This document was produced by scanning the original publication.

Ce document est le produit d'une numérisation par balayage de la publication originale.

MEMOIR 302

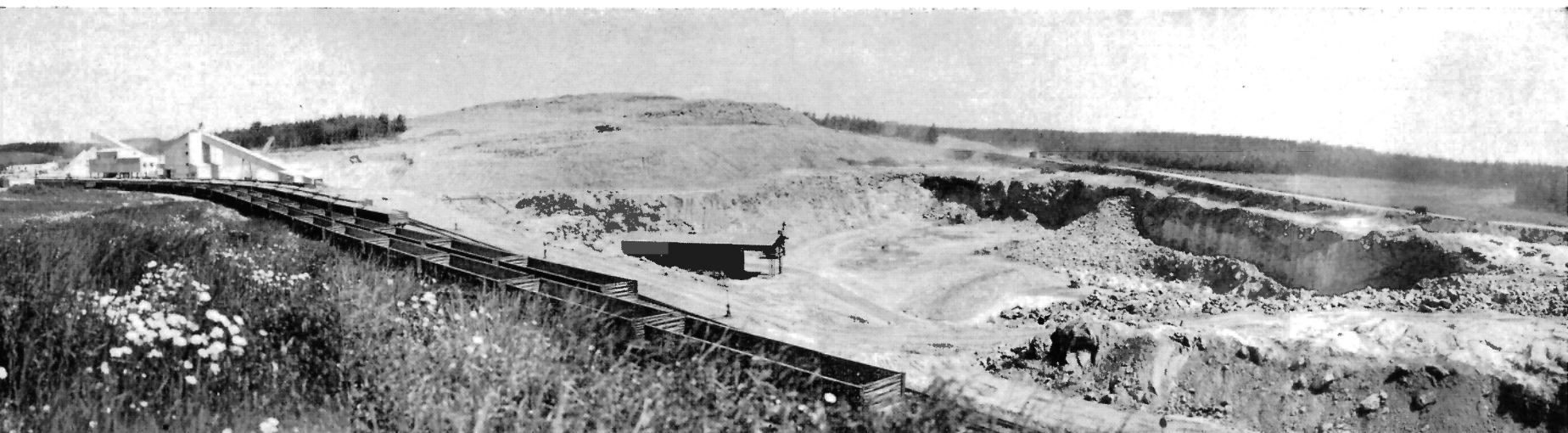
SHUBENACADIE AND KENNETCOOK MAP-AREAS, COLCHESTER, HANTS AND HALIFAX COUNTIES, NOVA SCOTIA

BY

I. M. STEVENSON

GEOLOGICAL SURVEY
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
OTTAWA
1959

Plate I



IMS, 5-5, 6, 7, 8-56

Gypsum quarry of National Gypsum (Canada) Limited, Dutch Settlement, Halifax county, N. S.

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

MEMOIR 302

SHUBENACADIE AND KENNETCOOK MAP-AREAS, COLCHESTER, HANTS AND HALIFAX COUNTIES, NOVA SCOTIA

By

I. M. Stevenson

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY

OTTAWA, 1959

April 26, 1960

3,000-1958-1286

No. 2549

61511-2—1½

Price $1.00 Cat. No. M46-302
Available from the Queen's Printer
Ottawa, Canada

Preface

The areas covered by this report, as well as other areas of Nova Scotia, were mapped geologically in the 19th century. However, geological concepts have changed, methods have improved and basic knowledge of the general stratigraphy has so increased that re-mapping on a scale of 1 inch to 1 mile appeared advisable. This was especially so as the earlier mapping had been concentrated on the rocks of the gold-bearing Meguma group, then thought to be of Precambrian age, almost to the exclusion of the younger strata.

As anticipated, the present study has yielded new information on the structural relationships of several of the formational units, particularly those of Carboniferous age. The author also describes in detail all known metallic and nonmetallic deposits of possible economic importance.

J. M. HARRISON,

Director, Geological Survey of Canada

OTTAWA, December 2, 1957

CONTENTS

CHAPTER I

PAGE

Introduction 1
- Acknowledgments 1
- Previous geological work 1
- Accessibility 2
- Industries 3
- Physiography 3
- Drainage 5

CHAPTER II

General geology 6
- Table of formations 6
- Meguma group 8
  - Structural relations 8
  - Origin and age 10
  - Goldenville formation 11
  - Halifax formation 13
- Horton group 14
- Windsor group 18
  - Macumber formation 19
  - Pembroke formation 20
  - Undivided Windsor rocks 22
    - Marine limestones 23
      - Lower Windsor limestones 23
      - Upper Windsor limestones 25
    - Rock salt 28
    - Red shales 29
    - Calcium sulphate beds 30
- Scotch Village formation 31
- Annapolis formation 34
- Cretaceous deposits 34
- Pleistocene deposits 36

CHAPTER III

PAGE

Structural geology 37

Unconformities 37

Folds 38

Faults 39

Cleavage 41

CHAPTER IV

Economic geology 42

Gold 42

Rawdon gold district 46

East Rawdon gold district 48

Renfrew gold district 49

South Branch gold mine 50

Gays River gold deposit 51

Alluvial gold deposits 53

Lead 54

Gays River lead deposit 54

Walton River lead prospect 57

Antimony 57

West Gore antimony deposit 57

Barite 61

Middle Stewiacke barite deposit 61

Manganese 61

Hibernia manganese mine 62

Whale Brook prospect 62

Other occurrences 63

Coal 63

Upper Kennetcook prospect 64

Stanley prospect 64

East Gore prospect 64

East Brook prospect 65

Alton prospect 65

Gypsum 66

Origin of gypsum deposits 67

Dutch Settlement quarry 68

Fry's Mountain quarry 68

Maynard quarry 69

PAGE

Fire-clay 69
Middle Musquodoboit deposit 70
Paint Brook deposit 70
Shubenacadie deposit 70

Limestone 70
Admiral Rock deposit 71
Latties Brook deposit 72
Middle Musquodoboit deposit 72
Riverside Corner deposit 73
Anthony's Nose deposit 73
Brentwood deposit 74
Other occurrences 74

Salt 74

Slate 74

Sand and gravel 75

Building stone and scythestones 75

Petroleum 76

Bibliography 80

Index 87

Illustrations

Map 1076A. Shubenacadie, N. S. ..... *In pocket*
1075A. Kennetcook, N. S. ..... "

Plate I. National Gypsum quarry, Dutch Settlement, N. S. *Frontispiece*

II. A. Unconformable contact between Horton conglomerate and Halifax slates. Gays River gold deposit, near Coldstream, N. S. 83
B. Unconformable contact between Horton shales and sandstones and overlying Triassic conglomerate. Near mouth of Whale Brook 83

III. A. Karst topography in gypsum beds, Dutch Settlement gypsum quarry, N. S. 84
B. Stratification in glacial sand deposit, Nine Mile River, N. S. 84

IV. Lignite in clay pit, Shubenacadie, N. S. 85

PAGE

Plate V. Contact between Horton conglomerate and Halifax slate, Glen Brook, N. S. 86

Figure 1. Plan of Rawdon gold district, showing positions of main veins 45

2. Plan of Renfrew gold district, showing position of main veins and workings ..... *In pocket*

3. Plan of Gays River gold deposit, showing position of main workings 52

4. Plan of Gays River lead-zinc deposit, showing mineralized zones 55

5. Plan of West Gore antimony deposits, showing position of main workings 59

Shubenacadie and Kennetcook Map-Areas, Colchester, Hants, and Halifax Counties, Nova Scotia

Chapter I

INTRODUCTION

Shubenacadie and Kennetcook are adjoining map-areas in central Nova Scotia, lying between lat. 45°00′ and 45°15′N and long. 63°00′ and 64°00′W. Together they comprise an area of approximately 850 square miles.

Field work in the areas was commenced in 1953 and completed in 1956. The investigation was primarily to establish the age relationships and boundaries of the various rock formations and to assess the mineral potentialities of the region. Preliminary geological maps of Shubenacadie and Kennetcook map-areas were published earlier on a scale of 1 inch to 1 mile (Stevenson, 1956, a and b)[1].

Acknowledgments

During the field seasons, C. Gourley, R. Chisholm, W. MacIntosh, G. Breau, H. Harvey, G. Taylor, C. Cameron, D. Ross, and J. MacNeil ably discharged their duties as student assistants. W. A. Bell and P. Harker of the Geological Survey of Canada identified the Mississippian and Pennsylvanian fossils collected.

Mr. Bruce Hume, in charge of operations at the gypsum quarry at Dutch Settlement, generously provided unpublished information concerning that operation.

In 1954, the Nova Scotia Research Foundation commenced a gravimetric survey of the Kennetcook map-area. The writer is indebted to Dr. J. E. Blanchard who was in charge of this work and who willingly made available the results of the investigation. Professor M. F. Bancroft of Acadia University provided unpublished information on the results of his field work in Kennetcook map-area.

Previous Geological Work

Probably no part of Nova Scotia has been subjected to such an intensive geological investigation as that section underlain by rocks of the Meguma gold-bearing group. As early as 1829 Judge Haliburton described these rocks as consisting of clay slate occasionally interstratified with trap. In 1832 Jackson and Alger briefly described the quartzites and slates of southern

[1] Names and dates in parentheses are those of references cited at the end of the report.

Nova Scotia, and recognized the presence of quartz veins. They incorrectly assumed the sedimentary rocks to be younger than the granites.

In 1836 Gesner published his work on the geology of Nova Scotia. He was the first to prophesy the finding of ore in the relatively unexplored parts of the country underlain by slates and quartzites. In his "Industrial Resources of Nova Scotia" (1849) he stated these sediments to be of Cambrian age.

Dawson (1855, p. 362) in his first edition of "Acadian Geology" stated that "Quartz veins, however, occur abundantly in some parts of this district, and it would not be wonderful if some of them should be found to be auriferous". Subsequent editions of "Acadian Geology" provide a monumental tribute to the great observant powers of Dr. Dawson.

The first systematic geological mapping of Nova Scotia was begun by Hugh Fletcher in the 1870's. He was primarily interested in rocks of Carboniferous age, particularly those containing coal. Much of his work was carried out in conjunction with that of E. R. Faribault, whose chief interest lay with the older gold-bearing sediments. The excellent maps and accompanying reports produced by these men attest to the care and diligence with which their work was conducted.

To enumerate the various persons who at one time or another have dealt with Nova Scotian geology would be merely to repeat the comprehensive summary given by Malcolm in his memoir on the gold fields of Nova Scotia (1929, pp. 1-12), particularly as regards the gold-bearing rocks. In Shubenacadie and Kennetcook map-areas, interpretation of the regional geology has remained practically unaltered for the last 50 years. Investigators have been content to adopt the work of their predecessors and have devoted their time and energy to studying individual mineral properties and in searching for oil.

Recently, however, field work has been carried out on adjoining map-areas by L. J. Weeks (1948), and D. G. Crosby (1951). The present writer has endeavoured, as far as possible, to follow the classification of formations as worked out by these authors.

Accessibility

Kennetcook and Shubenacadie map-areas are readily accessible by road and railroad. Paved highway 2, linking Truro and Halifax, runs south across the west half of Shubenacadie map-area. Route 24, running east from highway 2 through Middle Musquodoboit, was paved in 1956. A new highway is also being constructed between highway 2 and Windsor, passing through Nine Mile River and Rawdon. Good secondary roads give access to other parts of the map-areas.

The main line of the Canadian National Railways is parallel to highway 2 and a branch of this railway links the Musquodoboit River valley villages to Dartmouth. Kennetcook map-area is serviced by the Dominion and Atlantic Railway, which follows Kennetcook River and provides access to both Windsor and Truro.

Industries

The principal industries are farming and lumbering, but the gypsum quarries at Walton and Dutch Settlement offer employment to many local residents. A few fishermen are engaged in netting salmon on Shubenacadie River during open season.

The once-prosperous gold mining centres of Rawdon and Rawdon Gold Mines are now only small community centres. In recent years the cutting of pulpwood has provided an additional source of income for many of the farmers. Although most of the large timber has been cut from forested areas, some sections of the country still support good marketable timber and numerous sawmills are in operation. That part of Kennetcook map-area drained by Walton River and its tributaries contains the most valuable stands of timber. These have been preserved by an intelligent and systematic logging program.

Mixed farming is carried on mainly in the fertile, well-drained valleys of the major rivers. Those areas underlain by Carboniferous sediments have proved to be best suited for agriculture because of the presence of lime-rich soils. Where a considerable thickness of overburden covers the upland areas underlain by the Meguma gold-bearing rocks, good farm lands may be found, but, in general, soils produced from these rocks are deficient in lime and require the addition of suitable fertilizers. Many of the earlier upland farms have long been abandoned and are completely overgrown. At one time or another lime has been produced at various places in the map-area for local use and a crusher is in operation near North Salem.

