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HEAVY METAL (Zn, Cu, Pb) CONTENT OF WATER AND SEDIMENTS IN THE STREAMS, RIVERS, AND LAKES OF SOUTHWESTERN NOVA SCOTIA
(20P, 21A, B, and H, parts of)

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Figure 3. Heavy metal (Zn, Pb, Cu) content of river and stream sediments in southwestern Nova Scotia.

HEAVY METAL (Zn, Cu, Pb) CONTENT OF WATER AND SEDIMENTS IN THE STREAMS, RIVERS, AND LAKES OF SOUTHWESTERN NOVA SCOTIA

INTRODUCTION

The reconnaissance geochemical investigation described in this report was carried out during the summer of 1956 and covers that part of Nova Scotia lying southwest of a line drawn from Walton to Lunenburg (see Figure 1).

The heavy metal (Zn, Cu, Pb) content of the water and stream sediment was determined by dithizone (diphenythiocarbazone) methods, and the accuracy is within 25 per cent of the actual amount of metal present. The detailed procedure for the analysis of water has been described by Boyle, Illsley, and Green (1955)[1]. The procedure for the determination of the concentration of heavy metal ions in the stream sediment followed that described by Bloom (1955). On the accompanying maps the total heavy metal content of the water is expressed as zinc in parts per million, and the concentration of the cold extractable heavy metal ions in the sediment is expressed as the number of millilitres of 0.003 per cent solution of dithizone in xylene to titrate a standard volume (approximately 0.10 gram) of sediment to a distinctive blue-grey end point. Both procedures were standardized in the laboratory and in the field and all results are, therefore, comparable.

The results of the investigation indicate that most of the rivers and streams draining the Southern Upland, North and South Mountains, and the Annapolis Valley carry relatively little heavy metal in both the water and sediment. This suggests that extensive zones of base metal mineralization are absent in these regions.

In a belt extending from Walton to Lower Burlington the heavy metal content of stream sediment is uniformly higher than in the other regions investigated, and some streams are anomalous. Likewise, certain springs in or about barite occurrences carry high amounts of zinc and copper. All the anomalous springs and streams occur near or rise in the vicinity of the contact between rocks of Horton and Windsor age and are evidently deriving their metal from sources at or near this contact. It follows, therefore, that prospecting for base metals should be concentrated along this contact particularly where barite (a mineral often associated with lead-zinc-silver deposits) occurrences are known.

The report outlines the general geology and topography of the southwestern part of Nova Scotia and describes briefly the various types of mineral deposits and occurrences seen

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[1]Dates in parentheses are those of references cited in the bibliography, page 10.

during the investigation. An appendix is included at the end of the report covering the topographic, geological, geochemical, and economic geology features of each topographic sheet investigated.

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TOPOGRAPHIC, GEOLOGICAL, AND CLIMATIC FEATURES

Three main topographic features dominate the region covered by this report: (1) The North Mountain consisting of a narrow flat topped belt averaging about 500 feet in elevation and extending along the southeast side of the Bay of Fundy from Cape Blomidon southwest through Kings, Annapolis, and Digby counties, ending in Digby Neck and its pendant islands. Both the north and south slopes of this feature are steep towards the Bay of Fundy and the Annapolis-Cornwallis valley respectively. (2) The Annapolis-Cornwallis valley represented by a long trough-like depression lying between the North Mountain and the opposing South Mountain escarpment. (3) The Southern Upland comprising the region lying southeast of the Annapolis-Cornwallis valley and extending westward, and southeastward to the Atlantic seaboard. The northern edge of this upland region is marked by the South Mountain which slopes steeply towards the Annapolis-Cornwallis valley and extends southeastward some 12 miles or more to the height of land. Southeast of the height of land the country is undulating and slopes gently from elevations of 700 feet or less southward and southwestward to the Atlantic Ocean.

The whole of the Southern Upland is underlain by rocks of Palaeozoic age (see Figure 1). These rocks known as the Meguma group (Gold-bearing series) are separable into two conformable formations, the older Goldenville formation consisting of thick-bedded quartzite and greywacke with a few interbedded layers of argillaceous, siliceous and micaceous slates; and the younger Halifax formation consisting chiefly of grey to black pyritiferous slates and argillites. The Meguma group has been closely folded into northeast-trending anticlines and synclines. In addition there are many cross-folds giving rise to a series of domes and canoe-shaped structures. The

strata are traversed by many faults, some traceable for many miles.

In the central and northern parts of the Southern Upland and in the Wedgeport, Shag Harbour, Shelburne, and Port Mouton areas the Meguma group has been granitized and intruded by granites, probably of Devonian age. Dykes and sills of basic rocks of uncertain age also intrude the series at various points. In the granitized areas and adjacent to the intrusive granites the greywackes, quartzites, argillites, and slates are metamorphosed to gneiss and schist. Quartz-feldspar-mica pegmatites are abundant in the granitized areas and also occur locally in the massive granite.

South of Kentville the rocks are probably of Ordovician age (Kentville formation) and comprise principally fossiliferous, fawn and dark coloured shales and variegated green and purple argillites.

Devonian slates, quartzites, limestones, and associated ferruginous beds underlie the Nictaux Falls-Torbrook area of Annapolis and Kings counties. Similar rocks occur farther southwest in the Bear River area, southeast of Digby.

In the Windsor-Walton area two groups of rocks of Carboniferous (Mississippian) age are present. The lower, Horton group, rests unconformably on pre-Carboniferous metamorphic and igneous rocks and consists of a lower formation of dark grey to black shale, red and grey shale, and conglomerate (Horton Bluff formation), and an upper formation of sandstone, arkose, conglomerate, mudstone, and shale (Cheverie formation). The upper, Windsor group, rests with apparent conformity on the Cheverie and comprises limestone conglomerate, fossiliferous limestone, shale, sandstone, anhydrite, and gypsum.

A narrow belt of Pennsylvanian rocks occurs southeast of the Cogmagun River.

The youngest rocks are of Triassic age and rest unconformably on all older rocks. The Annapolis-Cornwallis valley is underlain by gently dipping, easily weathered and eroded, red sandstones, shale and conglomerates of the Annapolis formation. These are capped by about 750 feet of resistant amygdaloidal basaltic lavas forming the North Mountain. Uneroded remnants of brick red Triassic sandstones and conglomerates are also present along the shore near Walton.

The entire region has been glaciated by an ice-sheet whose general movement was from north to south. Glacial deposits cover most of the bedrock and exposures are found only along the coasts or along stream and river courses.

The most marked result of the glaciation is the extensive denudation of the Meguma group and their associated granites. Great areas of these rocks have been scraped clean, polished, and later mantled with till, sand, and boulders. Although numerous erratics occur throughout the region most

of the boulders and rock fragments in the glacial debris appear to be locally derived and generally reflect the type of bedrock below. In fact in many areas it is possible to map the underlying rock by the distribution of angular boulders.

Much of the glacial drift lies in moraines, kames, eskers, and innumerable drumlins. In Yarmouth, Shelburne, Queens, and Lunenburg counties drumlins are particularly abundant and typical drumlinoid topography is displayed. Soils developed on the drumlins are fertile, and most of the farms in Lunenburg, Queens, and Shelburne counties are located on them. Many of the prominent valleys, and some upland areas as well, are covered by deep glacial debris on which fertile soils are also developed. Examples are the fertile Annapolis-Cornwallis valley and the agricultural areas around Windsor, Walton, Meteghan, and Yarmouth.

The present drainage system owes its origin to (1) Southeasterly trending pre-Glacial valleys, many of which follow faults or joint systems in the rocks. Examples are the La Have and Jordan Rivers. (2) Northeasterly trending pre-Glacial valleys due to differential weathering of sediments as contrasted with basalts or granites. An example is the Annapolis River. (3) Glacial erosion and damming of pre-Glacial valleys or depressions by glacial debris resulting in the modification of the stream and river patterns. Many of the streams and rivers draining the Southern Upland have been modified in this manner. Thus the numerous southeast-trending streams, marshes, and lakes in Shelburne, Queens, and Lunenburg counties are controlled by a great series of low southeast-trending drumlins.

