuing project, commenced some years ago, intended to accumulate criteria required for more satisfactory interpretations of aeromagnetic maps. Most of the field season was devoted to an examination of six anomalous areas. It is anticipated that the geology of these areas will be described, and correlated with the aeromagnetic data, in a report now being prepared.

K.H. Owens, accompanied by K.G. Eisener, F. Essex, J.P. Houlihan, J.W. Kempt, and D.A. Reveler, commenced an aeromagnetic survey of that part of southeastern Ontario and southwestern Quebec lying between longitudes 76°00' and 82°00', and bounded on the north and south by areas for which Geological Survey aeromagnetic maps[1] are now available, or by Georgian Bay. The survey of this area was completed, except between longitudes 78°45' and 80°15'.

In addition, an aeromagnetic survey was made of the following map-areas in the vicinity of Montreal, thus completing another gap in currently available Geological Survey aeromagnetic maps: 31 G/1, 2, 7, 8, 9, 10, 15, and 16; and 31 H/3, 4, 5, 6, 10, 11, 12, 13, 14, and 15.

These projects involved 821 hours flying, and 88,410 line-miles of surveying. The field operation cost about $1.21 a line-mile, excluding overhead and salaries of Geological Survey employees.

G.M. Wright commenced the geological study and mapping of Deep River West Half (31 K W½) map-area, and completed field work in the south half for publication on the scale of 1 inch to 4 miles. The mapped area is underlain, in order of abundance, mainly by granitic gneisses, hornblende-plagioclase gneisses and amphibolite, migmatites, and scattered small bodies of meta-gabbro. The boundaries between various rock types are generally gradational. The hornblende-plagioclase gneiss and amphibolite occurs mainly in the north-west quarter of the mapped area; the migmatite mainly in the northeast quarter; and the remainder of the mapped area is underlain mainly by granitic gneiss.

QUEBEC

A. Larochelle continued his evaluation of the capabilities and limitations of the palaeomagnetic method for

[1] Geological Survey of Canada: Aeromagnetic Series, Index to Map Sheets; Sheet No. 2 (Information to December 31, 1957)

dating intrusive igneous rocks. Fifty-seven appropriate samples were collected, some from each of, the essexite ring dyke of Mount Megantic and the granitic rocks of Mount Ste. Cecile and Spider Lake stocks[1]. An attempt will be made in the laboratory to date these rocks by palaeomagnetic methods, and to compare these results with ages obtained, or to be obtained, by potassium-argon methods.

E.R. Rose continued his study of the petrology and mineralogy of the anorthosite bodies of eastern Canada with particular reference to contained or nearby deposits of iron and titanium. The 1959 field season was confined to the Morin anorthosite in the Ste. Marguerite-Ste. Agathe region northwest of Montreal, the Baie St. Paul anorthosite, and to similar rocks between Chicoutimi and Alma.

NEW QUEBEC AND NEWFOUNDLAND (COAST OF LABRADOR)

W.R.A. Baragar continued and completed his geological study and mapping of Wakuack Lake (23 O) map-area. Maps and reports resulting from this project will incorporate data from previous detailed surveys by the Iron Ore Company of Canada and by the geological Survey of Canada[2].

After the field season Dr. Baragar was transferred to Yellowknife as Resident Geologist, replacing Dr. J.C. McGlynn who had been transferred to Ottawa.

K.E. Eade, O.L. Hughes, and I.M. Stevenson continued and concluded helicopter-supported Operation Fort George which was commenced in 1957. The 1959 field work involved the study and mapping of the bedrock and surficial geology of 23 NW and 23 SW (except 23 C), an area of some 36,350 square miles, for publication on the scale of 1 inch to 8 miles. O.L. Hughes was responsible for the surficial geology.