Physiography

Shubenacadie and Kennetcook map-areas comprise part of the so-called "Atlantic Upland" which may be traced from the south shore of Nova Scotia northwestward to the highlands of New Brunswick and northeastward to the flat tablelands of Newfoundland. This surface, whose relief increases from sea-level on the south shore of Nova Scotia to approximately 2,000 feet in Newfoundland, forms a facet that apparently originated as a plain of denudation caused by the wearing down of an ancient complex mountain system by either subaerial or marine erosion. It is evident that this part of the upland reached its present elevation by gentle upwarping.

Since the upwarping took place, the less resistant rocks have been gradually removed by the normal erosion of rains and rivers to form a lowland that on the average is 400 feet lower than the upland surface. In Shubenacadie and Kennetcook map-areas, the parts underlain by Carboniferous and Triassic sedimentary rocks form the lowlands and the more resistant slates and quartzites of the Meguma gold-bearing group the uplands, the latter forming about one-quarter of the whole.

It is generally supposed that the present-day plain of the Atlantic upland was completed in the Cretaceous period, and that the modern lowlands were formed during the Tertiary period (Goldthwait, 1924, p. 59). However, the presence of clays of Cretaceous age at Shubenacadie and Middle Musquodoboit indicates a Mesozoic age for at least some of the valleys.

In the lowland areas, bedrock has been effectively masked in all but scattered localities by a mantle of glacial debris which in places is more than 250 feet thick. The more resistant upland areas, which project in northeast-trending bands above the lowlands, have been smoothed and rounded by glaciation, and are covered with a relatively thin mantle of drift. Viewed from the summit of an upland hill, the surrounding Carboniferous lowlands present a monotonous expanse of thickly wooded, flat terrain, broken only by the occasional gently rounded hill, meandering river, or open section of tilled land.

Those areas underlain by gypsum and anhydrite offer a distinctive type of topography. Where the gypsum lies close to the surface, karst topography prevails, and numerous sink-holes, most of which are roughly circular and filled with water, serve to outline the strike of the underlying gypsum beds.

An interesting example of cave formation is found in the gypsum beds about 2½ miles east of Burtons Crossing on the south bank of Fivemile River. The mouth of the cave, which is half-way up the face of a 100-foot gypsum cliff, is about 15 feet wide and 6 feet high. The entrance, although rapidly becoming clogged by blocks of gypsum that have spalled off the roof, was evidently once much larger.

The cave, which must be penetrated with the aid of flashlights, has an arched roof about 50 feet high and 125 feet wide. The main passageway strikes approximately south for about 300 feet and then makes a gradual turn to the west to a bearing of S20°W. On the east side of the passageway the floor is covered with mud and shallow ponds; on the west the floor of the tunnel is covered with broken gypsum blocks sloping gradually upwards almost to the roof, which becomes flat rather than domed. The maximum width of the cave is 215 feet and the maximum height of the ceiling an estimated 75 feet. Entrance was made for a distance of about 1,200 feet,

at which point the passageway became very difficult to follow. According to local residents, the cave has been penetrated for a distance of about a quarter of a mile.

Drainage

In general, the area is one of small consequent streams which are tributaries of larger subsequent rivers. Shubenacadie River, largest in the area, is an exception and is thought to follow the channel of an old antecedent preglacial river. Numerous tributaries of Shubenacadie River, including Gays, St. Andrew's, Stewiacke, Fivemile, and Ninemile Rivers, are subsequent and have developed their channels upon weak underlying beds of the Carboniferous Windsor series.

Musquodoboit River is evidently of compound origin. Within the boundaries of the map-area the river is of the subsequent type and maintains a southwesterly course upon soft Carboniferous bedrock that forms a broad syncline between ridges of the more competent Meguma sediments. Just south of the map-area the river swings sharply to a southeasterly course and continues in that direction to the sea. This latter course is consequent upon the Atlantic upland, which here consists of granite, quartzite, and slate. Goldthwait (1924, p. 46) suggested that at one time Musquodoboit River may have had its headwaters north of Minas Basin and that the old Musquodoboit River was beheaded by the growth of the Minas Basin system. Such a supposition seems feasible, and it is of interest to note that the continuing growth headward of Gays River might result in its capture of Musquodoboit River, and consequent re-routing of these waters into Cobequid Bay.

Kennetcook River with its various tributaries drains a large part of Kennetcook map-area, and is evidently of subsequent origin, having developed its channel upon easily eroded sediments of Carboniferous age. Its course follows the regional structural trend of the more resistant quartzites and slates of the Meguma group, and is parallel to that of Musquodoboit and Stewiacke Rivers.

Lowland areas are generally poorly drained. Where relief is slight, run-off is poor and the land boggy. Most rivers are slow-running and meander over their valley floors with constantly shifting channels. Excellent examples of ox-bow cut-offs may be seen along Stewiacke and Musquodoboit Rivers.

The increased relief and shallow soil-mantle of the upland areas combine to increase the run-off, and there fewer marshy areas exist. Only rarely are streams on upland areas of the subsequent type and where they do exist, such as Gulf Brook south of Valley Lake, jointing is believed to be the controlling factor in determining the course of the stream.

Chapter II

GENERAL GEOLOGY

The oldest rocks in the area are the quartzites and slates of the Meguma group, whose age has long been a subject of controversy. The trend of present opinion is to assign to them an early Palæozoic age. They are normally overlain with marked angular unconformity by Mississippian conglomerates, sandstones, and shales of the Horton group (*see* Plate V). Directly overlying the Horton with apparent conformity are Mississippian limestones, shales, and calcium sulphate beds of the marine Windsor group. In areas where the Horton is lacking, Windsor strata rest directly upon those of the Meguma group. The Windsor is in turn overlain, probably disconformably, by sandstones and shales of the Scotch Village formation, of probable early Pennsylvanian (Riversdale) age.

The youngest rocks in the area, a narrow band of coarse red conglomerates and sandstones of Triassic age, unconformably overlie the Horton on the shore of Minas Basin (*see* Plate II B).

Prior to the Carboniferous, the rocks underwent several periods of severe deformation but rocks of Carboniferous age and younger are relatively undisturbed. The area forms part of the Appalachian geosyncline extending from Newfoundland to Florida, and the geological history of the region is similar to that of other parts of the Appalachian province.

No outcrops of igneous rocks were found. The quartzites and slates of the Meguma group have been cut, however, by numerous veins and stringers of white quartz.

Table of Formations

Era	Period or epoch	Group	Formation	Lithology
Cenozoic	Recent			Stream gravels, tidal alluvium, lake deposits
	Pleistocene			Glacial drift, stratified gravel

***Table of Formations**—Conc.*

Era	Period or epoch	Group	Formation	Lithology
unconformity				
Mesozoic	Cretaceous			Clay, sand, lignite
	Triassic		Annapolis	Brick-red, calcareous conglomerate, sandstone, shale
unconformity				
Palæozoic	Pennsylvanian	Riversdale (?)	Scotch Village	Grey and buff-coloured sandstone, red shale, red conglomerate
	disconformity			
	Mississippian	Windsor	undivided	Limestone, gypsum and anhydrite, red shale, salt, sandstone
			Pembroke	Red limestone-conglomerate, red calcareous shale
			Macumber	Grey, arenaceous, laminated limestone
		minor disconformity		
		Horton		Red and grey sandstone, shale, grit, conglomerate
unconformity				
Palæozoic (?)	Ordovician (?)	Meguma	Halifax	Black and grey slate, argillite, siltstone, minor grey quartzite
			Goldenville	Grey and green quartzite, minor black and grey slate

61511-2—2

Meguma Group

The name Meguma was first applied by J. E. Woodman (1904a) to an immense thickness of sedimentary rocks, consisting of quartzites[1] and slates that cover approximately the south half of Nova Scotia proper. At the same time, he recognized and named two distinct formations, the Goldenville and the Halifax, the latter conformably overlying the former. Together, the two formations have an estimated thickness of at least 30,500 feet, with an unknown amount removed by erosion (Faribault, 1908, p. 152).

The formations are folded in long anticlines and synclines parallel to the general trend of the Atlantic sea-coast, which in the longitude of Halifax county is about N65°E. The anticlines, many being several miles in length, alternate in plunge from northeast to southwest thereby forming a series of domes. The major gold deposits have been found along these domes. The force that produced these plications probably came from the southeast.

Both the Goldenville and Halifax formations have been cut by a series of northwest-striking normal and reverse faults. Elsewhere in Nova Scotia these faults have displacements of considerable magnitude (Malcolm, 1929, p. 27). Underground work at the various gold properties has established the existence of numerous minor faults, many striking northwest. Normally, these faults do not continue for great distances along strike, and are of shallow depth. Good examples of such faults are found at the West Gore antimony mine and the Renfrew gold deposit. Only rarely is surface manifestation of the faulting not obscured by the drift.

In general, the Goldenville formation has been exposed by erosion of the crests of the anticlines and the Halifax formation preserved mainly in the synclines. Locally, however, erosion may not have removed the Halifax rocks to expose the underlying Goldenville formation, even on the crests of the anticlines. Such a situation exists in Shubenacadie map-area, where Wittenburg Mountain, composed of Halifax slates and quartzites, forms a series of anticlines and synclines about 4 miles wide across strike.

Both the Goldenville and Halifax formations have been closely folded and in places overturned.

Structural Relations

Anyone attempting to decipher the structure of the Meguma group in Kennetcook and Shubenacadie map-areas is faced with many difficulties. Foremost of these is the lack of suitably exposed continuous sections coupled

[1] According to nomenclature of the National Advisory Committee on Research in the Geological Sciences (1956), a quartzite is a metamorphic rock consisting largely of quartz, characterized by an irregular fracture that tends to break across individual grains rather than around them.

with a paucity of outcrops in interstream areas. The contact between the Meguma rocks and the overlying Mississippian strata may generally be accurately located, but the boundary between the Halifax formation and the older Goldenville formation is rarely well defined.

The structure of the Goldenville strata is easier to determine than that of the Halifax formation. In the Goldenville, individual quartzite beds are interlaminated with narrow bands or films of slate and hence the structural features of the strata may be determined with a fair degree of accuracy. But in the Halifax formation bedding can rarely be seen in the monotonously homogeneous slates and the structures consequently are difficult to determine. In such instances, bedding is easily confused with cleavage which is all through the formation, but where banded argillites and siltstones are present bedding may be more easily traced. The colour of individual beds may, however, change over short distances along strike, and coloured beds are therefore extremely unreliable horizon markers.

The rocks of the Halifax formation have apparently been preserved in synclinal troughs floored with Goldenville strata. Locally, as in Wittenburg Mountain and Rawdon Hills, secondary folding has warped the strata in these synclines into northeast-plunging and southwest-plunging minor anticlines, whose axial planes parallel those of the major synclines.

The Goldenville quartzites have been folded into a northeasterly striking system of parallel folds that plunge both northeast and southwest. These elliptical-shaped, anticlinal domes are as much as several miles long with a gentle plunge at either end. Locally, however, as at Carroll Corner, Chaswood, and Renfrew, the plunge of the domes is steep.

Both formations are extensively faulted. Numerous local faults, most with but slight displacement, are visible in many stream beds and road-cuts. The crests of the domes in particular contain many such faults that do not appear to follow any set pattern, but whose formation is in some way related to the doming of the strata. Elsewhere in Nova Scotia cross-country faults with northwest trends and appreciable displacements have been recognized (Malcolm, 1929, p. 27). No such faults were observed in either Kennetcook or Shubenacadie map-area, perhaps because of the extensive drift mantle.

The severe compressive forces to which the rocks of the Meguma group were subjected resulted in an extremely complex arrangement of joints and cleavage, the latter being well developed in the incompetent slates of the Halifax formation. Joints, present in both the Halifax and the Goldenville formations, are particularly noticeable in shallow-dipping beds of the latter formation, where combined cleavage, stratification, and jointing commonly causes the quartzite to break into sharply angular rhombohedral blocks.

61511-2—2½

Origin and Age

The slates and quartzites of Kennetcook and Shubenacadie map-areas have been correlated with the Meguma group on the basis of similar lithological and structural characteristics. Until fossil evidence proves otherwise, they are considered to form part of the gold-bearing Meguma group found elsewhere in Nova Scotia.