The streams draining the northern and southern slopes of the North Mountain are short and many dry up to trickles in late summer. Many of these streams flow over basaltic bedrock or over boulders and gravel derived from this rock. Stream sediment is generally scarce in these streams. The streams draining the northern slope of the South Mountain are small but maintain a fairly regular flow throughout the summer. They flow over bedrock or a mass of boulders and generally contain a small amount of stream sediment. The streams in the Windsor-Walton area flow over glacial drift along part of their courses but cut into bedrock at many places. Stream sediment is plentiful in this area. The rivers and larger streams draining into the Atlantic Ocean are approximately parallel to one another and follow the general slope of the Southern Upland to the southeast. In the course of their descent they frequently expand into lakes or receive the overflow from innumerable small lakes, marshes, and muskegs that lie in low depressions dammed by glacial debris. Many of these stream and lake bottoms are covered by a great assortment of boulders; others are boggy and choked with much black decaying organic matter. Good stream sediment is uncommon in such streams and lakes. Many of the rivers and streams along the coast are tidal and salt water reaches far inland in places. The Cornwallis and Annapolis Rivers are tidal for more than half their courses.

The climate of the region is temperate and the rainfall is moderate.

Much of the southwestern part of Nova Scotia is covered by heavy forests and low scrub. Many areas underlain by granites are relatively barren of thick forest growth but sustain various species of heath plants, blueberry, cranberry, foxberry, and other low bushes. Marshes, muskegs, and wet grassy meadows abound throughout the Southern Upland region.

The principal agricultural area is the Annapolis-Cornwallis valley. Farming is also done on fertile soils near the coast in Digby, Yarmouth, Shelburne, Queens, Lunenburg, and Hants counties, and inland on the numerous drumlins in Queens, Shelburne, and Lunenburg counties.

MINERAL DEPOSITS AND OCCURRENCES

The Meguma group contains numerous gold-quartz veins, many of which have been mined in the past. The principal gold districts within the region covered by this report are Malaga Lake, Brookfield, West Caledonia, Whiteburn, Chegoggin River (4 miles northwest of Yarmouth), Kemptville, and Ovens, Blockhouse, and Indian Path near Lunenburg.

Most of the quartz veins occur as saddle reefs along the slate beds, and their outcrops form a series of concentric ellipses or parts of ellipses following domes or plunging anticlines. Others occur in tension fractures on the crests of anticlines or in small faults that cut across the strata. The principal minerals in the veins are quartz, carbonate minerals, pyrite, arsenopyrite, and gold. Galena, chalcopyrite, sphalerite, and pyrrhotite are present in most veins but only in small amounts. A little scheelite occurs in some quartz lenses.

Quartz-feldspar-mica pegmatites are common in the Meguma group and associated granites. The pegmatites are concentrated in the highly metamorphosed gneisses and schists close to the granites as well as in the massive phases of the granitic bodies. Small amounts of molybdenite, cassiterite, wolframite, beryl, gummite, monazite, fluorite, and other typical pegmatitic minerals occur in some pegmatites, but these are not abundant enough to make them economic in any of the occurrences seen.

Three miles north of Jordan Falls, Shelburne county, a molybdenite-bearing pegmatitic quartz body has been recently prospected by an open cut along its length. The quartz pegmatite is 3 to 5 feet in width and 75 or more feet in length. Molybdenite occurs as segregations in white quartz and in bunches and seams of muscovite. In places a few beryl crystals are also present. The quantity of molybdenite and beryl is, however, insufficient to form an economic deposit.

In the New Ross area certain pegmatites and red-stained shear zones in granite and quartz porphyry contain gummite, monazite, meta-torbernite, and other radioactive minerals together with small amounts of pyrite, chalcopyrite, cassiterite, and fluorite. None of the mineralized shear zones or pegmatites seen contains sufficient radioactive minerals to be economic. The cassiterite occurrences are associated with a muscovite granite. Tin zones covered by glacial drift might be found by geochemical prospecting in this granite and the surrounding sediments.

Scattered occurrences of native copper and copper carbonates are present in the Triassic amygdaloidal basalts of the North Mountain. These are of mineralogical interest only and do not constitute economic deposits where seen.

Numerous bodies of iron ore occur in the northern part of the region and some have been mined in the past. In the Nictaux Falls-Torbrook area the iron ore is of sedimentary origin (Clinton type) and occurs interbedded with slates and quartzites of early Devonian age. The strata are folded into a pitching synclinorium and have suffered some metamorphism where cut off on the south by granite. The ore beds, of which there are several ranging from 2 to 10 feet thick, lie in two nearly parallel bands about a mile apart. These two bands have been traced along strike for about 5 miles and probably represent the same horizon on the flanks of the synclinorium. Some of the ore beds are fossiliferous, oolitic, and contain hematite, but most contain magnetite and spherulitic green iron silicates. The magnetite ore appears to be of primary sedimentary origin, but may be secondary, as suggested by some geologists, derived by metamorphism of hematite-bearing beds. In past years a small amount of iron ore was produced from the area, but the readily available rich ore has been exhausted and all mines are now closed. During 1956 Torbrook Iron Ore Mines Ltd. carried out geophysical surveys and a diamond-drilling program, but their efforts failed to find a sufficient tonnage of ore to mine economically.

In the Clementsvale area, northeast of Bear River, iron-bearing beds of Devonian age, similar to those of the Nictaux Falls-Torbrook area, are present. The ore is mainly magnetite in beds up to 3 feet thick. Only small trenches and pits have been dug on the ore beds, and there does not seem to have been any production of note from the area.

The Triassic basalts of the North Mountain contain isolated pockets, seams, and veins of magnetite and specular hematite. All of these are small containing only a few tons of ore and hence are not of economic value.

Several occurrences of manganese ore are known in the region. Eight miles north of New Ross, manganese ore was mined during the first years of the present century from lenticular veins in faults and crushed zones in granite. The ore consisted of pyrolusite, manganite, and psilomelane in a gangue of calcite, barite, and limonite. Small occurrences of vein manganese ore, bog manganese ore, ochre, and bog iron

ore were seen during the investigation, particularly in Kings county (Beech Hill), Lunenburg county (Conquerall Station, Chester, and La Have), Shelburne county and Hants county (along the Windsor-Horton contact zone). Most of these occurrences are described by Hanson (1932).

Industrial minerals occur in several areas. Near Walton a large pitching pipe-like body of barite in a brecciated part of a fold at the Windsor-Horton contact is mined by Magnet Cove Barium Corporation. The barite is microcrystalline and massive, varying from white to grey to red. The principal associated minerals are hematite and numerous manganese oxides. Sporadic occurrences of galena, pyrite, chalcopyrite, tetrahedrite, and sphalerite have also been noted. Several other occurrences of barite were seen along the Windsor-Horton contact zone from Lower Burlington to Walton. Gypsum is quarried extensively from marine evaporites of Windsor age in the Windsor, Cheverie, and Walton districts. Many occurrences of diatomite and peat are known on Digby Neck and south of Bear River as well as in other areas. Peat moss is cut and processed from the Caribou Bog 3 miles east of Aylesford in the Annapolis Valley. A bed of pure quartzite has been quarried near Yarmouth for silica flux, and deposits of silica sand lie in dunes at the head of Port Mouton harbour, Queens county and along parts of Barrington Bay, Shelburne county.

RESULTS OF THE INVESTIGATION

In the Southern Upland region the water in the streams and lakes generally contains a large amount of organic matter (humic complexes) which gives it an acid pH ranging from 4 to 6. The acidity of the water as determined accurately by pH meter appears to vary directly with the amount of organic matter present. Thus, sluggish streams with dark brown water and boggy bottoms may have pH's as low as 4 whereas faster flowing streams with clearer water have higher pH's ranging from 5 to 6.