Pre-granitic rocks are confined to a few minor bodies of greenstone. Most of the area mapped during 1959 is underlain by either granite-gneiss, charnockite-granulite rocks, or massive to slightly foliated granite, granodiorite,

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1
Lord, C.S.: Megantic Sheet, Quebec; Geol. Surv., Canada, Map 379A (1938)
Marlow, R.A.: Preliminary Report on Waburn Area; P.R. No. 336, Quebec Department of Mines
McGerrigle, H.W.: Mount Megantic Region, Southeast Quebec, and Placer Gold Deposits; Department of Mines, Quebec, Ann. Rept., 1934, Pt. D, pp. 69-220

2
Baragar, W.R.A.: Ahr Lake, New Quebec; Geol. Surv., Canada, Map 21-1957
Frarey, M.J.: Wilbob Lake, Quebec and Newfoundland; Geol. Surv., Canada, Map 52-16A

and similar intrusions. The charnockite-granulite rocks may prove to be similar to those mapped in the adjacent Mount Wright map-area[1]. The granite gneiss, charnockite-granulite rocks, and granitic rocks, are about equally abundant.

Much of the south half of 23 D is underlain by gently inclined, Proterozoic-type, sandstone, quartzite, conglomerate, and argillite, intruded by gabbro sills. This assemblage is cut by northeasterly trending faults.

It was found that Pleistocene ice first moved west-southwest and southwest across the 1959 area from a source slightly northeast of latitude 56° at longitude 68°; and that at a later period moved north-northeasterly from a front extending northwesterly from Opiscoteo Lake to Lac Gayot. Thus field evidence indicates that the ice did not, in the 1959 area, move simultaneously outward from an ice divide as shown on the Glacial Map of Canada published by the Geological Association of Canada in 1958.

W.F. Fahrig commenced and completed the geological study and mapping of Shabogamo East Half (23 G E½) map-area for publication on the scale of 1 inch to 4 miles. The Wabush Lake iron deposits (Carol Project) of Iron Ore Company of Canada are in the extreme southwest corner of the map-area. Geological maps and reports to be prepared will incorporate the results of previous more detailed mapping and studies by Iron Ore Company of Canada in and near the Trough.

The Labrador Trough trends southerly from the mid point of the northern boundary of the map-area, and thence southwesterly to the southwest corner. The "Grenville Front" trends about northeast through the southwest corner of the map-area. It is a metamorphic front and a structural feature, marking the approximate boundary between northeasterly trending structures to the southeast and northerly trending structures to the northwest.

All rocks west of the Trough, in other words nearly all rocks on the western border of the map-area and for some distance to the east, are of the charnockite suite. These are presumably part of a very substantial body of these rocks as mapped previously in Mount Wright map-area, and during 1959 in NTS 23 NW and 23 SW[2]. The charnockites are the oldest rocks

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[1] Duffell, S. and Roach, R.A.: Mount Wright, Quebec-Newfoundland; Geol. Surv., Canada. Map 6-1959

[2] -------------------------- : op. cit.

See K.E. Eade, Operation Fort George, p. 28

recognized in the map-area, and are overlain, presumably unconformably, by the Trough rocks although the contact with the latter is commonly faulted or otherwise disturbed.

Gabbro and anorthosite are widespread southeast of the Grenville Front and in areas adjacent to that Front, and are confined to this Grenville Region. They are believed to have been introduced during late stages of the Grenville orogeny, and to be of Grenville age. They are thus the youngest widespread rocks recognized within the map-area.

R. Kretz made a reconnaissance of the bedrock geology and glacial features of that part of New Quebec lying west of longitude 72°, and north of a line extending from the east coast of Hudson Bay at longitude 77°40', to latitude 58°40' at longitude 76°00', to latitude 59°30' at longitude 75°00', and thence to latitude 59°30' at longitude 72°00'. This was done while attached to a Dominion Observatory gravity field party and the geological work was, therefore, incidental to Dominion Observatory requirements. The reconnaissance is based on 4,000 miles of aerial observation, and about 320 scattered ground observations. The results are being prepared for publication on a preliminary map, at the scale of 1 inch to 8 miles, accompanied by a brief report.