The source of the Goldenville and Halifax formations is not known for certain, but the enormous thickness of sediments that make up the formations was probably derived from the waste of an ancient extensive mountainous landmass, known as Old Appalachia, which at one time lay to the south of the present shore of Nova Scotia (Dunbar, 1949, p. 130). King (1951, p. 71) suggested that at least part of the sediments was derived from secondary ridges on the geosynclinal floor.

The trend of popular opinion is to ascribe a marine source to the Meguma rocks. The general uniformity and great thickness of the group point to deposition in a gently subsiding, marine, geosynclinal basin where the water was fairly shallow and very muddy. Alternating layers of fine and coarse material may have been caused by seasonal deposition (Douglas, 1938, pp. 34-45) or by periods of abundant precipitation alternating with periods of drought (Malcolm, 1929, p. 39). Bell (1929, pp. 24-25), on the other hand, pointed out the possibility of a continental fluvial origin for at least part of the group.

In the adjoining Wolfville map-area to the west of Kennetcook map-area, Crosby (1951) found specimens of *Medusaegraptus* in black slates that he ascribed to the Halifax formation. Such fossils are indicative of a marine origin for the host rocks. In the same map-area, Crosby also found several specimens that were identified as *Dictyonema websteri* Dawson 3,950 feet above the "whin" rock which Faribault had previously placed in the Goldenville formation. According to Moore, Lalicker, and Fischer (1952, p. 722) such colonies of Dictyonema led a pseudo-planktonic type of existence, attached to floating objects in the sea.

From time to time investigators have placed the Meguma group in various parts of the Geological column from Precambrian to lower Silurian (Malcolm, 1929, pp. 30-34). Until recently general opinion favoured a Precambrian age for the group but fossils have been found that indicate an early Palæozoic age.

In 1955, the previously mentioned collection of fossils from Crosby's Wolfville map-area was re-examined by Dr. D. E. Thomas, Chief Government Geologist for Victoria, Australia. He identified the specimens as *Dictyonema flabelliforme* (Eichwald) sensu lata, and assigned an early Ordovician age to them.

The Meguma group in Nova Scotia moreover bears a distinct resemblance to many of the Ordovician slates and quartzites of Newfoundland. In 1951, specimens of middle Ordovician graptolites from the southwest shore of Grapto Lake in southern Newfoundland were identified by Miss A. E. Wilson of the Geological Survey of Canada (Rept. No. 06/51) as being similar to those found in the Magog region of Quebec. A poorly preserved gastropod fossil from the Bay d'Espoir group in southern Newfoundland has also been given an Ordovician age by Miss Wilson (Rept. No. 1/53). Jenness (1954, pp. 43-48) collected several specimens of graptolites and brachiopods of Ordovician age from slates in the Gander area of north-central Newfoundland that bear a marked resemblance to slates of the Halifax formation in Nova Scotia.

Although an early Ordovician age appears most likely for rocks of the Meguma group it must be noted that the so-called Halifax formation in Wolfville map-area is isolated from strata that are without doubt part of the Halifax formation by a considerable thickness of younger rocks or by granitic intrusions. Until identifiable fossils are found in rocks of the type Halifax formation correlation must be made on lithological grounds only.

Goldenville Formation

Distribution and Thickness. In Kennetcook map-area, Goldenville strata underlie an area in the south-central part. Excellent exposures of typical grey to green Goldenville quartzite can be seen on Herbert River, along Gulf Brook, and on Oak Hill near Nine Mile River village.

In Shubenacadie map-area, Goldenville strata outcrop as domes in the vicinity of Carroll Corner and Chaswood. Smaller areas of these rocks are probably present east of Newcomb Corner and in the vicinity of Glenmore and Centre Musquodoboit.

The thickness of the Goldenville formation cannot be accurately computed as there are no complete sections. One of the best-exposed sections is in the vicinity of Renfrew, and there, Faribault (1899, p. 170A) stated, 8,700 feet of Goldenville rocks had been eroded away. Woodman (1904b, p. 16) gave 17,670 feet as the exposed thickness of the Goldenville formation elsewhere in Nova Scotia. As the bottom of the Goldenville formation has not yet been recognized in Nova Scotia its true depth cannot be determined, but a minimum thickness of 16,000 feet is assumed in the map-areas.

Lithology. The Goldenville formation consists of alternate bands of quartzite and slate, with slate forming an estimated 5 per cent of the whole. The quartzite is light grey to dark greenish grey, breaks with a conchoidal

fracture, and commonly grades into narrow bands of micaceous, siliceous slate rarely more than a few inches thick. Individual quartzite beds may be several tens of feet thick.

Megascopically, the quartzite is a dense, uniformly textured, chloritic, fine-grained rock that characteristically weathers light grey to white. Some beds contain cubes of pyrite, whose individual crystals may be up to a quarter inch across.

The slate bands are normally light grey, but locally may be dull grey, bluish grey, green, or black. Where the chlorite content is high, the slates are green, similar to the adjacent quartzite beds. Pyrite and other sulphides, when present, occur along the bedding planes and impart a brown colour to the weathered surface of the rock. The slates of the Goldenville formation are rarely graphitic. The contact between the slate bands and adjacent quartzite beds is generally gradational.

Under the microscope, the quartzite is seen to consist mainly of angular to subrounded quartz fragments, with a few feldspar fragments intermingled. The feldspars are commonly clouded and the lamellae indistinct. Chlorite and muscovite are abundant and some kaolin was noted in a few thin sections. Calcite is conspicuously rare. Distinct schistosity, which megascopically could not be discerned, was revealed by the microscope in many sections.

In composition, the Goldenville quartzite closely resembles Pettijohn's (1949, p. 255) definition of a subgreywacke. The feldspar content normally does not exceed 10 per cent, and the quartz content may be as high as 85 per cent of the whole. The matrix consists of 15 per cent to 75 per cent silt and clay particles. A few fragments, up to 5 per cent, and invariably chlorite and muscovite in small amounts are also present.

The narrow bands of Goldenville slates are extremely fine grained and vary widely in colour, composition, and degree of metamorphism. The most common type is a greyish green, shiny, micaceous slate, composed almost entirely of grains of mica, individual bands rarely exceeding a foot in thickness. Other slate bands are composed of a dark grey to black, dense, siliceous, partly micaceous rock, rich in iron pyrites that weather brown and impart a brown colour to the slate. The green colour of the Goldenville slates varies directly with the amount of chlorite present.

The entire Goldenville formation has been affected by various degrees of regional metamorphism. Both quartzites and slates have been compacted, the former in many instances becoming extremely hard. Cleavage is generally conspicuous in areas that have been tightly folded, but where the folding is gentle, as along Gulf Brook, the rocks are much less fissile. The microscope, however, generally reveals distinct schistosity. Where folding

has been extremely severe, chlorite schists and mica schists are well developed, particularly in the interlayered slaty bands. Only rarely are cleavage and bedding planes parallel, and the cleavage planes always dip north or south at high angles.

Goldenville strata are cut by numerous systems of joints, whose attitudes vary greatly from place to place and do not follow any prescribed pattern.

Halifax Formation

Distribution and Thickness. Sedimentary rocks of the Halifax formation form by far the larger part of the Meguma group exposed in Shubenacadie and Kennetcook map-areas. In the former, the parallel series of northeast-striking ridges that form Wittenburg Mountain are composed almost entirely of slates, banded argillites, siltstones, and quartzites of the Halifax formation. In the Kennetcook map-area that part of the upland surface known locally as the Rawdon Hills is also underlain by strata of the Halifax formation.

No reliable estimate of the thickness of Halifax rocks in the map-areas could be determined. Only incomplete sections are exposed, and these have been intensely folded and crumpled. Traverses made across strike on Rawdon Hills and Wittenburg Mountain, indicate a maximum thickness of probably 5,000 feet.

Lithology. The Halifax formation is characteristically composed of a succession of dark, commonly graphitic slates with minor interbedded layers of argillite, siltstone, and quartzite. The greater part of the Halifax formation was adequately described by Faribault (1886, p. 147) as consisting of "bluish-black ferruginous, graphitic slates, easily distinguished from and unlike any others in the province, having a characteristic fibrous texture. Certain flinty layers are full of arsenical and iron pyrites distributed through the mass in small, perfect crystals."

The Halifax formation as represented in the map-areas forms a monotonously uniform succession of rusty weathering, sericitized, banded slates and argillites, commonly interbedded with relatively narrow bands of siltstones and chloritic, dense quartzites, the quartzites forming probably less than 5 per cent of the whole. In some sections, where the chlorite content of the rocks is excessively high, the rocks are a peculiar olive-green. Normally, however, most of the Halifax strata vary from black through grey to light greyish green, but a few dull red and purple bands may be encountered. Bedding, formed by the alternation of light siliceous layers and dark carbonaceous material, imparts a rhythmic banded appearance to many of the slates and argillites, individual beds rarely exceeding an inch or so in thickness.

The entire Halifax formation is steeply folded, and only rarely do cleavage and bedding coincide. Current ripple-marks, crossbedding, and truncation of lenses are common features, indicative of shallow-water deposition. As in the Goldenville formation, wherever pyrite is present the slates weather a dull brown. Excellent examples of such weathering may be seen along the large brook immediately east of Southvale, where the pyrite content of the slates is extremely high. In such areas springs issuing from fissures in the bedrock carry much iron oxide, sometimes deposited as yellow ochre.

Where a thick succession of black, carbonaceous slates occur, as along Capt. McPhee Brook south of East Gore, bedding may be indistinct even to the trained eye, and great care must be exercised to distinguish between cleavage and bedding. Siltstone beds, where present, are extremely helpful in identifying structure.

Microscopically, the slates are seen to be mainly a mixture of biotite, muscovite, and very fine, subangular quartz and feldspar crystals. The feldspars form probably less than 10 per cent of the rock and consist of albite or acid oligoclase. Some of the biotite may be original, but most is secondary after muscovite that formed from feldspars.

The siltstones are similar in composition to the slates, differing only in degree of metamorphism and size of particles. They are intensely sericitized, the matrix of the rock consisting almost entirely of sericite.

Horton Group

Horton rocks exposed in the map-area consist of conglomerate, grit, sandstone, siltstone, and shale with the coarser members predominant. In his description of the Mississippian of central Nova Scotia, Bell (1929, p. 30) divided the Horton into two formations, a lower, the Horton Bluff formation, and an upper, the Cheverie formation. Lack of outcrop and a general scarcity of identifiable fossil remains render such a division impossible in Kennetcook and Shubenacadie map-areas.

Economic interest was first drawn to the Horton sediments in the area by several narrow seams of low-grade coal, a few of which were worked on a small scale. A small amount of Horton sandstone was quarried in by-gone years for building purposes, and over 100 years ago gold was discovered in the basal Horton conglomerate on McLean Brook, north of Coldstream.

Horton sedimentary rocks in Kennetcook and Shubenacadie map-areas are lithologically similar to those found in Truro map-area to the north. For a detailed description of the Horton rocks, the reader is referred to the report on that area (Stevenson, 1957).

Distribution and Thickness. Rocks of the Horton group are exposed in a belt of variable width that reaches from Meander River in the vicinity of Upper Newport northeastward to Shubenacadie River. They overlie unconformably the quartzites and slates of the Meguma group, and are in turn overlain, probably disconformably, by marine strata of Windsor age.

Horton conglomerates and sandstones outcropping north of Stewiacke River form part of the eastern extension of the south limb of the so-called "Walton anticline" described by Weeks (1948, p. 15). The north limb of this anticline is also briefly exposed along Whale Brook in the northwest corner of Kennetcook map-area.

Accurate measurement of the thickness of Horton rocks in the area is rendered impossible by lack of outcrop. In drilling for oil at Kennetcook, approximately 750 feet of Horton strata were pierced before the hole was abandoned. Along Whale Brook, about 3,000 feet of Horton rocks are intermittently exposed in the creek bed. Rock exposures are fairly plentiful along several of the brooks that drain south into Stewiacke River, but the strata have been cut by numerous faults of appreciable displacement. A well-exposed section on the west bank of Shubenacadie River just south of the mouth of Fivemile River has also been extensively faulted and as horizon markers are lacking, the thickness of strata cannot be reliably measured. From available evidence, a maximum thickness of 3,000 feet is estimated for Horton sedimentary rocks in the map-areas.

Lithology. Owing to lack of complete sections containing recognizable marker horizons, the lithological characteristics of rocks of the Horton group can best be described on a geographic rather than a stratigraphic basis. The best rock exposures, found in the channels of rapidly moving streams, are most easily examined during late July and August, when normally the streams are easily waded.