Few streams draining the Southern Upland carry heavy metal values in excess of 0.005 ppm. In many places the amount of heavy metal in the water of bogs and lakes is slightly greater than that in the streams flowing into these bodies. This is evidently due to a concentrating action resulting from evaporation or organic activity.

Heavy metals in higher than average amounts occur in several streams northeast of Wentworth Lake, Digby county, and along a crescent-shaped area passing through the Brookfield Mines-Bridgewater areas. Other higher than average concentrations occur in several widely separated streams.

The significance of the higher than average amounts of heavy metal in the stream water of the above areas is difficult to assess. None appears to be high enough to suggest

the presence of extensive zones of base metal mineralization, and it is probable that they reflect a higher than average content of heavy metals in the rocks or glacial material through which the streams flow. The higher content in the Brookfield Mines-Bridgewater areas may reflect the presence of the mineralized gold-quartz veins that occur in these areas, or it may simply be a reflection of the numerous bands of pyritiferous slates that underlie large parts of these areas. Some of the widely separated anomalous concentrations in the stream water of other parts of the Southern Upland may be due to local domestic contamination or to the presence of old mine dumps or prospects.

The water in the streams draining the North and South Mountains is relatively clear, contains only small amounts of organic humic complexes and has a higher pH (6 to 7) than in the streams draining the Southern Upland. In nearly all streams the heavy metal content is low suggesting that few if any zones of base metal mineralization exist. Two streams, however, 3 miles southwest of White Rock Mills contain relatively large amounts of heavy metals. One stream drains into the Gaspereau River, the other into the Cornwallis River. Both appear to originate in a series of springs and pools in which there is a large amount of gelatinous iron hydroxide. The rocks in the immediate vicinity are slaty argillites and quartzites containing numerous narrow white quartz veins, some of which carry minor amounts of pyrite. No evidence of large scale base metal mineralization was seen in either the rocks or float in the vicinity.

In the Lower Burlington-Walton area the water in the streams is relatively clear with pH's ranging from 6 to 7. The heavy metal content of the water in several springs at or near the contact of Windsor and Horton rocks is high, particularly the water flowing from faults and springs in and about the large barite quarry near Walton. These waters are saline and average 0.26 ppm. heavy metal. The principal metal is zinc, but copper is also present. Such large amounts of zinc and copper suggest the presence of zinc and copper minerals in much greater abundance than those seen sporadically in the quarry.

In most streams in the Southern Upland region good stream sediment is generally difficult to find, because of their boggy nature and boulder bottoms. The heavy metal content of stream sediment is, however, generally low, supporting the conclusions reached from the water samples, that few if any extensive belts mineralized with base metals exist. In the Brookfield Mines-Bridgewater district the content of heavy metals in stream sediment is generally high, which may reflect the presence of mineralized gold-quartz veins in this district, or perhaps the presence of numerous pyritiferous slate bands.

Numerous other higher than average concentrations occur in the stream sediment of widely separated streams. These are difficult to assess but may owe their origin in places

to contamination or to the presence of local, higher than average heavy metal contents in the rocks or glacial drift.

In the Whiteburn Mines area soil samples were tested on a series of traverses across the gold-quartz veins to ascertain their heavy metal content. The results indicated that the content of heavy metals in the soils near and over the gold veins is ten times or more higher than elsewhere in the vicinity. This suggests that the gold veins could be traced by close grids of soil samples where the cover is not too heavy.

In the streams draining the North and South Mountains, stream sediment is more plentiful than in those of the Southern Upland. Only at a few widely separated places was the heavy metal content above normal suggesting that extensive zones mineralized with base metals are absent.

Stream sediment is plentiful in the streams draining the Walton-Lower Burlington district. The heavy metal content of the stream sediment in nearly all streams is uniformly higher than in the other regions of the southwestern part of the province, and some streams, such as Bass Brook, Rainy Cove Brook, and the streams near Lower Burlington, are anomalous near their sources. Most of these streams rise near the Windsor-Horton contact and are evidently deriving their metal from sources at or near this contact.

CONCLUSIONS

The results obtained from the geochemical reconnaissance in the Southern Upland, North and South Mountains, and Annapolis Valley suggest that few if any extensive zones mineralized with base metals exist in these regions. There are, however, restricted areas in which the heavy metal content of samples was higher than that of the background and some of these may warrant more detailed prospecting.

The limited investigation of the heavy metal content of soils overlying the gold-quartz veins of the Southern Upland indicates that these veins can be traced by pedogeochemical methods where the cover is light.

The results of the analysis of both water and stream sediment in the vicinity of the Windsor-Horton contact suggest the presence of base metals at or near this contact. Further geochemical work, particularly soil analyses, and detailed prospecting of all barite occurrences for base metals should be carried out along this contact, not only in the Walton-Lower Burlington district but eastward across the province.

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APPENDIX

The following notes summarize the significant geological and geochemical features of the region covered by the investigation (see Figure 1). The name of the investigator who examined the area covered by each topographic sheet is given in brackets.

The topographic sheets with the plotted field data are available in the open files of the Geological Survey of Canada, Ottawa.

Yarmouth (20 0/16) (Palmer)

The area is one of low relief, bedrock being mantled by thick glacial drift lying in low hills and drumlins. Outcrops are few. Settled areas are numerous throughout.

The Meguma group, consisting of metamorphosed slates and quartzites, underlies nearly all the area except for the extreme southeast corner where there is a small stock of granite.

Near Cranberry Point and Chegoggin some gold has been won from gold-quartz veins in slates, quartzites, garnet-staurolite schists, and mica schists.

The rivers and streams flow slowly and many near the coast are tidal. Almost all drain marshy lakes, swamps, and bogs and contain much brown organic matter (humic complexes). The temperature of the river water varied from 55 to 68 degrees F., and the pH ranged from 4.5 to 6. No heavy metal anomalies were found in any of the river or stream systems. One higher than average sample came from a stream flowing into the ocean near Port Maitland. This appears to be an isolated instance and its significance is uncertain.

Good stream sediment is difficult to find as the bottoms of most streams are covered with black, mucky, organic material. In any case no anomalies were found in either material.

Meteghan, East Half (21 B/1 E 1/2) (Moxham)

The area is characterized by low relief, thick glacial deposits, and relatively few outcrops. Settled areas are mainly along the coast; inland the country is heavily wooded.

The area is underlain by rocks of the Meguma group, consisting essentially of dark green to grey slates, quartzites, and their metamorphic equivalents. These rocks are highly folded into anticlines and synclines whose axes trend north 30 degrees east.

Diatomite occurs in the Meteghan River area.

The rivers and streams are slow flowing and drain swampy lakes, bogs, and marshes. They are high in dissolved brown organic material and have temperatures ranging from 60 to 70 degrees F., and pH's from 5 to 6. No anomalous amounts of heavy metal were found in either the stream water or organic stream sediment.

Church Point, West Half (21 B/8 W 1/2) (Koehler)

Long Island and Briar Island are both moderately covered with glacial drift and outcrops are largely restricted to the coast. Settled areas are mainly around Westport, Freeport, and along the road following the spine of the two islands. The remainder of the area is covered with forest.

The basement rocks on both Long Island and Briar Island are Triassic amygdaloidal basalts.

Diatomite occurs in places in the lake and swamp bottoms of Long Island.

The main stream on Long Island drains numerous marshy areas. No anomalous amounts of heavy metal were found in either the water or stream sediments.

Church Point, East Half (21 B/8 E 1/2) (Koehler)

Glacial deposits cover most of Digby Neck and the mainland area and outcrops are few except along the coasts. Relief is moderate on Digby Neck and low on the mainland. Settled areas on Digby Neck and Long Island are concentrated along the road running through the central parts. On the mainland the settled areas and farming communities are mainly along the coast; inland the terrain is heavily forested.

Long Island and Digby Neck are underlain by Triassic amygdaloidal basalt; the mainland area is underlain by rocks of the Meguma group, consisting of slates, quartzites, and their metamorphic equivalents.