No major bodies of non-granitic rock were noted south of the Cape Smith-Wakeham Bay Belt[1], and probably none exist. A rock relatively rich in iron was observed at six places along the south contact of the Cape Smith-Wakeham Bay Belt, and in the outliers that occur to the south. The occurrences along the contact were noted as far as 45 miles southwestward from Joy Bay. The iron-rich rock contains magnetite, quartz, carbonate, cummingtonite, actinolite, and biotite, in various proportions.

H.R. Wynne-Edwards, now on the staff of Department of Geology, Queen's University, Kingston, commenced and completed field work within Michikamou Lake West Half (23 I W½) map-area. Almost the entire eastern boundary of the map-area is underlain by gneissic or massive, coarse-grained, porphyritic, hypersthene syenite and charnockite. Granitic and gneissic rocks lie between the hypersthene syenite - charnockite assemblage, and the formations of the Labrador Trough that underlie the western part of the map-area.

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1 Bergeron, Robert: Quebec Department of Mines, P.R. No. 355 (1957)

----------------: Quebec Department of Mines, P.R. No. 392 (1959)

NEW BRUNSWICK

R.W. Boyle continued geochemical studies of the Bathurst-Newcastle base metal district, a project started in 1958. The 1959 field work included: the study, sampling, and mapping on a scale of 1 inch to 400 feet, of Nigadoo Mine; surface mapping, at the same scale, of Brunswick No. 6 Orebody and vicinity; and the study, sampling, and mapping of Bathurst (Drummond) Iron Mines, likewise at a scale of 1 inch to 400 feet. The project has not yet progressed to a stage where a preliminary or other report is warranted.

A former post-doctorate fellow, S. Roy from India, chose for his research with the Geological Survey of Canada a study of the mineralogy and paragenesis of the ore minerals of the principal deposits of the district, including Nigadoo Mine. Since completing his tenure in the Geological Survey laboratories he has submitted a manuscript, for publication by the Survey, incorporating the results of this research. These data will contribute to Dr. Boyle's more comprehensive studies, expected to require several more field seasons.

L.M. Cumming continued a regional study, commenced in 1957, but discontinued during the summer of 1958, of the palaeontology and stratigraphy of Silurian and associated strata in the northern counties of New Brunswick. Appropriate sections were examined in Madawaska, Restigouche, Northumberland, York, and Victoria Counties. Most of the field work was done in areas recently mapped, or currently being mapped, by the Geological Survey.

Trilobites and brachiopods were found in limestone mapped[1] with the Tetagouche group north of Camel Back Mountain. These rocks were previously thought devoid of fossils. Fragments of bryozoans and corals were collected from Ordovician greywacke on the Steward Highway 16.3 miles south of Tidehead. This greywacke has only rarely afforded fossils. In addition, Ordovician and Silurian graptolites and Devonian echinoids and crinoids were collected from various widely separated localities that had not previously afforded fossils. The diagnostic value of all these collections remains to be determined.

W.H. Poole commenced the geological study and mapping of Hayesville (21 J/10) and Doaktown West Half (21 J/9 W½) map-areas. Field work was completed within Doaktown West Half map-area and somewhat more than the eastern third of Hayesville map-area.

Many of the geological features trend northeasterly. Thus

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1 Skinner, R.: Tetagouche Lakes, Restigouche, Gloucester, and Northumberland Counties, New Brunswick; Geol. Surv., Canada, Paper 55-32 (1956)

much of the geology mapped during 1959 is an extension of that shown on Maps 11-1958 and 37-1959[1].

The northwest fringe of the mapped area is underlain mainly by Devonian(?) granitic rocks. It is suspected that much, but not all, of the unmapped Hayesville West Half and the northwest part of Hayesville East Half areas will prove to be underlain by similar granitic rock. In the southeast part of the mapped area it was found that the southeast half of Doaktown West Half map-area is underlain by Carboniferous sedimentary strata.