Rock exposures are fairly plentiful along Whale Brook for a distance of about 3,000 feet upstream from the shore highway. Beneath the bridge, fine-grained, red, hard, jointed Horton sandstone strikes 40 degrees west of south and dips 60 degrees northwest. This rock outcrops intermittently upstream for about 800 feet from the bridge with a gradual decrease in dip, at which point the strata become much contorted. The red sandstones there become predominantly grey and contain beds of red mudstone several feet thick. At a distance of about 2,000 feet from the bridge the rocks are again much fractured and contorted. Intermittent outcrops of red and grey sandstone with narrow shaly layers are exposed for an additional 2,000 feet, at which point the beds strike 70 degrees west of north and dip 60 degrees southeast. The gradient of the stream then gradually decreases, with no additional rock exposures.

About 150 feet downstream from the road bridge, laminated, folded, black to reddish grey limestone of the Macumber formation, overlies the Horton sandstone and forms a continuous hill along the south bank of the brook. The nature of the contact between the Horton rocks and younger Windsor strata in this area could not be accurately determined, but a 50-foot band of brecciated and schisted calcareous shale on the shore just southeast of the mouth of Whale Brook is indicative of a fault zone, and the Windsor sediments may be preserved in a down-faulted block. Along the shore, Horton shales and sandstones have been extensively twisted and sheared.

On the shore 1,000 feet northeast of the mouth of Whale Brook, an excellent angular unconformity is exposed between red Horton mudstones and shales and the overlying Triassic conglomerates and sandstones (*see* Plate II B).

About 2 miles upstream from the mouth of McLean Brook, south of Riverside Corner, gypsum and red shales of the marine Windsor group are in contact with jointed, fractured, arenaceous, red and green shales and grey-brown sandstone of Horton age. The contact between the two groups may be a fault that is a poorly exposed highly fractured zone about 10 feet wide in the shales. Farther upstream brown sandstone and very quartz-rich, medium-grained conglomerate are exposed alternately in the banks of the brook. The sandstone and conglomerate are frequently interbedded with layers of arenaceous red and green mudstone containing lenses of grey shale. About 500 feet upstream from the Horton-Windsor contact, grey, micaceous Horton sandstone is underlain by medium-grained, buff weathering, grey conglomerate, composed primarily of glassy quartz pebbles and fragments of slate. The conglomerate contains a fair proportion of feldspar, which upon kaolinization renders the rock friable. The individual quartz pebbles are well rounded and evidently of stream-laid origin. The slate fragments are more angular, and were apparently derived from the Halifax formation of the Meguma group to the south. The Horton conglomerate lies, with marked angular unconformity, upon Halifax slates which there form part of the north limb of a northeast-striking anticline whose crest is visible about 150 feet south of the contact.

A similar situation exists on Glen Brook where Windsor gypsum is underlain by fine-grained, grey Horton conglomerate containing many rounded pebbles of free quartz. The conglomerate is in turn followed by grey and brown Horton sandstone interspersed with grey, chocolate, and green arenaceous shales, followed in turn by continuous, fine-grained, stream-laid conglomerate. Interbedded with the conglomerate and sandstone is a 20-foot

band of black, carbonaceous shale containing abundant carbonized plant remains. It is undoubtedly this shale that instigated the search for coal on Glen and McLean Brooks.

The contact between the Horton rocks and those of the underlying Halifax formation is well exposed on Glen Brook. At the contact, black, fractured Halifax slates, cut by numerous white quartz stringers, are overlain with marked angular unconformity by a basal Horton conglomerate containing rounded quartz and slate boulders up to 6 inches in diameter (*see* Plate V). The attitude of the Halifax slates is 40 degrees west of north, with a gentle dip to the northeast of 15 degrees, whereas the Horton rocks strike 60 degrees east of north and dip northwest at 60 degrees.

Poorly exposed sections of typical Horton rocks are found on the upper reaches of the branches of Little Ninemile River, about a mile northeast and a mile northwest of Roulston Corner, where carbonaceous sandstones and shales of Horton age rest in apparent faulted contact upon rocks of the Halifax series.

Horton rocks outcrop continually along Fivemile River from the confluence of the river with Fisher Brook downstream to a point about 750 feet south of the railway, where red and grey micaceous Horton sandstones are overlain, apparently conformably, by laminated sandy limestone of the Macumber formation. Upstream along the river, the micaceous sandstones are interlayered with bands of red, ripple-marked, arenaceous mudstones. Attitudes are in general very inconsistent, and the rocks are jointed and folded.

Immediately south of the mouth of Fivemile River, along the west bank of Shubenacadie River, a section of predominantly grey-black, micaceous, shaly sandstone with some layers of soft grey shale has been exposed for a distance of about a half mile. The complex system of faults that cuts these rocks renders measurement of the section useless, but one can visualize from the general contorted attitudes of the strata just how great must have been the compressive forces that affected the region.

Horton rocks exposed along the various streams draining south into Stewiacke River consist of typical conglomerates, sandstones, and shales similar to those encountered elsewhere in the area. That repetition of strata occurs is indicated by the numerous faults with general east-west trends and unknown displacements displayed on Putnam Brook.

The gold-bearing Horton conglomerate on McLean Brook, north of Coldstream, deserves special mention. Attention was first drawn to this area in 1862 when the conglomerate was found to contain fossil placer gold. The rock in the area attains a maximum thickness of about 50 feet and has

been traced for some 6 miles. It outcrops in a narrow band along the base of a ridge composed of Halifax slates rising some 150 feet above the Carboniferous rocks.

The conglomerate, of a peculiar dull-brown colour, is composed principally of detritus derived from the Halifax formation and overlies that formation with marked angular unconformity. It is composed of rounded pebbles of slate, quartz, and quartzite, ranging in size from that of a walnut to that of an egg with occasional more angular fragments up to several inches in diameter. The matrix consists of a mixture of quartz, slate, and quartzite. The individual pebbles exhibit a rough orientation of 40 degrees east of south with the lighter end of the pebble to the northwest, thereby indicating a general northward course for the streams that deposited the conglomerate. The source rocks were evidently the uplifted igneous and metamorphic rocks that lay to the south in pre-Mississippian time. During the interval of time between the late Devonian orogenies and the incursion of the Windsor seas, the Horton conglomerate was laid down as a piedmont and/or intermontane deposit. The greatest amount of gold is found in the matrix and as a coating on pebbles at the base of the conglomerate, but gold is also found concentrated in crevices in the underlying slate. The gold was probably derived from auriferous quartz veins that cut the gold-bearing Meguma group to the south.

Age. The Horton is the oldest Carboniferous group in Nova Scotia, and is of lower Mississippian age. Within the limits of the map-area, the abundance of *Lepidodendron* cf. *corrugatum* in the rocks just described is sufficient evidence to correlate them with strata of the Horton group at Windsor, just west of the Kennetcook map-area, described by Bell (1929, pp. 30-45).

Spore analyses of coal samples from prospects in Horton rocks, a mile north of East Gore and a mile west of Roulston Corner indicate that at least the strata containing the coal seams are of lower Mississippian (Horton Bluff) age[1].

Windsor Group

The Windsor group, of late Mississippian age, consists of a series of soft, marine, sedimentary rocks outcropping over about two thirds of the map-areas. Normally, basal Windsor beds conformably overlie rocks of the Horton group, with little if any evidence of an erosional break. In the greater part of the area, however, the Horton group does not appear, and

[1] Analyses by P. Hacquebard, of the Geological Survey of Canada. Personal communication.

Windsor strata apparently form part of a marginal basin succession, resting directly with marked angular unconformity upon the slates and quartzites of the pre-Carboniferous Meguma group.

In the adjoining map-area to the north, Weeks (1948, p. 19) recognized five formational units in the Windsor. Bell (1929, p. 46), in Windsor map-area, divided the Windsor into two major zones, each consisting of a number of subzones with its own peculiar fauna. Bell's succession, in descending order, is as follows:

Upper Windsor
- Subzone E
- Subzone D
- Subzone C

Lower Windsor
- Subzone B
- Subzone A

Crosby (1951), in Wolfville map-area which adjoins Kennetcook map-area on the west, separated the Windsor into three mappable units. The present writer, although in agreement with Bell's more detailed division, was unable, owing to lack of outcrop, to adopt his zonation for mapping in the Kennetcook-Shubenacadie areas. For this reason, the classification as worked out by Crosby has been adopted. It is, in descending order:

Windsor Group (undivided)

Grey and black limestone, red and green shales, gypsum and anhydrite, minor sandstone, salt.

Pembroke Formation

Red, unfossiliferous limestone and limestone-conglomerate.

Macumber Formation

Sandy, laminated, unfossiliferous grey and black limestone.

Macumber Formation

Distribution and Lithology. The name Macumber was first proposed by Weeks (1948, p. 20) for a grey, laminated, sandy limestone which conformably overlies the sandstones and shales of the Horton group. The Macumber may readily be distinguished from other marine limestones of Windsor age by its lack of fossils and the layers of fine sand and silt between those of limy material. It is overlain, with evidence of a slight erosional break, by red limestone-conglomerate of the Pembroke formation.

Macumber limestone was recognized at only three localities, all in Kennetcook map-area. In areas where Horton rocks are present and the Macumber limestone that should overlie them is absent, the latter either was not deposited or else has been entirely removed by erosion or faulting.

Typical Macumber limestone outcrops on Whale Brook, just north of the road bridge, at the base of the block of Windsor sedimentary rocks previously referred to. The rocks there have been contorted and slightly sheared and the contact with the underlying Horton is not exposed. Many years ago pits were dug along the west bank of the brook in search for manganese, and some ore was removed. The workings, now completely caved in, are on a hill just east of the brook and approximately 250 feet north of the highway. The Macumber there is estimated to be about 20 feet thick.

A few fragments of Macumber limestone were found scattered about the old workings of the Hibernia manganese mine to the east, but no exposures were found.

The best exposures of Macumber limestone are found on Fivemile River, just south of the railway and a half mile east of Burtons. There the grey-black, sandy, laminated limestone is exposed in the creek bed, conformably overlying reddish shales and sandstones of the Horton group. The estimated thickness of the Macumber at this point is about 25 feet, and it is in turn overlain by red limestone-conglomerate of the Pembroke formation, the base of which is composed mainly of angular fragments of Macumber limestone.

The absence of the Macumber limestones in Shubenacadie map-area may be due to the area being covered by later marine rocks deposited in the Windsor sea, which spread out over the original basin in which the Macumber was deposited.

Age. The distinctive lithological characteristics of the Macumber formation, coupled with a complete lack of fossils, is sufficient evidence to correlate it with the lowermost Windsor rocks, or subzone A, as described by Bell (1929, p. 45). Crosby (1952) mapped the Macumber formation in the adjoining map-area to the west and Weeks (1948, pp. 20-21) in the adjoining area to the north. The present writer (1957) described in detail the various occurrences of the Macumber in Truro map-area.

Pembroke Formation

Distribution and Lithology. The Pembroke formation, consisting of red limestone-conglomerate composed mainly of angular fragments of Macumber limestone, was recognized at only three localities, all in Kennetcook map-area.

The Pembroke formation was named and described by Weeks (1948, p. 21) as a red to grey-brown limestone-conglomerate, with lesser amounts

of calcareous sandstone and mudstone. It disconformably overlies the laminated limestone of the Macumber formation and is in turn conformably overlain by red shales, limestones, and calcium sulphate beds of later Windsor age.

The best-exposed section of Pembroke conglomerate in Kennetcook map-area is on Fivemile River, a mile southeast of Latties Brook. There a northeast-striking band of typical red Pembroke conglomerate, several tens of feet thick, has been cut through by the river. The band of conglomerate is believed to extend southeast for about a mile where it is terminated by a probable fault. The formation, which forms part of the south limb of a syncline, extends northeast along Fivemile River to the vicinity of South Maitland in Truro map-area.

Poorly exposed outcrops of Pembroke conglomerate occur on Whale Brook, in the extreme northwest corner of Kennetcook map-area. Boulders of the conglomerate found in the vicinity of the Hibernia manganese mine are thought to prove the eastward extension of the band of Pembroke traced by Crosby (1952) in the adjoining map-area to the west.

No outcrops of Pembroke were found along the Horton-Windsor contact elsewhere in the map-areas. The limestone-conglomerate, if originally present, has been either removed by erosion or faulting, or covered by drift. On the other hand, the conglomerate, if originally deposited as a basal formation of the lower Windsor group, may have been covered by sediments deposited from recurrent floodings of the depositional basin by the Windsor seas.

The lithology of the Pembroke formation will be but briefly described; for detailed descriptions, the reader is referred to the work of previous writers (Weeks, 1948, p. 22; Stevenson, 1954, pp. 100-106.) Information is not available to determine the thickness of the formation in Kennetcook map-area. Weeks (1948, p. 22) gave it a thickness of 115 feet and Crosby (1951, p. 94) an estimated thickness of 100 feet. The present writer believes the latter figure to be nearer the maximum than the minimum thickness in the Kennetcook map-area.