Small deposits of diatomite and peat occur in the small lakes and bogs on Digby Neck.

The streams on Digby Neck are relatively free of organic matter and flow with a moderate velocity whereas streams draining the mainland area are sluggish, have boggy organic bottoms, and are generally charged with much brown organic matter. No significant heavy metal anomalies were found in the stream water or sediment in this map-area.

Centreville, East Half (21 B/9 E 1/2) (Koehler)

Digby Neck is underlain by Triassic amygdaloidal basalts. The streams are relatively clear and fast flowing. No anomalies were found.

Pubnico, West Half (20 P/12 W 1/2) (Moxham)

The area is one of low relief with numerous bogs and marshes and mantled by thick glacial deposits. Outcrops are sparse except near the coast. Settled parts are concentrated along the coast. Inland the surface is covered with forest or low scrub.

The region north of Lower East Pubnico is underlain by the Meguma group consisting of various schists, slates, and quartzites. The region to the south is underlain by granite and granitized gneiss.

The streams are generally slow and drain marshy lakes, bogs, and swamps. They are characterized by their high content of brownish organic matter (humic complexes). The temperature of the water ranged from 60 to 75 degrees F., and the pH from 4.5 to 6. No anomalous amounts of heavy metal were recorded. East Goose Lake contains more heavy metal than the streams flowing into it and probably forms a settling basin.

Good stream sediment is uncommon because most of the stream bottoms are covered with black mucky organic material. No anomalous values were found in the stream sediments.

Pubnico, East Half (20 P/12 E 1/2) (Moxham)

This is an area of low relief with elevations rarely exceeding 200 feet. Glacial drift covers most of the area and forms drumlins in places. Swamps, bogs, and barrens are widespread. Outcrops form less than 1 per cent of the area. Settled parts are confined to a narrow strip along the coast. Most of the higher ground is covered with forest, heath, or scrub. The central part of the area is underlain by granite and granitized rocks; the eastern and western borders are underlain by metamorphosed rocks of the Meguma group.

Granite has been quarried for fill near Barrington Passage. Quartz-feldspar pegmatites containing tourmaline are common in the sediments near their contact with granite. None of the pegmatites observed carried valuable minerals nor were any seen in pegmatite float.

The stream water is generally brown, high in organic (humic) complexes, and had a pH between 5 and 6. Temperature of the water ranged from 60 to 75 degrees F. Because of the low relief, the streams flow slowly and drain or traverse many bogs and marshes. No anomalous amounts of heavy metals were found. The normal background averaged .002 ppm. and the highest amount recorded was .005 ppm. The water in lakes and bogs generally showed a higher heavy metal content than the streams feeding them.

Most of the stream bottoms are boggy and covered with black peaty material. No anomalous amounts of heavy metal were recorded from this material.

Tusket, West Half (20P/13 W 1/2) (Palmer)

The area is one of low relief and characterized by numerous southeast-trending lakes, bogs, and drumlins. Most of the area is heavily drift covered and outcrops are sparse. Most settled areas follow the main coast road but there are some inland, on drumlin terrain. Scrub, barrens, and forest cover most of the land in the map-area.

The Meguma group, consisting of slates, quartzites, and their metamorphic equivalents, underlies the whole area.

The streams are sluggish and generally highly charged with brown organic complexes. No anomalies in the heavy metal content of the waters were noted.

Due to the general boggy nature of most streams, good stream sediment was difficult to find. Analyses of the organic boggy material in the stream bottoms showed no heavy metal anomalies.

Tusket, East Half (20 P/13 E 1/2) (Moxham)

The area is one of low relief marked by several southeast-trending lakes, marshes, and bogs. Drumlins, which trend southeast, are also common and most of the area is mantled with glacial drift on which scrub, heath, and forest are abundant.

The central part of the area is underlain by biotite granite and the east, west, and north edges by metamorphosed Meguma rocks consisting of slates, quartzites, mica schists, staurolite schists, etc.

Numerous quartz-feldspar pegmatites containing tourmaline occur in the sediments and granites near their contact. None of the pegmatites nor the pegmatite float observed contained enough rare minerals to be of economic importance.

The streams and rivers throughout the region are sluggish and are charged with much brown organic matter. The temperature of most streams ranged from 55 to 68 degrees F., the pH from 5 to 6. Analyses of the water showed only background amounts of heavy metals in the streams, with some higher than average amounts in the lakes.

Stream sediment is generally restricted to black organic debris and analyses of this material showed only background amounts.

Wentworth Lake, West Half (21 A/4 W 1/2) (Moxham)

The area is low, mantled with glacial drift, and dotted with numerous south-southeast-trending drumlins. Outcrops are sparse. Settled areas are confined to the main roads, the remainder of the region being covered with forest, scrub, and bogs.

The bedrocks are dark green and grey chloritic and sericitic schists, slates, quartzites and their metamorphic equivalents, all belonging to the Meguma group.

Gold-quartz veins, crossing the strata at various angles, occur near Carleton and on the south shore of Crawley Lake northwest of Kemptville. At the latter place several shafts have been sunk and some gold was extracted during the early part of the century.

The streams and rivers are generally slow and most are charged with large amounts of dissolved, brown, organic complexes. No anomalous concentration of heavy metal was found in any of the streams.

Good stream sediment is rare; in most places only black organic material covers the stream bottoms. Manganese stain occurs in the stream bottoms at several scattered points. No anomalous amount of heavy metal was noted in the stream sediments.

Weymouth, West Half (21 A/5 W 1/2) (Koehler)

Elevations range from sea-level to 500 feet, and the area is mantled by thick glacial deposits lying in irregular hills and drumlins. Outcrops are sparse. Settled areas are concentrated along the coast and inland along the main roads. Scrub and forest cover much of the southeastern part of the area.

The western part of the area is underlain by metamorphosed rocks of the Meguma group, the eastern side partly by granite and partly by granitized sedimentary rocks.

The streams are relatively slow flowing and charged with organic matter. Stream bottoms are generally choked with boulders of coarse sand and black organic matter. The pH of water was 5 to 6, the temperatures ranged from 60 to 75 degrees F. Several streams in the southeast corner of the area contained more than normal amounts of heavy metal. The significance of these anomalous streams is uncertain. No anomalies were noted in the stream sediment in the map-area.

Digby, West Half (21 A/12 W 1/2) (Koehler)

The area is one of moderate relief with the North Mountain and a high area in the southeast standing in contrast to the Digby basin. Glacial deposits cover much of the area and only along the coast are there many outcrops. The main settled areas are in the Digby basin and along the shores of St. Mary's Bay.

Digby Neck and its northeastern extension are underlain by Triassic amygdaloidal basalt and Digby basin by the Triassic Annapolis formation. Most of the mainland part of the area is underlain by metamorphosed slates and quartzites of the Meguma group. In the extreme southeast corner are granite and granitized sediments.

Scattered showings of native copper, malachite, and magnetite occur in the basalts, but none is of commercial size. Agates and zeolites occur at several places in the basalt, particularly around Murphy Cove.

The streams draining the basalt ridge are clear, fast, and eroding rapidly. The heavy metal content of the water of the streams was always low (.000 - .001 ppm.). The streams draining the sedimentary and granitized terrains are slower, generally laden with brown organic matter, and averaged .002 ppm. heavy metal. Many of the streams flow over boulders or are choked with organic material, thus making it difficult to obtain good samples of sediment. No anomalous amounts of heavy metal were recorded in the sediment except in Young Brook, northeast of Brighton. This is an isolated occurrence and its significance is uncertain.

Digby, East Half (21 A/12 E 1/2) (Koehler, Moxham)

Both the north peninsula and mainland areas are characterized by considerable relief with elevations ranging from sea-level to 600 feet. Glacial drift mantles most of the region, and outcrops are present principally along the coast and in deep stream-cuts. Settled areas are concentrated along the shores of Annapolis Basin and inland along the roads paralleling the basin.