Between these granitic rocks on the northwest, and Carboniferous strata on the southeast, is a northeasterly trending belt of Ordovician and Silurian sedimentary formations that, in the main, strike northeasterly. The Ordovician members flank the granitic rocks, and are overlain to the southeast by Silurian formations. This sedimentary assemblage is believed to occupy a major northeasterly trending syncline, the axis of which lies close to the Carboniferous strata that underlie the southeast half of Doaktown West Half map-area. Thus most of the southeastern flank of the syncline is masked by Carboniferous formations.

<u>A.Y. Smith</u>, a seasonal employee studying for his doctor's degree at Carleton University, Ottawa, commenced, under the supervision of R.W. Boyle, a geochemical reconnaissance of southeastern New Brunswick.

Stream sediments were tested for lead, zinc, copper, and total heavy metals within an area bounded on the east by the Nova Scotia-New Brunswick boundary, on the west by the Petitcodiac River, on the northwest by New Brunswick Highway No. 11, and on the northeast by Northumberland Strait and Baie Verte. The resulting data, including several interesting anomalies, have been plotted on four preliminary maps forwarded for publication. It is anticipated that this work will be continued, in 1960, southwesterly to Saint John.

In addition, Mr. Smith examined, sampled, and studied all copper occurrences in the above area, and in the Amherst-Oxford area of adjacent Nova Scotia, with a view to determining the mode of concentration of copper in these deposits, and its dispersion pattern. The data obtained are expected to provide the basis for a Ph.D. thesis at Carleton University, and for an appropriate publication by the Geological Survey.

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1 Poole, W.H.: Napadogan, York County, New Brunswick; Geol. Surv., Canada, Map 11-1958

Anderson, F.D. and Poole, W.H.: Woodstock-Fredericton, York, Carleton, Sunbury and Northumberland Counties, New Brunswick; Geol. Surv., Canada, Map 37-1959

NOVA SCOTIA

P. Hacquebard, M.S. Barss, T.F. Birmingham, A.R. Cameron, and J.R. Donaldson of the Nova Scotia Coal Research Laboratory, Sydney, were transferred to Ottawa after that laboratory was closed in August. This move gives the coal research staff access to the modern laboratory facilities of the new Geological Survey of Canada building, including laboratories designed for their specialized studies.

D.G. Kelley completed field work within St. Ann's (11 K/7) map-area by mapping the western five-eighths to which the following remarks apply.

Minor parts of the area are underlain by Precambrian sedimentary and meta-volcanic rocks. These comprise quartzite, quartzose gneiss and schist, quartz-muscovite schist, and minor limestone, an assemblage lithologically similar to the George River group; and meta-rhyolite and meta-andesite. The remainder is underlain by about equal areas of Devonian(?) granite, a mixed assemblage resulting from the emplacement of granitic rocks in the Precambrian strata, and Horton-Windsor sedimentary strata. The Horton-Windsor rocks lie in or near the Northeast Margaree River-Lake O'Law Valley.

Two minor occurrences of galena were found on the northwest side of Sugarloaf Mountain. They are close to a granite-metasediment contact and about 1,500 feet apart. They are close to a major fault that follows the Northeast Margaree River. One showing is near the top of the falls on the brook flowing northwest from the "S" of "Sugarloaf" of the St. Ann's topographic map[1]. The other is on the east side of the Northeast Margaree River at the mouth of a small stream that enters it about 1,200 feet upstream from the above mentioned brook.

Massive specularite is common in the rocks north of the headwaters of the Middle Branch North River, especially along what is probably a northerly trending faulted contact between George River sediments and granite. This contact approximately follows the south flowing branch of Middle Branch North River which joins this river at 46°24' and 60°47'. The specularite is in places accompanied by small amounts of sulphide minerals.

A little nickeliferous pyrrhotite was found in gabbro on the brook that flows from the west into Lake O'Law at an old sawmill. The sawmill is shown on the St. Ann's topographic map (11 K/7). The gabbro is 1,800 feet west-southwest of the sawmill.

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[1] Department of Mines and Technical Surveys: St. Ann's, Nova Scotia, 11 K/7, West Half, first edition, National Topographic Series, scale 1:50,000; Surveys and Mapping Branch, Ottawa

The Northeast Margaree River valley is apparently underlain by a considerable quantity of gypsum as attested by outcrops and sink holes.