The basal part of the Pembroke formation consists primarily of angular fragments of Macumber limestone, up to a foot in diameter, cemented by a matrix of red, calcareous shale. A few pebbles of vein quartz, sandstone, and red shale are generally visible in the matrix. The conglomerate grades upwards into soft, red, calcareous mudstones and shales, which in places assume a mottled reddish green effect.

Origin and Age. The basal beds of the Pembroke conglomerate are composed almost entirely of fragments of the underlying Macumber limestone. The upper beds contain relatively more foreign material, apparently derived from the older Horton sediments and the gold-bearing Meguma group to the south. The manner in which the upper beds of the Macumber limestone were brecciated is puzzling, but it has been suggested that it resulted from severe tectonic movements of the sea floor accompanied by rapid burial with little or no transportation of the angular limestone fragments (Stevenson, 1957).

The Pembroke formation is unfossiliferous, but its stratigraphic position leaves little doubt as to its early Windsor age. Bell (1929, p. 46) placed the formation in subzone A of the Windsor group.

Undivided Windsor Rocks

Undivided Windsor sedimentary rocks consisting of calcium sulphate beds, rock salt, red shale, limestone, and minor sandstone comprise the Windsor succession exposed in the map-areas. Bell (1929, p. 46) divided the Windsor into two zones, an upper zone characterized by *Martinia galataea* Bell and a lower zone characterized by *Composita dawsoni* Hall and Clarke. The presence of sedimentary rocks of both upper and lower Windsor ages was proved by a series of fossils collected from various localities within both Shubenacadie and Kennetcook map-areas, but outcrops are so few that a sedimentary sequence could not be established. For this reason, no attempt has been made to separate the Windsor group into upper and lower zones on the accompanying maps.

The best sections of Windsor rocks are exposed along Shubenacadie River, but the strata are so folded and faulted that their thickness cannot be properly measured. Strata that normally overlie beds of calcium sulphate have invariably been severely contorted by the expansion of the anhydrite upon its conversion to gypsum when ground water is added.

With the probability of considerable error, the maximum thickness of undivided Windsor strata in the map-areas is estimated to be not less than 1,400 feet.

In the nearby Windsor map-area, Bell (1929, p. 45) recognized four and possibly five distinct stages of calcium sulphate deposition, separated by beds of red shale and limestone. He estimated calcium sulphate to constitute 20 per cent of the total volume of Windsor sedimentary rocks, the rest being red shale, 55 per cent, and calcareous beds, 25 per cent.

Lack of outcrop in Kennetcook and Shubenacadie map-areas prevents any comparison of respective volumes, but as environmental conditions were probably approximately the same throughout the entire Windsor-Kennetcook-Shubenacadie basin during Windsor time, a proportion similar to that estimated by Bell is postulated.

Rock salt was not seen in an outcrop, but was found near the village of Kennetcook in 1945 when drilling for oil. About 140 feet of salt of various degrees of purity were cut by the drill at depth of about 1,300 feet. As the dip of the strata is not known, the true thickness of the salt could not be determined. Numerous brine springs are present, particularly in Kennetcook map-area.

MARINE LIMESTONES

Marine limestones, varying from thin-bedded, shaly, arenaceous, grey, unfossiliferous limestone to granular, massive, grey to black, highly fossiliferous limestone outcrop throughout the map-areas in those parts underlain by Windsor sedimentary rocks. The inherent soft nature of the limestone results in widely separated outcrops, and close-folding, overturning, faulting, and brecciation render interpretation of structures and correlation of outcrops indefinite and in many instances impossible. Only isolated exposures of the thicker beds of limestone provided worthwhile fossil collections. As previously mentioned, the beds of red shale and gypsum and anhydrite are mainly unfossiliferous.

Fossils were collected in an attempt to correlate the different outcrops. These collections were later examined by W. A. Bell and Peter Harker of the Geological Survey of Canada, and the results of their investigations are listed herein. In general, individual specimens were very poorly preserved, and only a few collections yielded a sufficient number of diagnostic species for the age relationships to be accurately determined.

Lower Windsor Limestones. In general, lower Windsor limestones consist of two main types: a partly dolomitic, black and red, massive, extremely fossiliferous limestone, and a grey to black, well-bedded, fossiliferous, often fetid-smelling limestone. Fossils are mostly well preserved in the first type, but generally poorly preserved in the latter. The latter type also characteristically weathers to a buff in exposed outcrops, and commonly contains shaly layers. Lower Windsor limestones of both types may or may not be underlain and/or overlain by beds of calcium sulphate or red shale. The limestones have almost invariably been faulted and folded subsequent to consolidation.

61511-2—3

Fossils from a few of the best-exposed outcrops of lower Windsor limestones are listed below.

G.S.C. Loc. Cat. No. 24846

Locality: Quarry ½ mile northwest of Admiral Rock

Fossils: *Linoproductus lyelli* (Verneuil)
Linoproductus dawsoni (Beede)
Composita dawsoni Bell
Dielasma sp.
Diodoceras sp.

Age: Lower Windsor, subzone B

G.S.C. Loc. Cat. No. 24850

Locality: Branch of Field Brook, Brookfield-Middle Stewiacke road

Fossils: *Productus* aff. *P. subfasciculatus* Bell
Platyschisma dubium Dawson
Edmondia sp.
Diodoceras ? sp.
Composita sp.
Pelecypods indet.

Age: Lower Windsor, probably subzone B

G.S.C. Loc. Cat. No. 24859

Locality: Quarry on Shubenacadie River, east of Admiral Rock

Fossils: *Linoproductus lyelli* (Verneuil)
Dielasma sp.
Composita sp.
Polypora schucherti ? Bell

Age: Lower Windsor

G.S.C. Loc. Cat. No. 24860

Locality: Anthony's Nose, Shubenacadie River

Fossils: *Composita windsorensis* Bell
Composita dawsoni (Hall and Clarke)
Dielasma latum Bell
Dielasma davidsoni (Hall and Clarke)
Pugnax dawsonensis ? (Davidson)
Linoproductus lyelli (Verneuil)
Productus sp.
Parallelidon dawsoni Beede

Age: Lower Windsor, subzone B

G.S.C. Loc. Cat. No. 24847

Locality: Quarry 1½ miles east of south tip of Shortt Lake

Fossils: *Linoproductus lyelli* (Verneuil)
Diaphragmus tenuicostiformis (Beede)
Composita dawsoni Bell
Composita sp.
Sanguinolites sp. ?
Polypora cf. *P. schucherti* Bell
Straparollus ? sp.
Diodoceras sp.

Age: Lower Windsor, subzone B

G.S.C. Loc. Cat. No. 24856

Locality: Glenmore quarry near Middle Musquodoboit

Fossils: *Aviculopecten lyelli* ? Dawson
Dielasma sp.
Septopora ? sp.

Age: Probably lower Windsor

G.S.C. Loc. Cat. No. 24851

Locality: West bank of Shubenacadie River, a mile north of Admiral Rock quarry

Fossils: *Linoproductus lyelli* (Verneuil)
Composita sp.
Dielasma sp.
Fenestella sp.
Pelecypods indet.

Age: Probably lower Windsor

G. S. C. Loc. Cat. No. 24849

Locality: Parker Brook, ¾ mile northeast of North Salem

Fossils: *Linoproductus lyelli* (Verneuil)
Composita dawsoni (Hall and Clarke)
Pseudamusium simplex Dawson
Polypora schucherti Bell
Diodoceras avonensis (Dawson)

Age: Lower Windsor, subzone B

Upper Windsor Limestones. Marine limestones of proven late Windsor age outcrop over a large part of the Kennetcook map-area underlain by Windsor strata. The best-exposed outcrops are along the banks of Herbert

61511-2—3½

River and a few of its tributaries. Kennetcook River also flows over rocks of late Windsor age for at least part of its length. Many of the limestones outcropping along Shubenacadie River are also of late Windsor age.

Very little is known of the bedrock in that part of the area immediately east of Shubenacadie River and north of Stewiacke River, apart from the fact that the greater part is floored with strata of Windsor age. Evidence gleaned from a few scattered outcrops indicates the structure to be a broad anticline plunging to the east, with the axis running easterly from the vicinity of Urbania through Shortt Lake. Limestones of early Windsor age are exposed in an abandoned quarry 1½ miles east of the south tip of Shortt Lake, and limestone of late Windsor age outcrops near Forest Glen. The steeply dipping strata at the latter locality indicate severe folding, and the structure in this area may be extremely complicated.

Representative fossils collected from several of the better-exposed outcrops are:

G.S.C. Loc. Cat. No. 28283

Locality: Quarry on farm of Albro Miller, 2¼ miles northeast of Hines Lake

Fossils: *Productus* cf. *P. spinocardinata* Bell
Buxtonia ? sp.
Martinia sp.

Age: Upper Windsor, probably subzone D or E
(*see also* Weeks, 1948, p. 26)

G.S.C. Loc. Cat. No. 24858

Locality: West bank of Shubenacadie River, 2 miles southeast of Urbania

Fossils: *Ambocoilia acadia* Bell
Martinia galataea Bell
Productus semicubiculus Bell
Productus sp.

Age: Probably upper Windsor

G.S.C. Loc. Cat. No. 24857

Locality: Barney Brook, about 2,500 feet south of bridge on Hardwood Lands road

Fossils: Pelecypod indet.
Girvanella-like concretions

Age: Possibly upper Windsor

G.S.C. Loc. Cat. No. 24852

Locality: East bank Shubenacadie River, ½ mile west of sawmill on road 3 miles south of Greens Creek

Fossils: *Linoproductus semicubiculus* Bell
Age: Upper Windsor, probably subzone D

G.S.C. Loc. Cat. No. 25796
Locality: Herbert River, ½ mile west of bridge on road that passes railway station a mile southeast of Scotch Village

Fossils: *Tabulipora acadica* Bell
Linoproductus lyelli (Verneuil)
Productus avonensis Bell
Buxtonia cogmagunensis Bell
Martinia galataea Bell
Camarotoechia atlantica Bell
Crinoid stems
Algae ?
Age: Upper Windsor, probably subzone E

G.S.C. Loc. Cat. No. 24854
Locality: East bank of Shubenacadie River, 300 yards south of Anthony's Nose
Fossils: *Productus avonensis* Bell
Spirifer nox Bell
Streblotypa sp.
Age: Upper Windsor, probably subzone E

G.S.C. Cat. No. 24855
Locality: Bridge over creek ½mile south of Greens Creek
Fossils: *Productus subfasciculatus* ? Bell
Pelecypods indet.
Age: Probably upper Windsor

G.S.C. Loc. Cat. No. 25794
Locality: Limestone quarry on railway, opposite mouth of Philip Brook
Fossils: *Schuchertella pictoense* Bell
Linoproductus lyelli (Verneuil)
Productus avonensis Bell
Buxtonia cogmagunensis Bell
Martinia galataea Bell
Age: Upper Windsor, probably subzone E

G.S.C. Loc. Cat. No. 25797
Locality: Herbert River, ¼ mile east of river bridge, ¼ mile north of Woodville

Fossils: *Linoproductus lyelli* (Verneuil)
Productus subfasciculatus ? Bell
Martinia galataea Bell
Linoproductus semicubiculus Bell
Productus tenuicostiformis Beede
Buxtonia cogmagunensis ? Bell
Sanguinolites striatogranulatus ? Hind
Spathella insecta (Dawson)
Age: Upper Windsor, either subzone C or D

G.S.C. Loc. Cat. No. 28292
Locality: Hennigar Brook, ¾ mile upstream from mouth of brook
Fossils: *Productus avonensis* Bell
Productus cf. *P. semicubiculus* Bell
Pugnax sp.
Composita sp.
Martinia cf. *M. galataea* Bell
Age: Upper Windsor, probably subzones D or E

ROCK SALT

Numerous salt springs in Kennetcook map-area early led to a controversy regarding the presence of salt deposits of economic value. In 1928 an examination was made of the Windsor basin to determine the possibility of establishing a potash and/or sodium chloride industry. Detailed work was carried out on Kennetcook and Shubenacadie map-areas by W. J. Wright (1930), and numerous brine springs were sampled. Results were more or less inconclusive, but an appreciable thickness of rock salt was believed to be present in Kennetcook map-area.

Wells drilled near Kennetcook since 1945 in a search for oil encountered impure salt beds at a depth of about 1,100 feet. At a depth of 1,365 feet, 28 feet of salt carrying up to 88 per cent NaCl was cut by the drill. The true thickness of this bed is unknown. In 1955 a well drilled for water near the high-school encountered only brackish, salty water unfit for human consumption.