The peninsula is underlain by Triassic amygdaloidal basalt, and red shales and sandstones of the Annapolis formation. The central part of the area is underlain mainly by metamorphosed rocks of the Meguma group. The Bear River and Clementsvale area is underlain by Devonian shales and limestones containing iron-rich beds. The southeastern part of the area and the southwestern and northeastern corners are underlain by granite and granitized sediments.

Scattered occurrences of native copper, malachite, and magnetite occur in the basalts but none is large enough to warrant prospecting. In the Clementsvale area, northeast of Bear River, iron-bearing beds, up to 3 feet thick and carrying mainly magnetite, were prospected many years ago by shallow trenches and pits. These deposits are similar to those in the Nictaux Falls-Torbrook area and, as far as known, have never produced any iron ore.

The streams draining the basalt ridge are relatively clear, fast, and eroding rapidly. There was little heavy metal in the water (.000 - .001 ppm.). The streams draining the sedimentary and granite areas are slow, generally laden with much brown organic matter, and averaged a little higher in heavy metal content (.002 ppm.). With the exception of one stream southwest of Cornwallis no anomalous amounts of heavy metal were recorded in the stream water. This stream may be

contaminated by domestic refuse. No heavy metal anomalies were detected in the stream sediment.

Granville Ferry, East Half (21 A/13 E 1/2) (Moxham)

The area is underlain by Triassic amygdaloidal basalt with a little shale of the Annapolis formation in the extreme southeast corner.

Scattered occurrences of copper stain and small magnetite seams and pods are present in the Triassic basalts but none seen was of economic importance.

The streams are fast and clear and no heavy metal anomalies were found in any of them.

A higher than average amount of heavy metal occurs in the stream sediment of McCall Brook, flowing into Delap Cove. The source of the metal is unknown but may be the disseminated copper in the basalts.

Margaretsville, East Half (21 H/3 E 1/2) (Koehler)

The area is underlain by Triassic amygdaloidal basalts.

Scattered showings of native copper, oxidized to malachite, and seams and small pods of magnetite occur, but none is of sufficient size to warrant prospecting.

The streams are fast and clear. No anomalous readings were found in either the water or stream sediment.

Bridgetown, West Half (21 A/14 W 1/2) (Moxham)

The area is marked by considerable relief with elevations on the North and South Mountains up to 900 feet. Most of the terrain is mantled with glacial deposits. The settled areas lie mainly in the Annapolis Valley, with some along the north shore.

North Mountain is formed by Triassic amygdaloidal basalts, and Triassic shales, conglomerate and sandstone underlie the Annapolis Valley. South Mountain is mainly granitic rocks.

Scattered occurrences of copper stain and specks of native copper were seen in the basalts of North Mountain. All are small and do not warrant prospecting.

Most of the streams are clear and fast flowing; Annapolis River and some of its tributaries are tidal. The stream water in the area carried little heavy metal and averaged .001 ppm. With the exception of one stream, Troop Brook, northeast of Granville Centre, the stream sediment also was low in heavy metals.

Bridgetown, East Half (21 A/14 E 1/2) (Moxham)

The area is one of marked elevation, North and South Mountains rising to elevations of 800 feet. Glacial drift mantles most of the country and outcrops are abundant only along the north coast and in river and stream cuts. Annapolis Valley is fertile and extensively settled. Numerous settled areas are also present on North Mountain. South Mountain and the region to the southeast are covered with forest and scrub.

North Mountain is underlain by Triassic amygdaloidal basalts and Annapolis Valley by shale, sandstone, and conglomerate of the Annapolis formation. South Mountain and the region to the southeast are mainly granite with some highly metamorphosed and granitized Meguma rocks. A southeast projecting tongue of Devonian shales and limestones is present in the Nictaux Falls area.

Scattered occurrences of native copper and malachite occur in the basalts but none is large enough to suggest economic quantities. Building stone has been quarried from the granite rocks of South Mountain. Thin iron-bearing beds similar to those mined at Torbrook (see Sheet 21 A/15 W 1/2, Gaspereau Lake, West Half) occur in the Devonian rocks southwest of Nictaux Falls. Torbrook Iron Ore Mines Limited investigated these beds in 1956 by cuts and diamond drilling but the investigation failed to reveal sufficient quantities of ore for mining.

The streams of the area are clear and relatively fast flowing with pH's that ranged from 5 to 6 and temperatures from 60 to 70 degrees F. The stream pattern covers the area rather thoroughly and the streams cut into bedrock in most places. No anomalous values were noted in the heavy metal content of the water or stream sediment in the map-area.

Kejimkujik Lake, East Half (21 A/6 E 1/2) (Palmer)

(See also Geol. Surv., Canada, Maps 437A and 438A, Kejimkujik Lake, East and West Halves (1938)

The area is part of a plain of low relief sloping to the southeast and marked by innumerable southeast-trending drumlins. Exposures of bedrock are moderately plentiful especially in the Whiteburn Mines and Tupper Lake - Harmony Lake district. Many of the drumlins provide good farming land and are settled. The remainder of the area is covered with scrub, forest, bogs, and marshes.

The major part of the area is underlain by the Meguma group consisting of folded slates, argillites, quartzites, and greywacke. The axes of the anticlines and synclines trend northeast. Granite and granitized sediments occur in the northeast and northwest corners of the map-area.

Gold-bearing quartz veins carrying small amounts of arsenopyrite, pyrite, and galena occur in two districts. In the Whiteburn Mines district the veins lie along the strata and are associated with a plunging anticline; in the West Caledonia gold district, south of Grafton Lake, the quartz veins occur on a plunging dome and lie along and also cut across the strata.

The streams contained a moderate amount of organic matter and ranged in pH from 5 to 6 and in temperature from 60 to 70 degrees F. Most streams are slow and drain marshes and bogs. The stream bottoms are generally covered with boulders of many types, but in some areas they cut through bedrock. No heavy metal anomalies were detected in the stream water.

Stream sediments are not plentiful in the area because of the presence of large amounts of boulders and coarse gravel in the stream bottoms. Organic debris abounds in many streams but is generally unsatisfactory for testing. No heavy metal anomalies were found in any of the stream sediments tested.

Soil samples obtained on traverses in the vicinity of gold-quartz veins were high in heavy metals, titrations of 50 to 60 ml. of 0.003 per cent solution of dithizone being recorded on 0.10 gram of fine soil over the veins. This suggests that these veins can be traced by soil analyses where the cover is not too heavy.

Lake Rossignol, East Half (21 A/3 E 1/2) (Palmer)

The area is characterized by extensive bogs and marshes that trend southeast between low drumlinoid hills. Forest and scrub cover most of the higher areas.

The Meguma group underlies the area, but outcrops are rare.

The streams drain or traverse the bogs and marshes and tend to have a high organic content. Most stream bottoms are either choked with boulders or covered with black organic matter, and stream sediment is not generally available. No heavy metal anomalies were found in the water or sediment in the districts sampled.

Shelburne, West Half (20 P/14 W 1/2) (Koehler)

The area is one of low relief with many southeast-trending drumlins, eskers, marshes, and bogs. Outcrops are rare except along the stream courses. The main settled districts are around Shelburne.

Slates, quartzites, argillites, and their metamorphic equivalents of the Meguma group form most of the underlying bedrock, but granite and granitized sediments underlie extensive areas north and west of Shelburne and along the northern border of the area. Quartz-feldspar pegmatites are abundant in the contact zones. A gabbro dyke cuts across part of the southeast quadrant.

Building stone for local usage has been quarried from the granite mass near Shelburne. Quartz-feldspar pegmatites containing tourmaline, apatite, and minor amounts of beryl were observed at several places in the contact zones of the granite and sediments.