E. Schiller, a graduate geology student at University of Utah, commenced the geological study and mapping of Guysboro (11 F/5) map-area. It is anticipated that the data obtained will provide material for his doctorate thesis, and a suitable map and report for publication by the Geological Survey. Field work was completed in all but the southwest corner of the east half of the map-area.

The mapped area is approximately bisected by the easterly trending Salmon River lineament, probably a fault. South of the fault are Halifax slates and Goldenville quartzites of the Meguma series, cut by Devonian(?) granitic bodies. North of the fault are rocks of probable Horton age, including widespread volcanic members of intermediate composition.

Andalusite occurs in Halifax slates in the south-central part of the mapped area, adjacent to the southwest corner unmapped at the end of the 1959 field season. Insofar as known at this time the andalusite deposits are less attractive economically than those in the adjacent Chedabucto Bay map-area[1].

W.G. Smitheringale, a geology student pursuing his doctorate studies at Massachusetts Institute of Technology, concluded field work within Clementsport (21 A/12 E½) map-area. During the remainder of the field season he prepared, in Ottawa, copy for a preliminary map on the scale of 1 inch to 1 mile, incorporating the results of his previous field work in Nictaux (21 A/14 E½) and Torbrook (21 A/15 W½) map-areas.

F.C. Taylor commenced the geological study and mapping of Shelburne (20 O and 20 P) map-area and completed about 65 per cent of the field work required by this project.

Devonian granitic rocks, distributed much as shown on Map 910A[2], cut tightly folded quartzite, andalusite schist, and black slate. Because of the scarcity of outcrops, the difficulty of determining tops of beds, and the lack of fossils, it has not been possible thus far to establish the stratigraphic sequence, the detailed structure, nor the age of the pre-granite rocks. Rare crystals of beryllium occur in pegmatites associated with the Devonian granitic intrusions. These occurrences, so far as known, are little more than mineralogical curiosities. A preliminary map is not warranted at this stage of the project.

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[1] Stevenson, I.M.: Chedabucto Bay, Guysboro and Richmond Counties, Nova Scotia; Geol. Surv., Canada, Map 3-1959

[2] Alcock, F.J.: Geological Map of the Maritime Provinces; Geol. Surv., Canada, Map 910A (1949)

PRINCE EDWARD ISLAND

G.H. Crowl, Chairman, Department of Geology and Geography, Ohio Wesleyan University, as a seasonal party chief employed by the Geological Survey, continued the geological study and mapping of the bedrock and surficial deposits of the Island. During 1959 he completed field work in Mount Stewart West Half (11 L/7 W½) map-area. His contribution to the current study of Prince Edward Island has thus, to date, been the completion of field work within Mount Stewart (11 L/7) and Souris (11 L/8) map-areas.

L. Frankel, a professor of geology at University of Connecticut, Storrs, Connecticut, as a seasonal employee, continued to participate in the same continuing project - the geological study and mapping of the bedrock and surficial deposits of the Island. He completed field work within Montague (11 L/2) map-area, and coastal appendages (11 E/15, 16 and 11 L/1).

NEWFOUNDLAND (ISLAND)

E.P. Henderson completed field work required to prepare a geological map and report describing the surficial geology of Avalon Peninsula (1 N, and appendages). A preliminary map of St. John's (1 N) map-area, the core of Avalon Peninsula, has been forwarded for publication[1].

Well developed "patterned ground", including frost polygons, is fairly widely distributed in southern Avalon Peninsula at elevations of a few hundred feet above sea-level. It generally occurs in nearly flat areas underlain by wet silty till.