Most of the salt springs issue from rocks of the Scotch Village formation which normally overlies marine Windsor strata. As elsewhere in Nova Scotia, salt does not normally occur in rocks of Pennsylvanian age.

The inference is that the salt springs originate in salt beds in the underlying Windsor strata. As proven elsewhere in the Windsor basin, most of the salt springs originate in the lower measures of the Windsor group, particularly in Bell's subzone A (Bell, 1929).

The only known brine spring in Shubenacadie map-area is near Otter Brook. Years ago, the local residents reportedly cured meat by hanging it in a well dug at the exit of the spring.

RED SHALES

Red shales form an estimated 55 per cent of all the undivided Windsor rocks in the map-areas. Although a rhythmic repetition of red shale, gypsum and anhydrite, and limestone is normally found, red shales may be lacking in any particular section. Patches of greyish green shales may on occasion be interlayered with the red shales, generally in narrow bands following joint planes. Whereas the inherent red colour is caused by a coating of hematite on individual grains, the grey or green colour is believed to be due to post-depositional reduction of the ferric iron to ferrous iron.

Red shales are remarkably uniform in grain size and composition. Most exposures are in stream beds and debris is rarely seen, owing to the inherent softness of the rocks which causes the exposures to wear away gradually with the resulting debris being transported away by the flowing water for deposition elsewhere.

Bedding is pronounced in the red shale beds, but it is visible more as a variation in colour than in grain size. Crossbedding is commonly present, and some beds show well-formed ripple-marks. Many of the shale beds are highly jointed and fractured. In thin section hematite is seen both as a coating on individual grains and as an interstitial filling.

Red shale beds in the map-areas are notably devoid of fossil plants or animals. The interlayered calcium sulphate beds are evidence of recurrent periods of salinity adverse to the existence of animal life. During deposition of the red beds, the extreme muddiness of the water would also be detrimental to both animal and plant life.

The ripple-marks indicate that the red shales were probably deposited in shallow water, and the fact that beds of calcium sulphate are interbedded with the red shales indicates a warm, semi-arid climate during their deposition.

That they are a part of the Windsor group is clear from the presence above and below of limestones bearing fossils of that age. The best-exposed sections of red shales are along Fivemile River where it parallels the railway, and along the tributaries which enter Fivemile River from the north. Unsatisfactory sections are exposed at several localities along Shubenacadie River.

CALCIUM SULPHATE BEDS

In both Kennetcook and Shubenacadie map-areas beds of anhydrite and gypsum outcrop more or less at random throughout much of the area underlain by Windsor sedimentary rocks. Owing to a more extensive drift mantle, karst topography is not as well developed as in the Londonderry and Bass River map-areas to the north and the individual beds of calcium sulphate could not be delineated accurately enough for detailed mapping.

A classification of the various types of calcium sulphate deposits is given by Bell (1929, pp. 81-82). Later Goodman (1952) carried out a comprehensive study of Nova Scotia's gypsum deposits, and, in agreement with Bell, concluded that the larger part of Nova Scotia's calcium sulphate deposits were precipitated from a concentration of sea-water in lagoons that were rhythmically replenished with marine waters. From a study of calcium sulphate deposits in the Truro, Shubenacadie, and Kennetcook map-areas, the writer is in agreement with Goodman regarding the origin of the gypsum deposits in this part of the Windsor basin.

Thickness. Owing to their lenticular nature and contorted attitudes, individual beds of calcium sulphate vary greatly in thickness over short distances. That several of the beds are at least 100 feet thick has been proved by excavations in quarries at Walton and Dutch Settlement. At Kennetcook, about 300 feet of gypsum was cut by the drill, but the bed may be severely folded and the true thickness much less. At least 100 feet of anhydrite and gypsum are exposed in a cliff along Fivemile River. Near Urbania a well was sunk through 125 feet of gypsum in a search for water.

Distribution and Age. Gypsum quarries have been in operation for almost a century but tremendous tonnages of marketable gypsum are still available.

Normally the red limestone-conglomerate of the Pembroke formation is overlain by a bed of gypsum and anhydrite. This relationship may be best seen along Fivemile River, where the calcium sulphate is about 100 feet thick. The gypsum quarries east of Walton are also opened along this basal gypsum bed. Elsewhere in the area the stratigraphic positions of the calcium sulphate beds are difficult to determine because of a lack of distinctive marker horizons. The greater part of the extensive acreage of gypsum in the southwest corner of the Kennetcook map-area is of upper Windsor age, because it conformably overlies beds of marine limestone rich in fossils of upper Windsor age. In the Shubenacadie map-area, however, fossils from the underlying limestones indicate that most of the calcium sulphate beds are of lower Windsor age.

Karst Topography. This type of topography is well displayed locally in the form of funnel-shaped cavities reaching from the surface down to ground-water level. It is normally best-developed in country underlain by beds of gypsum and anhydrite, but sink-holes may also form in beds of limestone. Readily accessible and excellent examples may be seen in the vicinity of the gypsum quarries east of Walton, along Fivemile River, near the head of West Tennycape River, and at the Dutch Settlement gypsum quarry. At the last-named locality the glacial debris has been stripped from the gypsum, exposing a typical karst surface that has been smoothed by glacial action (*see* Plate III A).

Scotch Village Formation

Distribution. The Scotch Village formation was named and described in detail by Crosby (1952) as a buff weathering, light blue-grey, medium-grained, feldspathic sandstone conformably overlying Windsor sedimentary rocks in the Avon River district immediately west of and adjacent to Kennetcook map-area. The present writer was able to trace the Scotch Village formation eastward to the vicinity of Doddridge in Kennetcook map-area, where it is in the form of a shallow syncline that gradually increases in width eastward to an estimated 11 miles at the western border of the map-area. The top of the formation is not exposed, but drilling carried out at Kennetcook in a search for oil indicates Scotch Village strata with a total thickness of 800 feet. On Tomcod River an estimated 1,200 feet of strata are exposed.

The boundaries of the formation are almost everywhere obscured by drift. The best sections are found along Cogmagun and Tomcod Rivers, and on the upper reaches of Walton River. Owing to lack of relief, much of the area is marshy and boggy. It is possible that patches of Scotch Village strata were removed by normal erosion in preglacial time and that the bogs, particularly those containing pools of water in karst-like depressions, were formed in post-glacial time by solution of the underlying Windsor sedimentary rocks. This, however, is pure supposition as bedrock is nowhere exposed in the vicinity of the bogs, and they may be due entirely to poor drainage.

Numerous salt springs occur in regions underlain by the Scotch Village formation. These springs, which have for the most part a typical brackish, gypsiferous taste, evidently originate in the underlying marine Windsor strata and reach the surface via fractures in the overlying Scotch Village rocks.

A shallow syncline of sedimentary rocks, probably of Scotch Village age, occurs in the central part of Shubenacadie map-area. No palæontological evidence was found to correlate these rocks with the Scotch Village formation, but lithologically they are very much alike. As in Kennetcook map-area the boundaries are not exposed, but the rocks appear to lie conformably on upper marine strata of Windsor age.

Lithology. The most striking feature of the Scotch Village formation is the peculiar buff weathering found on practically all outcrops to a depth of several inches. The rock is in general very porous and friable, and readily crumbles under the hammer. Sandstone makes up about 80 per cent of most outcrops and the remainder consists of red and grey shales and siltstone. The sandstone is very even grained, cross-laminated, friable, buff weathering, grey to brown, and well bedded. Several outcrops on Tomcod River show bands of hematite up to a quarter inch thick. Some beds contain abundant plant remains, most of which are poorly preserved. Coaly bands up to 2 inches thick in the bed of Kennetcook River east of Stanley were found to be lens-shaped, pinching out after a few feet. Pyrite is generally present in the coaly layers. Individual sandstone beds rarely exceed 10 feet in thickness, and individual laminae are mostly less than 2 inches thick.

The exposed shales are very fine grained and may be green, red, grey, or mottled red and green. They are soft, easily fractured, and most are interlayered with the sandstones. Plant remains are common in the Scotch Village shales, a fact that serves to distinguish them from similar shales of Windsor age.

Under the microscope the sandstone is found to consist mainly of well-sorted, medium-sized quartz grains with up to 20 per cent of fresh plagioclase feldspar. The individual grains are mostly subangular to subrounded. Fragments of chert and quartzite form possibly 2 per cent of the sections examined. Iron oxide, abundant in a few of the specimens and readily seen in hand specimens, imparts a pepper-and-salt appearance to a few of the outcrops. Calcite was recognized as scattered grains in some of the sections examined, but did not constitute any part of the cementing material.

Conglomerate, composed of a heterogeneous mixture of well-rounded pebbles of red shale, quartzite, quartz, feldspar, jasper, and fossiliferous limestone, outcrops in narrow bands on Cayley and McLean Brooks, and on one of the tributaries of the north fork of Walton River. The fossils, consisting of poorly preserved brachiopods and fragments of crinoid stems, occur in limestone pebbles of probable Windsor age. The conglomerate is

believed to represent the basal part of the Scotch Village formation from which the overlying beds have been stripped by erosion. The conglomeratic band is probably less than 30 feet thick.

Structural Relations. Structurally, the Scotch Village sandstone apparently conformably overlies the marine sedimentary beds of the Windsor series. Dips are commonly gentle, rarely exceeding 25 degrees. According to Crosby (1951) the contact between the Scotch Village sandstone and the Windsor sedimentary rocks is gradational, but no normal contacts between the two formations were found in Kennetcook or Shubenacadie map-area.

The sandstones are well bedded, with prominent cross-lamination. Channelling is a common feature. Along Cogmagun River the sandstones are highly jointed and in places slickensided, whereas on Walton River they are relatively undisturbed. Numerous current ripple-marks in the sandstones and shales indicate deposition of the sediments by currents flowing north and northwest.

Origin and Age. That the Scotch Village formation originated by fluviatile deposition is apparent from the accumulated evidence of cross-lamination, current ripple-marks, and channelling phenomena. The sandstones are well sorted, contain abundant plant remains, and are but little oxidized. Therefore, they were not subjected to intensely oxidizing conditions or deposited by torrential currents. The evidence favours deposition in a fluviatile environment supplied with a plentiful, but not torrential, rainfall.

Although plentiful, plant remains are not well preserved, and no specimens diagnostic of a definite age were found. The plant remains recognized were:

Calamites sp.
Neuropteris sp.
Calamites suckowi Brongniart
Cordaites principalis (Germar)

The stratigraphic position of the Scotch Village formation suggests that it forms part of the Canso group, of late Mississippian age. The buff weathering sandstone and fossiliferous limestone members are, however, lithologically unlike any Canso rocks so far recognized elsewhere in Nova Scotia. The combination of *Cordaites, Neuropteris,* and broad-ribbed *Calamites* is not indicative of the Canso group, but rather of the Riversdale group, of early Pennsylvanian age. According to Bell,[1] a conglomerate identical in appearance to that found at the base of the Scotch Village formation is found at the base of the Riversdale group elsewhere in Nova Scotia.

[1] Personal communication.

The writer observed a narrow band of limestone-conglomerate identical to that herein described about a mile upstream from the mouth of Calvary Brook, in Truro map-area, where the rocks are believed to be of early Riversdale age.

Available evidence thus favours an early Pennsylvanian age for the Scotch Village formation, and suggests that it should be correlated with the Riversdale group rather than with the Canso.

Annapolis Formation

Conglomerates and sandstones of the Annapolis formation occur in a narrow band on the south shore of Minas Basin, in the extreme northwest corner of Kennetcook map-area.

Lithologically the Annapolis sedimentary rocks grade from coarse conglomerates with boulders several feet in diameter to fine-grained sandstones that are strongly crossbedded. The brick-red to brownish red colour is peculiar to the Triassic rocks that border Minas Basin, and which have been described elsewhere (Weeks, 1948, p. 30).

The angular unconformity between the Annapolis formation and the underlying Horton sedimentary rocks is well exposed on the shore of Minas Basin a few hundred feet east of the mouth of Whale Brook, where the steeply dipping Horton sandstones and shales are overlain by the gently northward-dipping conglomerates and sandstones of the Annapolis formation. Immediately above the contact the constituents of the younger formation may be traced directly to the underlying Horton rocks. Farther above the contact, pebbles of quartzite, probably derived from the Meguma group to the south, form a large part of the content. The constituent grains are cemented by a mixture of calcite and iron oxide.

Because of its distinctive colour and lithological characteristics, the Annapolis formation in the map-area can readily be correlated with Triassic sedimentary rocks that occur along Minas Basin in adjoining map-areas.