The streams and rivers flow through or drain bogs and marshy lakes and generally contain an abundance of brown organic matter. Their pH was around 5, and their temperatures ranged from 60 to 70 degrees F. The streams rarely cut bedrock and their bottoms are filled with boulders of all sorts and much black organic matter. The background heavy metal content of the water ranged from .000 to .002 ppm. with amounts slightly higher in swamps and some lakes or in direct swamp drainage. East of Shelburne several streams draining from the west half of the Lockport area carry a higher content of heavy metals than normal background.

No heavy metal anomalies were recorded from the stream sediments.

Shelburne, East Half (20 P/14 E 1/2) (Palmer)

The area is low and heavily covered with glacial deposits, particularly drumlins and eskers. These features, as well as the numerous bogs which lie in the low depressions, trend south-southeast. The settled areas are concentrated along the highway that skirts Jordan Bay and passes through Sable River. The Meguma group forms the bulk of the basement rocks, and small granite masses occur north and east of Sable River. A southwest-striking gabbro dyke cuts across the centre of the area.

Quartz-feldspar pegmatites occur near the granite contacts in the sedimentary rocks. None observed contained rare minerals in economic quantities. Three miles north of Jordan Falls a quartz-mica pegmatite containing molybdenite has been explored along its length by bulldozer cuts, trenches and rock cuts. At the time of examination insufficient molybdenite had been found to make the deposit economic.

The streams drain the numerous marshes and lakes of the area and are slow flowing, with much dissolved brown organic matter. The pH of the water was 5 or 6, and the temperature ranged from 60 to 70 degrees F. Stream sediment is rare because most streams are choked with boulders and gravel or their bottoms are covered with black organic matter. No heavy metal anomalies were found in either stream water or sediment.

Lockport (20 P/11) (Palmer)

The area is low, covered with glacial drift and marked by many extensive southeast-trending bogs and marshes. Outcrops are mainly along the coast. Settled areas fringe the coast. The remainder of the terrain is covered with scrub, forest, and barrens.

Meguma rocks, consisting of slates, quartzites, argillites, and their metamorphic equivalents, form most of

the bedrock, but a granite tongue projects southward into the area as far as Gunning Cove. The contact zones contain quartz-feldspar pegmatites.

The streams are slow, brown coloured, and filled with boulders and much black organic matter. No anomalous amounts of heavy metal were recorded in either the stream water or sediment.

Port Mouton (20 P/15) (Moxham)

The area is thickly covered with glacial debris, and drumlins, eskers, and kames are abundant throughout the map-area, giving a low relief of 50 to 100 feet. Settled districts are clustered in a narrow strip along the coast. The remainder of the area is covered with scrub, marsh, bog, forest, or barrens.

The northern and southern parts of the area are underlain by meta-sediments of the Meguma group. The central part is underlain by a pink weathering grey biotite granite. Quartz feldspar pegmatites are common in the contact zones. A southwest-striking gabbro dyke cuts across the northern part of the area.

The streams are slow flowing and contain much brown organic matter. The temperature of most streams ranged from 60 to 70 degrees F.; the pH from 4 to 6. Stream sediment is not abundant, because streams are filled with boulders and black organic muck. No anomalies were found in either the water or stream sediment.

Liverpool, West Half (21 A/2 W 1/2) (Koehler)

(See also Geol. Surv., Canada, Map 440A, Liverpool, West Half 1938)

The area is part of a plain of low relief sloping to the southeast. Bedrock is covered by a thick mantle of glacial drift and is largely concealed except near the north border of the sheet. The area is mostly unsettled and is covered with a dense growth of scrub and forest, and with several large southeast-trending bogs and marshes.

Slate, quartzite, and argillite of the Meguma group underlie the entire area. These are folded into northeast-trending synclines and anticlines. A gabbro dyke cuts across the extreme southeast corner.

In the Fifteenmile Brook gold district, southeast of Pleasantfield, gold-quartz veins containing small amounts of galena, pyrite, and arsenopyrite occur in grey slate and quartzite on the north limb of an anticline. Both interbedded veins and cross veins are present and some mining has been done in the past.

The streams are slow flowing and laden with brown organic matter. The pH of most water was 5 to 6 and the

temperature 60 to 70 degrees F. Anomalous amounts of heavy metal were recorded from the water of Fifteenmile Brook. These are probably due to leaching of old mine dumps containing some galena and other sulphides. The stream sediment in Fifteenmile Brook was also anomalous, probably due to the same cause. In the rest of the area the water and stream sediment had a normal background amount of heavy metals.

Liverpool, East Half (21 A/2 E 1/2) (Moxham)

(See also Geol. Surv., Canada, Map 439A, Liverpool, East Half, 1938; Vogler Cove sheet, No. 90, 1924; and Bridgewater sheet, No. 89, 1929)

The area is part of a plain of low relief sloping to the southeast. Bedrock in most of the central, southwest, and northwest parts is concealed by a thick mantle of glacial drift, but in the southeast and northeast parts it is only lightly covered and outcrops are abundant. The area northeast of the Queens-Lunenburg county line is marked by numerous southeast-trending drumlins. Numerous settled areas fringe the coast.

The Meguma group, consisting of slates, quartzites, and argillites, underlie most of the area and lie in northeast-trending anticlines and synclines. Three small granite bodies occur along the coast in the vicinity of Liverpool Bay, and a gabbro dyke strikes northeast across the southeast part of the land area.

Gold-quartz veins lying along and cutting across the strata, occur in the Mill Village gold district and northeast of Vogler's Cove. Mining has been carried out in both districts in the past.

The streams in the area are generally slow flowing and contain much brown organic matter. No heavy metal anomalies were found in the stream water in the map-area.

Heavy metal anomalies were, however, found in the stream sediment of Salter Brook and Tumblingdown Brook. In the former, black manganiferous material on the stream bottom in places contained much heavy metal. This manganese material appears to come from the slates that outcrop along a synclinal axis. The excess heavy metal content is probably due to strong adsorption of the manganese sols. The high heavy metal content in Tumblingdown Brook is probably due to leaching of old mine dumps, etc., in the Mill Village gold district.

Bridgewater, West Half (21 A/7 W 1/2) (Koehler)

(See also Geol. Surv.,Canada, Map 436A, Malaga Lake, West Half, 1938)

The area is part of a plain of low relief sloping to the southeast characterized by numerous southeast-trending

drumlins. Outcrops are plentiful throughout, particularly north and northeast of Malaga (Molega) Lake. The farms and settlements in the area are located on the drumlins.

The bedrocks are mainly slates, argillites, and quartzites and their metamorphic equivalents, all belonging to the Meguma group. These are folded into northeast-trending anticlines and synclines. A granite mass outcrops in the extreme northwest corner of the area.

Gold-quartz veins have been mined in the Brookfield, Malaga, and Pleasant River barrens gold districts. The veins lie parallel to the strata or cross them at a small angle. The principal metallic minerals are pyrite, arsenopyrite, galena, and gold. Large gold-quartz lenses also occur in the Westfield gold district near the western margin of the sheet.

Streams in the area flow slowly and carry much organic matter. An interesting zone, where the content of heavy metal was above average, was found in stream and marsh waters in the northwest quadrant of the area. The water covering and draining from one of the marshes in this part of the area contained 0.01 ppm. of heavy metal, an amount that is exceptionally high for the district. The zone of higher amounts of heavy metal appears to parallel a synclinal axis projecting southwestward through the Westfield gold district. The area is heavily drift covered, but it was noted that the slates in the general vicinity are relatively rich in pyrite which may account for the higher heavy metal content of the water. The anomalous zone may also contain veins that are the northeast extension of the Westfield gold district.

No significant heavy metal anomalies were found in the stream sediments.

Bridgewater, East Half (21 A/7 E 1/2) (Moxham)

(See also Geol. Surv., Canada, Map 435A, Malaga Lake, East Half, 1938; Mahone Bay sheet, No. 88, 1929; and Bridgewater sheet, No. 89, 1929)

The area is part of a plain of low relief sloping towards the southeast and dotted by innumerable southeast-trending drumlins. Outcrops occur in places over most of the area, but bedrock is much obscured by drift especially in the northern part. Farms and settled areas are concentrated in the drumlin areas or along La Have River. The remainder of the country is covered with thick scrub, forest, and marsh.