Gravel deposits were found to be more abundant in the southern part of the peninsula than elsewhere, although many of these, because of their location, are too costly for current commercial use. Perhaps the largest amounts are found along the coast between Peter's River and Holyrood Pond, at the southern tip of the Avalon, where sand and gravel bluffs face the sea over a distance of nearly 2 miles. On the St. John's-Trepassey road 1½ miles north of Cappahayden, a gravel pit in an esker constitutes a considerable reserve; and at the mouth of Chance Cove Brook, 8 miles south of Cappahayden, an area of large kames apparently contains a large reserve of commercial gravels. This latter deposit is not readily accessible, lying almost 2 miles from the nearest point on the road. Other smaller amounts of gravel occur at Renews Harbour, south of St. Mary's, and at several points along the east side of Placentia Bay south of

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1 Henderson, E.P.: St. John's Map-Area, Newfoundland; Geol. Surv., Canada, Map 35-1959 (in press)

Point Verde. The Point Verde lighthouse is built on a large mass of outwash gravels. Large gravel flats floor the valleys of Crossing Place River at the head of Holyrood Pond, and Peter's River at the head of Peter's Pond. Many of the tills are gravelly, having a low silt content, and make good road material.

E.R.W. Neale commenced field work in King's Point (12 H/9) map-area, and completed his task within the west half of that map-area and within the western 15 per cent of the east half. Most of the remainder has been mapped by the Newfoundland Geological Survey[1]. Concessions granted to British Newfoundland Exploration Limited and to Advocate Mines Limited include most of the map-area.

Several other tasks were undertaken. Field work within Fleur de Lys (12 I/1) map-area[2] was completed. A sub-party under G.M. Innes, a seasonal employee, mapped on a scale of 1 inch to 400 feet the belt of ultrabasic rocks that extends southwestward from Mic Mac Lake (King's Point map-area) into Hampden (12 H/10) and Sheffield Lake (12 H/7) areas. Another sub-party, under seasonal employee W.A. Nash, mapped Jackson's Arm East Half (12 H/15 E½) map-area in about the detail required for publication on the scale of 1 inch to 2 miles. The rocks encountered by Mr. Nash are mainly or entirely Fleur de Lys gneisses and schists.

The following remarks apply to that part of King's Point map-area completed in 1959.

The northwest corner of the mapped area is underlain by schists and gneisses of the pre-Ordovician Fleur de Lys group (Unit 1, Map 10-1958)[3]. The contact between these rocks, and intermediate meta-volcanic members of the Ordovician Baie Verte group (Unit 3, Map 10-1958) to the southeast, lies immediately northwest of Mic Mac Lake and extends north-northeasterly into Baie Verte map-area. Serpentinized ultrabasic rocks are localized along the contact zone in the vicinity of Mic Mac Lake and south-southwesterly beyond the map-area. These ultrabasic rocks contain asbestos prospects presently being investigated by Canadian Johns-Manville Company.

The Baie Verte meta-volcanic rocks, occupying a belt up to 1½ miles wide, are bounded on the southeast by a similar

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1 MacLean, H.J.: Geology and Mineral Deposits of the Little Bay Area; Geol. Surv., Newfoundland, Bull. 22 (1947)

2 Neale, E.R.W.: Fleur de Lys, Newfoundland; Geol. Surv., Canada, Map 16-1959

3 -------------: Baie Verte, Newfoundland; Geol. Surv., Canada, Map 10-1958

width of silicic and basic flow rocks with intercalated sandstone and conglomerate. Relationships are obscure and these rocks, best exposed near Mic Mac Pond, may belong either to the Baie Verte group or to a younger group.

These rocks are separated by large bodies of Devonian(?) granite and quartz-feldspar porphyry from a Middle(?) Ordovician group of intermediate and silicic volcanic rocks that outcrops southeast of the Shoal Pond - Rattling Brook scarp. Inclusions of the silicic volcanics within the quartz-feldspar porphyry are heavily pyritized near and west of the scarp. Pyrite, and traces of lead, zinc, and copper minerals, were noted within intermediate volcanics of the group.

GENERAL

D.M. Baird, Head of the Department of Geology, University of Ottawa, made a study of gypsum deposits of Canada. It is expected that the results of this study, together with pertinent published and unpublished data available to the author, will be published as an Economic Geology Series report of the Geological Survey. All producing properties in Canada, and many critical occurrences, were examined. No field work was done north of the 60th parallel, such as in Mackenzie Valley or Arctic Islands. Data from such deposits will, however, be obtained from other officers or sources, and included in the forthcoming report.