Cretaceous Deposits

Distribution. In the vicinity of the villages of Middle Musquodoboit and Shubenacadie, stratified layers of clay, sand, silt, and lignite, rich in concretionary iron pyrite, outcrop at several points. The areal extent of the deposits is not known, but at Middle Musquodoboit the clay outcrops for at least 7 miles along the valley of Musquodoboit River. The upper surface of the clays is very uneven, and as a result is encountered at different levels by the drill; only in a few places does the clay outcrop. The original upper surface of the clays was probably eroded to a considerable depth prior to

the deposition of the overlying glacial material, and much of the unconsolidated material was undoubtedly scoured off by the advancing ice-sheet.

The individual deposits are described elsewhere in this report (pp. 69, 70).

Age. Several macerations were made of samples from a layer of lignite interbedded in the clay exposed in a pit at Shubenacadie and pollen and spore analyses were made by P. Hacquebard and J. Terasmae of the Geological Survey of Canada. In addition, several specimens from the same locality were forwarded to Dr. R. A. Scott of the United States Geological Survey for examination. Microscopic examinations of the macerations yielded information as follows:

The coal samples contained a fair-sized, well-preserved assemblage of gymnospermous pollen and spores, among which the following were identified:

Appendicisporites
Cicatricosisporites
Monosulcites (cf. *Ginkgo*)
Abietineaepollenites
Schizaeaceae cf. *Lygodium*
Podocarpaceae cf. *Podocarpus* and others
Cycadophyte pollen

Pollen from various coniferous trees predominate (*Podocarpus*-type, *Picea,* Taxodiaceae, *Taxodium, Pinus, Pityosporites*). Next in abundance are trilete spores (*Deltoidospora, Gleichenia,* etc.). Several spores, resembling *Tasmanites* were found, as well as scattered spores of: *Osmunda, Laevigatosporites, Raistrickia ?*. One pollen grain of *Cycadopites* and one of *Ephedra* were noted. Fragments of woody tissues are abundant, particularly tracheid cells with bordered pits. A few scalariform tracheids are present. An important feature is the absence of spores of Palæozoic plants, indicating that the lignite is definitely not of Carboniferous age.

According to Scott and Terasmae, the lignite is definitely of Cretaceous age. Its Cretaceous aspect stems from the presence of schizaeaceous genera such as *Cicatricosisporites* and *Appendicisporites.*

The occurrence of *Appendicisporites* is of special significance, as this genus is known only from the Cretaceous. In Europe it has been found in the Lower Senonian of Germany and Wealden of England. In United States the form has proved to be a reliable index for Upper Cretaceous age. However, the complete lack of angiosperm pollen in the Shubenacadie specimens, which contain schizaeaceous ferns, suggesting warm temperature climatic conditions, is indicative of a Lower Cretaceous age.

Ries (1911, p. 87) noted a striking similarity between the Shubenacadie clays and clays of Cretaceous age found in New Jersey.

Pleistocene Deposits

The area is everywhere mantled by glacial debris, consisting primarily of boulder clay. The thickness of the mantle varies from a few inches on the tops of ridges in the upland areas to more than 250 feet in the lowland areas. Deposits of glacial gravels of fluvial origin are scattered throughout the lowland areas. The extensive deposits of sand in the district immediately south of the Shubenacadie Indian Reserve are evidently of the outwash type, and the position of foreset beds indicates that the sand was deposited by east-flowing streams that emptied into Shubenacadie River (*see* Plate III B).

Glacial striae are plentiful on the resistant ridges of the upland areas, particularly on the quartzite beds of the Goldenville formation, but are lacking on the less competent Carboniferous rocks. The general movement of the ice was 30 degrees east of south, with local variations. A few well-rounded erratic boulders of syenite and granite, probably derived from the Cobequid Mountains to the north, are scattered haphazardly throughout the area. Numerous rounded fragments of dark coloured trap rock, similar in appearance to that found on Economy Mountain north of Cobequid Bay, may be found in many of the stream beds in the southwest corner of Kennetcook map-area.

During stripping operations at the Dutch Settlement gypsum quarry in 1954, numerous fragments of well-preserved spruce branches were collected from near the base of the glacial till, which in this vicinity is about 40 feet thick. Subsequent carbon datings on the specimens, carried out by the Nova Scotia Research Foundation, indicated an age for the wood of not less than 18,000 years.

Chapter III

STRUCTURAL GEOLOGY

Kennetcook and Shubenacadie map-areas are a part of the Appalachian folded belt, and as such have been subjected to at least three major periods of orogeny. The quartzites and slates of the Meguma group are characterized by high-angle faults, tight folds, and low-grade metamorphism, whereas rocks of the Horton, Windsor, and Riversdale groups are, in general, more openly folded and unmetamorphosed. The Triassic rocks are relatively flat lying and undisturbed.

Unconformities

A marked angular unconformity exists between the quartzites and slates of the Meguma group and the overlying younger Mississippian sedimentary rocks. In Kennetcook map-area this contact may be examined on Glen, McInnis, and McLean Brooks, where black slates of the Halifax formation are unconformably overlain by conglomerates, grits, and sandstones of the Horton group (*see* Plate V). In Shubenacadie map-area the unconformable contact between the Halifax slates and basal Horton conglomerate is well exposed at the Gays River gold workings near Coldstream (*see* Plate II A).

Over the greater part of the map-areas the Meguma group is unconformably overlain by sedimentary strata of the marine Windsor group. Due to the inherent soft nature of the latter the actual contact is but rarely exposed. The angular discordance between the black, fractured slates of the Halifax formation and the overlying limestones, shales, and gypsum of the Windsor group is best seen at Southvale, near the extreme eastern limit of Shubenacadie map-area.

Horton rocks are normally overlain, with slight disconformity, by Windsor strata, but in many places the original contact has been obscured by faulting. This is so along the Horton-Windsor contact on Glen, McInnis, and McLean Brooks in Kennetcook map-area.

Windsor rocks are overlain, also probably disconformably, by rocks of the Scotch Village formation of Pennsylvanian age, although the actual contact between the two groups was nowhere seen because of the heavy drift mantle.

On the south shore of Minas Basin steeply dipping Horton rocks are overlain, with sharp angular discordance, by flat-lying conglomerates and sandstones of the Annapolis formation of Triassic age (*see* Plate II B).

Folds

Meguma rocks have been flexed into a series of parallel, tight folds that plunge gently to the northeast and southwest. The axial planes of the folds commonly dip at angles varying from 60 to 90 degrees. Subordinate flexures on the limbs of the main anticlines are structurally important because they form the loci for some of the gold deposits. An excellent example of such secondary folding is at Renfrew, where the auriferous veins are along an undulation on a limb of the main fold. The folding is very complex, and is locally complicated by numerous small drag-folds and faults.

In Kennetcook map-area, rocks of the Halifax formation form a parallel series of folds known locally as the Rawdon Hills. Along the north limit of the hills, an anticlinal axis follows the escarpment from near Upper Newport to the vicinity of Gore. The north limit of the fold is covered by Horton strata to within a short distance of the crest. The anticline forms a broad, gently northeast-plunging dome, with its centre just west of Upper Newport.

The central part of the Rawdon Hills has been closely folded into a parallel series of anticlines and synclines that plunge gently northeast beneath the Horton sedimentary rocks. The structure in these incompetent slates is extremely difficult to decipher as critical outcrops in interstream areas are scarce. The most striking structural feature is a syncline that traverses the entire length of the Rawdon Hills from southeast of Upper Newport to East Gore, where it is covered by Horton rocks. Less distinct folds are found on either flank of this syncline.

Goldenville strata are, in general, less severely folded than are rocks of the Halifax formation, and individual folds are more open and less deformed. A major anticlinal axis passes just south of Mason Lake and strikes northeast towards Upper Rawdon where it is covered by Windsor sedimentary rocks. The strata on the southwest extension of this fold have been extensively drag-folded in the vicinity of Blueberry Lakes.

Renfrew gold district lies on the south limb of an important anticlinal dome, whose axis runs with a variable northeasterly strike through Story and Three Cornered Lakes and plunges beneath Horton strata near Nine Mile River village. Near the Renfrew gold workings the competent Goldenville quartzites have been warped into a series of minor flexures that radiate from the main fold.

In Shubenacadie map-area the Halifax slates that form Wittenburg Mountain have been preserved in a closely compressed, parallel series of folds, consisting of a gently southwest-plunging anticline flanked on either

side by a well-defined syncline. The plastic Halifax strata have locally been intricately folded into numerous minor flexures. Goldenville strata have been exposed by erosion along the crests of elliptical domes in the vicinity of Ervin Brook and Carroll Corner.

Relative to the Meguma group, Horton and Windsor strata are but little disturbed. Where dips of beds are steep and attitudes contorted, the cause may generally be attributed to local faulting and/or the expansion of gypsum upon its conversion from anhydrite. Regional dips are gentle, rarely exceeding 20 degrees. That some folding did occur between the Mississippian and Triassic is evident, however, from the undisturbed attitude of the Triassic rocks which lie unconformably upon contorted Horton strata along the south shore of Minas Basin. Pennsylvanian rocks in both map-areas also have gentle regional dips, except where disturbed by faults.

Faults

Strata in both map-areas have been extensively faulted, but the topographic expression of the faults is rarely seen because of the covering of glacial debris. The structure in the Carboniferous lowlands is particularly difficult to determine, and only by the absence or repetition of formations or beds may the presence of a fault be determined.

The faults fall into two main systems. The first, of the normal type and generally with left-hand displacement, strikes northwest and dips from about 70 degrees southwest to vertical. The second system strikes northeast and generally dips steeply northwest.

Numerous local, oblique, high-angle, strike, and cross-faults of slight displacements are common in both map-areas, particularly intersecting the Meguma rocks. These minor faults are closely related to the doming of the anticlines and appear to radiate from the centres of the domes. Locally these faults are important as they must be considered when tracing the gold-bearing veins. The homogeneity of most of the Meguma rocks renders the displacement along such faults extremely difficult to determine.

Northwest Faults. In the Kennetcook map-area, strata of all ages have been cut indiscriminately by numerous northwest-striking faults of the first set mentioned above. In the northwest corner of the area, the eastward extension of the Pembroke and Macumber formations has been terminated by a fault with downthrow on the east side. This was observed by Weeks (1948, p. 35) in the adjoining map-area to the north. Near Ray Lake, at the eastern edge of the map-area, the abrupt termination of the same formations just south of the railway and the resulting off-setting of the Horton-Windsor contact can best be explained by an assumed northwest-striking fault, with downthrow on the east side.

61511-2—4

Northwest-striking faults with unknown extensions and displacements most of which are too small to map, were encountered in the underground workings of various gold properties and at the antimony mine at West Gore.

Surface expression of northwest-striking faults of mappable size was not recognized in Shubenacadie map-area. Many such faults must exist, however, because both Shubenacadie and Kennetcook map-areas must have been subjected to approximately the same deformational forces.

Northeast Faults. In Kennetcook map-area Windsor rocks of the Kennetcook River valley are limited on the southeast side against the Rawdon Hills escarpment by a northeast-striking, normal fault. This fault is believed to represent the eastern extension of the Butler Hill fault observed by Bell (1929, p. 12) in Windsor map-area to the west. The fault appears to extend from Meander River to near Georgefield where it seems to be cut off by an assumed northwest-striking fault, and is poorly exposed on Glen, McInnis, and McLean Brooks. The amount of displacement along the fault is not known, but the apparent absence of basal Windsor limestone formations is indicative of downthrow on the north side.

Near Glen, McInnis, and McLean Brooks, a narrow band of Horton rocks has been thrust to the south for an unknown distance over Halifax slates. Individual beds of Horton conglomerates, sandstones, and shales have been repeated as a result of slicing at the time of thrusting, and as the thrust planes dip to the north, it is presumed that the pressure was from that direction. On McLean Brook, the fault does not follow the Horton-Meguma contact, but cuts the Halifax slates a few feet south of the contact, and about 150 feet north of the axis of an anticlinal fold in the slates. The southwest extension of the fault appears on McInnis Brook about 140 feet north of the same anticlinal axis. The eastward and westward extensions of this fault are unknown.

Goldenville strata on Herbert River have been cut by a northeast-striking, right-hand fault of unknown displacement, which approximately parallels Lagoon Brook. This fault is easily recognized in the map-area to the south, but in Kennetcook map-area surface expression is obscured by drift.