The entire area is underlain by slates, quartzites, and argillites of the Meguma group which lie in northeast-trending anticlines and synclines. The slates in the east and southeast part of the area are highly pyritiferous.

Gold-quartz veins occur in the Leipsigate Lake district where they are associated with an anticlinal dome. The veins lie both along and across the strata. Metallic minerals

are arsenopyrite, pyrite, and gold, and minor amounts of galena. Mining in this area is said to have been carried out as late as 1940 by the Micmac Mining Company.

Most streams have a low gradient and contain fair amounts of brown organic matter. The heavy metal background was a little higher in this area than in areas to the southwest, possibly because the streams have more access to bedrock. No significant heavy metal anomalies were detected in the stream water or stream sediment.

New Germany, West Half (21 A/10 W 1/2) (Palmer)

(See also Geol. Surv., Canada, Map 532A, Springfield, 1939)

The height of land passes through the northwest part of the area, therefore streams to the northwest of it drain towards the Annapolis Valley and those to the southeast follow a gently sloping plain of low relief to the Atlantic Ocean. The entire area is mantled with glacial drift, and southeast-trending drumlins are prominent in the southeast corner and central part of the area. Outcrops are sparse. Settled areas and farms cluster on the drumlins and in areas of relatively thick glacial deposits in the central and northeastern parts of the map-area. The remainder of the terrain is covered with scrub, forest, bogs, and marshes. The latter are common in the southwest part.

The southeast and northeast quadrants of the area are underlain by metamorphosed rocks of the Meguma group. The remainder of the area is underlain by coarse grey to grey-pink biotite granite.

One mile north of Dalhousie East, on the road leading to Crossburn, malachite stained quartz fills a fracture in the biotite granite. Some trenching has been done there.

The streams have a low gradient and generally contain moderate amounts of organic matter. The pH of the water ranged from 5 to 6 and the temperature from 60 to 70 degrees F. No anomalous amounts of heavy metal were detected in the stream water or sediment.

New Germany, East Half (21 A/10 E 1/2) (Palmer)

(See also Geol. Surv., Canada, Map 531A, Sherbrooke Lake, 1939; and Chester Basin sheet, No. 87, 1924)

The area is part of a plain of low relief sloping to the southeast and mantled by glacial deposits, of which the most characteristic are numerous southeast-trending drumlins. Outcrops are not abundant. The settled areas and farms are concentrated on the drumlins in the central and southwestern parts. The remainder of the area is covered with forest, scrub, and bogs.

The region southwest of Sherbrooke and Caribou Lakes is underlain by slates, argillites, quartzites, and their metamorphic equivalents of the Meguma group. These are folded into northeast-trending anticlines and synclines. Bedrock in the region embracing Lake Torment, Sherbrooke Lake, and northward is biotite granite, and that north of Caribou Lake is muscovite granite.

Several interbedded quartz veins containing gold occur in anticlinal domes of quartzite southwest of Church Lake and Caribou Lake. Southwest of Stanburn several interbedded quartz veins carrying free gold have been investigated. Approximately 1 mile south of Lake Ramsay, in the extreme northeast corner of the area, a quartz-fluorite vein in a greisen zone (Reeves tin prospect) has been prospected. This vein carries quartz crystals and is said to contain tin minerals. None of the latter was observed, however.

Most of the streams in the area contain a moderate amount of brown organic matter, but some are relatively clear. Good stream sediment is rather difficult to obtain. No anomalous amounts of heavy metal were found in either the stream water or sediment.

Gaspereau Lake, West Half (21 A/15 W 1/2) (Koehler)

The divide between streams flowing into the Annapolis Valley and those flowing towards the Atlantic passes roughly through the centre of the area. The surface north of the divide slopes rather steeply to the Annapolis Valley, but that south of the divide is a plain of relatively low relief sloping gently to the southeast. Much of the area is covered with glacial debris and outcrops are rare except along stream courses. The settled areas are concentrated in the northern part of the area, in Annapolis Valley and along the north slope of South Mountain. The remainder of the area is covered with forest, scrub, and numerous marshes and lakes.

The northwestern part of the area from north to south is underlain successively by the Annapolis formation, consisting of red shales, sandstones, and conglomerate; a wedge of Devonian shales, slates, limestone, quartzite, and conglomerate; and finally by metamorphosed sediments of the Meguma group. The remainder of the area is granite.

In the Torbrook area beds of sedimentary iron ore (Clinton type) are interbedded with Devonian slates and quartzites. The ore beds, of which there are several, range from 2 to 10 feet thick and lie in two nearly parallel bands about a mile apart. The iron ore minerals are hematite and magnetite. In past years a small amount of iron ore was produced from the area, but no mining has been done there for many years.

Only the streams in the northwest part of the area were investigated. Those draining South Mountain have a steep gradient and cut through bedrock. They are closely and evenly spaced and cover the area well. The pH of the water ranged

from 5 to 6, and the temperature from 60 to 75 degrees F. No significant anomalies in the heavy metal content of the stream water or sediment were found.

Berwick, West Half(21 H/2 W 1/2) (Koehler)

The area is one of marked relief with North Mountain rising to elevations of 600 feet or more above the Annapolis Valley. The area is mostly covered with glacial debris, except along the coast and stream courses where exposures are generally good. The settled parts of the area are concentrated in Annapolis Valley and along the coast. Most of North Mountain is covered with scrub and forest.

North Mountain is underlain by Triassic amygdaloidal basalts and Annapolis Valley by the Annapolis formation, consisting of sandstone, shale, and conglomerate. In the extreme southeast corner of the area is a narrow wedge of Devonian rocks and some of the Meguma group.

The basalts contain seams and small pods of magnetite of no commercial importance. Small concentrations of native copper also occur locally. Peat moss is cut and processed from the Caribou bog 3 miles east of Aylesford.

On North Mountain most of the streams flow over basalt and have a steep gradient. In most streams the water was clear and cold with temperatures from 50 to 60 degrees F. suggesting a source in springs. No anomalous amount of heavy metal was found in the stream water or sediment.

Berwick, East Half(21 H/2 E 1/2) (Moxham)

The area is one of marked relief, spanning North and South Mountains and including Cornwallis Valley. Glacial drift covers most of it and, with the exception of the coast and stream cuts, there are few outcrops. The farming communities and other settled areas are concentrated principally in Cornwallis Valley and along the coast. Most parts of both North and South Mountains are heavily wooded.

Triassic amygdaloidal basalt forms North Mountain and Cornwallis Valley is floored by the Annapolis formation, consisting of Triassic red shale, sandstone, and conglomerate. A wedge of Ordovician rocks (Kentville formation), consisting of shale, limestone, argillite, sandstone, and conglomerate is present south of Kentville. The remainder of the southern part of the area is underlain by meta-sediments of the Meguma group and coarse-grained granite.

Small pockets of iron and manganese minerals, generally of supergene origin, occur in the Ordovician rocks south of Kentville. Old pits near Vernon Mines were probably dug to investigate some of the magnetite pods or manganese occurrences in the Triassic basalt or the sedimentary rocks of the Annapolis formation.

The streams on North and South Mountains have steep gradients and are clear, and probably have their sources in springs. The streams draining into the Cornwallis River flow over drift and are generally sluggish. No anomalous amount of heavy metal was detected in the stream water or sediments.

Chester Basin, West Half(21 A/9 W 1/2) (Palmer)

(See also Geol. Surv., Canada, Chester Basin sheet, No. 87, 1924; New Ross sheet, No. 86, 1931; Mahone Bay sheet, No. 88, 1929)

The area has a surface of low relief sloping towards the southeast. Glacial drift covers much of it and drumlins are common in the southeastern part. Most of the settled parts and farms are concentrated along the coast or inland on the drumlins.