R.F. Black, replacing P.M. DuBois who resigned early in the summer, collected, for palaeomagnetic studies, about 130 appropriately oriented samples from known stratigraphic horizons within Proterozoic rocks of Beaver Mines (82 G/8 E½), Waterton (82 H/4), and Carbondale River (82 G/8 W½) map-areas[1]. Laboratory investigations now in hand are expected to indicate the magnetic pole positions during Proterozoic time, and thereby to provide a basis for correlation, structural determinations, and other aids in interpreting the geology of Proterozoic strata by palaeomagnetic methods.

In addition, a few samples were obtained of Cambrian sedimentary strata in the Banff and Jasper regions. It had been anticipated that palaeomagnetic data on these samples, when compared with data obtained from Proterozoic strata, would afford evidence for or against the so-called "Lipallian Interval". Preliminary laboratory work, however, suggests that it will be

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1 Hage, C.O.: Beaver Mines, Alberta; Geol. Surv., Canada, Map 739A (1943)

Douglas, R.J.W.: Waterton, Alberta; Geol. Surv., Canada, Map 52-10

Norris, D.K.: Carbondale River, Alberta and British Columbia; Geol. Surv., Canada, Map 5-1959 impracticable to determine a pole position from the samples of Cambrian rocks and that it is, therefore, unlikely that information concerning the "Lipallian Interval" will be forthcoming from the material at hand.

J.A. Chamberlain examined radioactive deposits near Beaverlodge in Saskatchewan, and Elliott Lake and Bancroft in Ontario. This work afforded information required for the maintenance of a confidential inventory of Canadian uranium and thorium deposits, and for research on the geology of radioactive deposits.

A geiger counter was used to test outcrops of Mesozoic and Tertiary strata of southern Saskatchewan from Weyburn to East End on the theory that the sedimentary type of radioactive deposits found in adjacent United States might occur in Canada. Although additional field work is required, no significant radioactivity was detected to the end of the 1959 field season.

M.J. Copeland made detailed stratigraphic collections of ostracods and other invertebrate fossils from the Upper Silurian, Stonehouse formation of Arisaig, Nova Scotia. It is hoped that data obtained from an office study of the microfossils will afford more precise information concerning the Upper Silurian-Devonian contact than has hitherto been possible from studies of macrofossils.

In addition, Dr. Copeland collected samples from the Jurassic, Fernie group at selected localities in the Foothills region between Crowsnest Pass and Cadomin, Alberta. It is hoped that this material will afford ostracods in sufficient variety and quality to define, according to microfossil evidence, various zones within the outcropping Fernie group of the Foothills. Subsurface samples and cores of Jurassic strata from southern Saskatchewan were collected for similar laboratory study. These specimens contain abundant ostracods and it is anticipated that the subsurface Jurassic zones can be satisfactorily defined according to microfossil content. The object of this project is to correlate, on microfossil evidence, the outcropping Fernie strata of the Foothills with the subsurface Jurassic rocks of Saskatchewan.

C.H.R. Gauthier collected about 12 tons of rocks and minerals from which to prepare suites for sale to the public. The material was collected in Ontario, Quebec, New Brunswick, and Nova Scotia, from some 30 localities.

G.A. Gross completed his third field season of a continuing study of the iron deposits of Canada. Most of the 1959 summer was spent in British Columbia, thereby completing a preliminary examination of selected iron deposits and regions of Canada.

Field work in British Columbia included examinations of properties on and in the vicinity of Vancouver Island; Lodestone Mountain deposit, near Princeton; Craigmont deposit, near Merritt; Kamloops area; Consolidated Mining and Smelting Company property, near Kitchener; and pyrrhotite beds at the Sullivan property of Consolidated Mining and Smelting Company.

In addition, iron deposits were examined near Bermis, Alberta, and at Albanel Lake, Quebec.

J. Houlihan, in addition to field duties in connection with the Geological Survey's aeromagnetic survey in Ontario and Quebec, gave technical assistance to the Hydrographic Service in operating a Varian sea-magnetometer aboard H.M.C.S. Kapuskasing out of Halifax.

R.D. Howie obtained, from the respective provincial governments, data concerning wells drilled for oil and gas in Quebec, New Brunswick, Nova Scotia, and Prince Edward Island.

B.A. Latour continued to collect data required to maintain an up-to-date estimate of the coal reserves of Canada. Visits for this purpose were made to all producing coal mines in Alberta, and in the Estevan district of Saskatchewan.

D.C. McGregor collected lower Devonian fossil plants from the Gaspé Sandstone at more than 100 localities, mainly in the vicinity of Gaspé Bay, Quebec, and lower Restigouche River, Quebec and New Brunswick[1]. Most of the material collected will be appropriate for spore studies as well as megafossil investigation. The plants were collected with the objective of redefining and contributing towards the age assessment of the classic lower Devonian Psilophyton flora of eastern Canada.

B. MacLean visited briefly the principal oil fields in southeastern and western Saskatchewan, and central and southern Alberta, in order to obtain data required for the revision of Geological Survey maps 1039A and 1044A and for the preparation of various reports on oil and gas in western Canada.

C.R. McLeod commenced a study of the placer deposits of Yukon. About 20 minor placer properties were visited, in addition to the operations of the Yukon Consolidated Gold Corporation.

R. Mulligan continued his study of the beryllium deposits of Canada, a project expected to provide, with a little

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1 McGerrigle, H.W.: The Geology of Eastern Gaspé; Department of Mines, Quebec, Geological Report 35 (1950)
Alcock, F.J.: Chaleur Bay Area, Quebec and New Brunswick; Geol. Surv., Canada, Map 330A (1936)

additional field work, data for an Economic Geology Series report. Beryl occurrences were examined near Revelstoke, St. Mary Lake, and Skookemchuck Creek, British Columbia, all of which are in pegmatites cutting Proterozoic strata; at Burnt Hill Tungsten Mine, New Brunswick; near Keswick and Bathurst, New Brunswick; and at Port Mouton, Jordan Falls, New Ross and Georgeville, Nova Scotia. Other examinations included: the Montgarry deposit, southeast Manitoba; Medicine Lake, east of Kenora; Nipigon area; Preissac-LaCorne area, Quebec; Mont Laurier and other localities in Pontiac and Gatineau County, Quebec; and Lyndoch, Raglan, and Mayo townships, Renfrew and Hastings County, Ontario.

C.H. Stockwell is Chairman of a Tectonic map committee responsible for the compilation of a Tectonic Map of Canada as part of a World Tectonic Map to be published by the International Geological Congress. A basic requirement for this project is a determination of the age and extent of the various orogenic belts in Canada, including those of the Canadian Shield. Assuming that orogeny, intrusion, and metamorphism are more or less contemporaneous, it is anticipated that these belts can be determined from potassium-argon ages on biotite (and muscovite) samples of metamorphosed sediments and other rocks from appropriately selected localities.

During the 1959 field season Dr. Stockwell obtained approximately 160 samples from the Canadian Shield for age determination. To obtain these he made field trips from Ottawa to Sept Isles along the north shore of St. Lawrence River; from the St. Lawrence River to Lake Chibougamau; throughout the Precambrian of Manitoba, Saskatchewan, and the mapped parts of District of Mackenzie and District of Keewatin. Other officers working in the Canadian Shield contributed additional samples so that the total collected during the summer exceeds 230. These are fairly uniformly distributed throughout the Canadian Shield except for outstanding gaps such as the Arctic Islands, the unmapped northwest mainland part of the Shield adjacent to the Arctic coast, western Quebec, Ontario north of the Great Lakes, north central New Quebec, and extreme northern Labrador. In addition to samples collected from the Canadian Shield, others were obtained within the Cordilleran region, including samples from the Shuswap complex, Wolverine complex, and Yukon group.

CSL/D