The area is underlain by several types of bedrock. The oldest rocks are slates, argillites, and quartzites of the Meguma group which occur in a broad strip along the coast and in the southern part of the area. These are intruded by muscovite granite which underlies the northern three-quarters of the area. Rocks of carboniferous age (equivalent to Windsor group) occur north and east of Chester Basin.

Gold-quartz veins in quartzite and slate occur 1 1/2 miles west of the village of Chester Basin (Gold River gold district). Another series of veins lie on the northeast extension of these, about 1 1/2 miles due north of Chester Basin. Both series of quartz veins lie along the strata on a prominent northeast-trending anticline. Some mining has been done on these veins in the past.

Wolframite, hubnerite, scheelite, molybdenite, cassiterite, and fluorite have been found in very small amounts in pegmatite dykes and quartz veins in the muscovite granite near New Ross and along Gold River. By pedogeochemical(soil analyses) prospecting in the areas underlain by the muscovite granite and its surrounding sediments, tin zones covered by glacial drift might be located.

Brown ochre and gypsum occur at several places in the Carboniferous limestone around Chester Basin. Diatomite occurs in Sabody Pond, 2 1/2 miles northeast of Chester Basin.

The streams of the area have a low gradient and moderate velocity. They are clear or moderately charged with brown humic complexes. The pH of the water ranged from 5 to 6, and the temperature from 60 to 75 degrees F. Good stream sediment is difficult to obtain because of the large number of boulders in the stream bottoms and a covering of organic debris. No anomalous amount of heavy metal was found in the stream water and sediment.

Lunenburg, West Half (21 A/8 W 1/2) (Palmer)

(See also Geol. Surv., Canada, Mahone Bay sheet, No. 88, 1929; and Bridgewater sheet, No. 89, 1929)

The area is part of a plain of low relief covered with glacial drift and dotted with numerous southeast-trending drumlins. The settled areas fringe the coast and the farms are concentrated on the drumlins.

Most of the area is underlain by slates, argillites, and quartzites belonging to the Meguma group. These are folded into northeast-trending anticlines and synclines. The mainland and islands off Indian Point and Second Peninsula are underlain by Carboniferous limestone, shale, and gypsum equivalent to the Windsor group.

In the past gold has been mined from quartz veins in slate and quartzite at Indian Path, Ovens, and Blockhouse. The veins lie along the strata at the first two places and cut across the general strike of the beds at the last named place. Gold has also been won from beach placers in Cunard Cove and Rose Bay, just off the Ovens.

Gypsum occurs at numerous places in the Carboniferous rocks.

The streams have a low gradient and carry a moderate amount of brown organic matter. No anomalies were found in the heavy metal content of either the stream water or sediment.

La Have Islands, West Half (21 A/1 W 1/2) (Moxham)

(See also Geol. Surv., Canada, Bridgewater sheet, No. 89, 1929; and Vogler Cove sheet, No. 90, 1924)

The area is low and underlain by slates, quartzites, and argillites of the Meguma group. A northeast-trending gabbro dyke cuts across Cape La Have and Apple Cove.

No heavy metal anomalies were found in the map-area.

Wolfville, West Half (21 H/1 W 1/2) (Moxham)

The area is one of marked relief embracing North and South Mountains and Cornwallis Valley between. Glacial drift mantles the area and outcrops are scarce except along the coast and some stream and river cuts. Settled areas and farms are distributed over much of the map-area.

The oldest rocks in the area are Meguma slates, argillites, quartzites and their metamorphic equivalents. These occur in the region south of Wolfville. Southeast of Kentville is a wedge of Ordovician sandstone, shale, limestone, and conglomerate (Kentville formation). Rocks belonging to the Horton group (Lower Carboniferous) underlie the region southeast of Wolfville. These consist of shales, sandstones, quarzites, and argillites. Cornwallis Valley is floored by red shales, sandstones,

and conglomerates of the Annapolis formation, and North Mountain is composed of Triassic amygdaloidal basalt.

Streams draining North and South Mountains have steep gradients, are clear with relatively little organic matter, and were cold (50 to 55 degrees F.) suggesting that springs are the source of most of them. Cornwallis River and other rivers and streams in Cornwallis Valley are sluggish and are tidal in part.

Two streams on the watershed between the Gaspereau and Cornwallis Rivers systems, approximately 3 miles southwest of White Rock Mills were found to carry 0.015 ppm. heavy metals. The rocks in the immediate area are steeply dipping, northwest-striking quartzites and argillites containing numerous narrow quartz veinlets. No base metal minerals were seen in place or in float in the vicinity.

No heavy metal anomalies were found in the stream sediment.

Wolfville, East Half (21 H/1 E 1/2) (Koehler, Boyle)

(See also Geol. Surv., Canada, Paper 52-18, Wolfville (East Half) (1952)

The area is one of low relief with elevations ranging from sea-level to 575 feet (Grey Mountain) on the west side of Avon River and 450 feet (Cheverie Mountain) on the east side. Outcrops are not numerous except along the coast and the area is mantled with glacial drift, in places more than 100 feet thick. Settled areas and farms are concentrated along the Avon and Kennetcook Rivers and the coast.

The oldest rocks (Horton group) are a succession of terrestrial and estuarine sediments consisting of grey, red, and black shales, calcareous argillites, sandstone, and arkose. The black shales contain much carbonaceous material and knots and seams of pyrite. In places copper stain is common in these rocks. Specks of galena and sphalerite have been noted in the calcareous argillites.

The Windsor group of rocks in the area comprise the lower Macumber formation, consisting of bedded arenaceous limestone, overlain by the Pembroke formation, made up of limestone-conglomerate, limestone and calcareous sandstone, and shale; the Pembroke formation is overlain by a series of red shales, gypsum and anhydrite beds, and some limestone.

A narrow belt of Pennsylvanian rocks comprising sandstone, shale, and conglomerate occurs southeast of the Cogmagun River.

The youngest rocks are Triassic red sandstones and conglomerates which occur in the vicinity of Cambridge Cove, Rainy Cove, and Whale Cove.

Several abandoned manganese mines and prospects occur within the area. These are concentrated at or near the Horton-Windsor contact.

Barite is mined in considerable quantity by Magnet Cove Barium Corporation from a deposit 1 1/2 miles southeast of Pembroke. The deposit is a pitching pipe-like body replacing a large brecciated zone developed in a fold at the contact between Horton and Windsor rocks. The common associated minerals are hematite, manganese oxides, pyrite, chalcopyrite, galena, and sphalerite.

Other barite occurrences were noted at Whale Cove, Goshen, and Lower Burlington, all at or near the Windsor-Horton contact.

Gypsum and anhydrite are quarried in large amounts one mile east of Walton in Kennetcook, West Half map-area (11 E/4 W 1/2). Other quarries were operated near Cheverie and Summerville.

The streams in the area have a low gradient and many are tidal near their mouths. Most flow over glacial till but cut through bedrock for part of their course. The pH of stream water ranged from 5.5 to 7.5; the temperature from 50 to 70 degrees F. Water from springs varied in pH from 6 to 7 but had a relatively constant temperature around 50 degrees F. No heavy metal anomalies of significance were found in the normal stream water in the area.

The water issuing from springs and fractures in and about the large barite quarry was tested for heavy metals and found to be high in both zinc and copper. Total heavy metal content of 0.26 ppm. was recorded in nearly all occurrences. Such high values suggest the presence of zinc and copper minerals in much greater abundance than those seen sporadically in the quarry.

In general the amounts of heavy metal detected in the stream sediments in the area are uniformly higher than those found elsewhere during the investigation. This may be due to the general higher heavy metal content of the Horton and Windsor rocks than that of other rocks of the southwestern part of Nova Scotia. Amounts slightly higher than background were found in the stream sediments of three streams--Rainy Cove Brook, Bass Brook, and a stream west of Lower Burlington. The higher amount in Rainy Cove Brook is probably due to mining operations, those at Lower Burlington and in Bass Brook perhaps to heavy metals associated with barite occurrences in the vicinity of the Horton-Windsor contact.