In Shubenacadie map-area Horton and younger rocks exposed along the streams draining south into Stewiacke River have been disturbed by numerous northeast-striking faults. The thickness of the overburden on interstream areas coupled with the contorted attitudes of the gypsiferous Windsor strata makes the structure difficult to interpret. Many of the faults cannot be traced from one stream-cut to the next. Immediately north of the Brookfield-Middle Stewiacke road, however, grey-green quartzites and

buff coloured sandstones of typical Scotch Village appearance are believed to be downfaulted against marine Windsor strata by a major fault that strikes slightly north of east.

Numerous strike-faults of minor displacement are exposed in many stream-cuts in the Halifax slates of Wittenburg Mountain.

Cleavage

A regional cleavage has been well developed in the more argillaceous strata of both the Goldenville and Halifax formations. The black fissile slates of the Halifax formation in particular show excellent cleavage.

The cleavage planes generally strike parallel with the fold axes of the rocks and are steeply inclined, rarely more than a few degrees from the vertical. Where the bedding dips at a low angle the rocks, particularly the more competent quartzites, tend to break into rhombohedral blocks.

Poorly developed cleavage is present in some of the more competent beds of the Horton group in areas where the strata have been severely deformed. Rocks of Windsor, Pennsylvanian, and Triassic ages do not display cleavage to any marked degree.

61511-2—4½

Chapter IV

ECONOMIC GEOLOGY

Gold mining has been carried on in Nova Scotia more or less intermittently for almost a century. The excitement aroused by the finding of gold in California and Australia in the middle of the 19th century triggered a search for gold in Nova Scotia. The first authentic discovery in the province in 1858 led to a gradually increasing search for the precious mineral. This search reached a peak in 1900, when the yield was 33,954 ounces. Production then gradually dropped off, the yield in 1921 being only 377 ounces. In the depression years of the late-thirties, unemployment and cheap labour lead to an increase in the gold output, and in 1938, 28,554 ounces were produced. Since that time production has declined steadily and at present is some 3,000 ounces a year.

During the war of 1914-18, the antimony deposit at West Gore was a major producer of antimony in Canada. Small amounts of manganese and barite, of little economic importance, are present in the map-areas. A considerable tonnage of low-grade lead-zinc has been blocked out near Gays River.

The nonmetallic mineral deposits are of considerable potential economic value. One of the largest gypsum quarries in Canada is in operation at Dutch Settlement near Milford Station, and gypsum is quarried on a smaller scale at several other places. Tremendous tonnages of agricultural-grade limestone are readily available; building stones and slates of good quality are abundant; and glacial gravels provide an accessible source of road metal.

The following are descriptions of known mineral deposits of possible economic interest found within the map-areas. Owing to the flooded condition of all underground workings the descriptions of the main gold deposits are mainly compilations of the work of previous writers who had access to the mines while they were in operation. Tribute is paid especially to E. R. Faribault who devoted a large part of his life to a study of the Meguma gold-bearing rocks.

GOLD

References:

Brunton, Stopford: The Gold Deposits of Nova Scotia; a New Hypothesis Concerning the Structural Features of the Province; *Can. Inst. Min. Met.*, Bull. 258 (1926).

Faribault, E. R.: On the Gold Measures of Nova Scotia and Deep Mining; *J. Can. Min. Inst.*, vol. 11, pp. 119-128 (1899).

———: Deep Gold Mining in Nova Scotia. A Report on the Best Methods of Testing the Value of the Deeper Gold Deposits of Nova Scotia; Halifax (1903).

Faribault, E. R.: The Gold Measures of Nova Scotia and Deep Mining; *N.S. Dept. Mines,* Ann. Rept. 1926, pp. 193-205.
Gilpin, Edwin, Jr.: The Mines and Mineral Lands of Nova Scotia; Halifax, pp. 30-51 (1880).
Harrison, R. B.: Paragenesis of Minerals in Nova Scotia Gold Ores; *N.S. Dept. Mines,* Ann. Rept. 1938, pt. 2, pp. 5-11.
Hind, H. Y.: Notes on the Structure of the Nova Scotia Gold District; *Trans. N.S. Inst. Nat. Sci.,* vol. II, pt. 3, pp. 102-109 (1869).
Hunt, T. Sterry: Report on the Gold Region of Nova Scotia; Rept. Prog., *Geol. Surv., Canada,* 1868.
Keating, B. J.: The Basal Conglomerates of Nova Scotia; *N.S. Dept. Mines,* Ann. Rept. 1948, pp. 136-142.
MacNeil, D. J.: Investigation of Basal Conglomerates; *N.S. Dept. Mines,* Ann. Rept. 1946, pp. 233-240.
Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156 (1929).
Messervey J. P.: Gold Mining in Nova Scotia, A Review; *N.S. Dept. Mines,* Ann. Rept. 1928, pt. 2.
Murray, J. C.: Gold Mining in Nova Scotia; *N.S. Dept. Mines,* Ann. Rept. 1926, pp. 179-191.
Poole, H. S.: The Gold Leads of Nova Scotia; *Quart. J. Geol. Soc. London,* vol. XXXVI, pp. 307-313 (1880).
Prest, W. H.: Deep Mining in Nova Scotia; *Proc. and Trans. N.S. Inst. Sci.,* Halifax, vol. VIII (vol. 1, 2nd ser.), pp. 420-434 (1895).
Rickard, T. A.: Gold Mining in Nova Scotia; *N.S. Dept. Public Works and Mines,* Report on the Mines, pp. 163-177 (1926).
Selwyn, A. R. C.: Notes and Observations on the Gold Fields of Quebec and Nova Scotia; Rept. Prog., *Geol. Surv., Canada,* pp. 252-282, 1870-71.
Stuart, G. W.: Some of the Causes of the Present Condition of Gold Mining in Nova Scotia; *Trans. Min. Soc. N.S.,* vol. XII, pp. 85-90 (1908).
———: The Gold Deposits of Nova Scotia; *Can Inst. Min. Met.,* Bull. 171, pp. 781-847 (1926).
———: The Gold-Bearing Series of Nova Scotia; *Geol. Surv., Canada,* Guide Book No. 1, pt. 1, pp. 158-205 (1913).

Although all gold mines within the map-areas are at present inactive, gold mining at one time was of considerable economic importance. Between 1862 and 1954, 107,050.6 tons of ore were crushed, from which 81,333.39 ounces of gold[1] were recovered. The gold mining industry reached its peak in 1900 and since then the output has gradually declined, owing mainly to rising labour costs.

The gold occurs in auriferous quartz veins in both the Halifax and the Goldenville formations of the Meguma group. The Halifax formation consists predominantly of slates, and the Goldenville mainly of hard quartzites with narrow interbedded slate bands. The gold-bearing veins occur mainly along the stratification planes of the Goldenville slate bands although a few cross-veins have proved auriferous. All important deposits are on plunging anticlines and domes.

Rock structure is the controlling factor in the distribution of the veins. On closely folded anticlines, where bedding planes on opposite limbs form

[1] N.S. Dept. Mines, Ann. Rept. 1954, p. 98.

an angle of less than 45 degrees with one another, the veins are close to the crest of the anticline and some curve over the anticline to form a series of saddles. In more open folds, where the angle between the limbs of the fold is greater than 45 degrees, the veins are farther from the axis. The richest veins mostly occur within the area of maximum curvature of the strata, which is some distance down the limbs from the crest of the fold. In symmetrical domes, the quartz veins form complete ellipses, but, as domes are rarely symmetrical, the veins are mainly on one limb of the dome only. Occasionally, as is the case at Renfrew, minor undulations on the main limb of the fold appear to control the location of the ore deposits.

The quartz veins generally occur in the relatively narrow slate beds, and most are close to the enclosing quartzite. The slate beds are commonly fractured and the veins are found on or along the quartzite foot-wall. Occasionally a vein may fork with one part passing along the foot-wall and the other along the hanging-wall.

Many slate beds contain numerous gold-bearing veins, too small to be separated from the slate. Such a group of veins is known as a lead, and veins and slate are mined together to form low-grade ore.

Interstratified veins occasionally display a corrugated structure known locally as "barrel" quartz from its similarity to a series of barrels laid end to end and side to side. This barrel quartz is generally found at the apex of an anticline, the individual barrels running parallel to the anticlinal axis. The corrugations dip with the strata on the nose of the fold and in the same direction as the plunge of the axis of the fold.

Generally, but not always, the largest auriferous veins are in tightly folded anticlines. Where a saddle-type of vein system exists, the veins are thickest on the crest of the fold, becoming thinner down the limbs.

Cross-veins, sometimes called fissure veins, are occasionally of importance. At Centre Rawdon, the rich Cope lode followed a well-defined fault plane. Most cross-veins cut across the strata in a straight line, but some curve and fork.

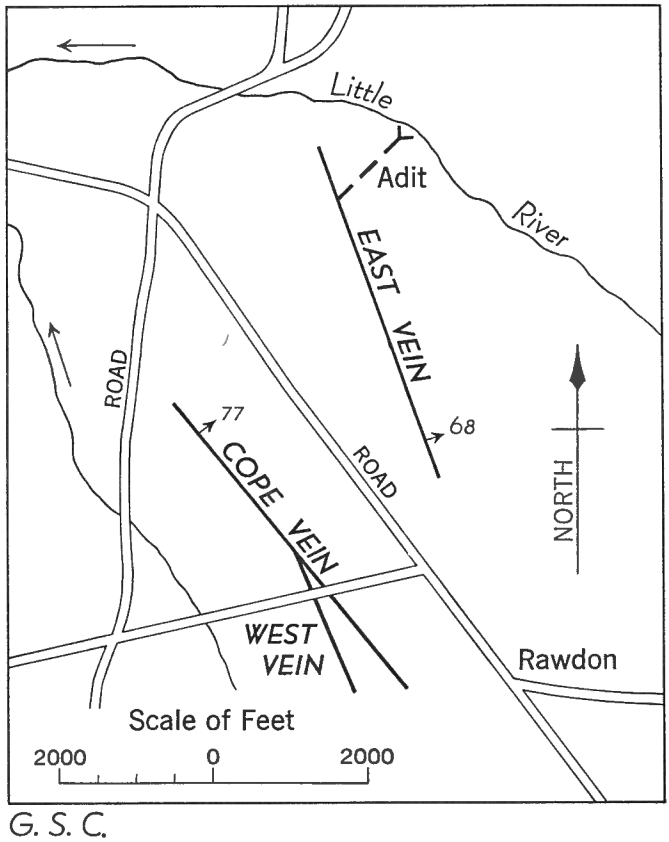
Branch veins that pass into the hanging-wall and foot-wall from the main veins are termed "angulars". Locally, they played an important part in ore deposition, rich deposits occurring at the intersection of the angulars with the main veins.

Most of the quartz veins exposed in the district are non-auriferous and free of metallic minerals. These veins, known locally as "bull" veins, may be several feet thick. The quartz is milky-white and generally coarsely crystalline. The auriferous quartz veins are mostly oily in appearance and rich in sulphides. Most of the gold is in pockets or shoots, whose

distribution has been controlled by some local structure in the host rock. At Renfrew deposition appears to have been determined by a minor undulation on the south limb of the main anticlinal fold.

The similarity of several of the main gold deposits in Nova Scotia to those of the "saddle-reef" deposits at Bendigo, Australia was early recognized, and a controversy was touched off with regard to deep-mining versus shallow-mining which to this day remains unsettled. That ore is still present in many of the abandoned mines is an established fact, but it is extremely doubtful if deep-mining would prove economically feasible, due to the present high cost of labour.

Age and Origin of the Deposits. The ore-bearing veins were apparently deposited by ascending solutions of deep-seated origin, which found a passage upwards through fractures striking across, as well as along the bedding planes. According to Malcolm (1929, p. 53) fracturing across



G. S. C.

Figure 1. Plan of Rawdon gold district, Nova Scotia, showing approximate positions of main veins projected to surface.

the bedding planes as well as fissuring along the bedding planes was essential for formation of the deposits. The source of the ascending solutions is a mystery, but it does not appear to be related to the granite intrusions that cut the Meguma rocks elsewhere in Nova Scotia.

Field evidence has proved the granite intrusions to be younger than the ore deposits. At Forest Hill, the writer observed gold-bearing quartz veins cut by granite dykes. At Mooseland, on Tangier River, interlayered quartz veins in the folded Meguma can be traced to the contact with the granite, where they have been assimilated by it (Malcolm, 1929, p. 54). At Bear River, south of Digby, Devonian rocks are conformably folded with rocks of Meguma age, and both are intruded by the granite believed to be of late Devonian age (Bailey, 1898, pp. 83, 123). At various places in the province, the folded Meguma group and the granite are overlain unconformably by sedimentary rocks of the Horton group of early Mississippian age. Therefore, as the folding cannot be younger than Devonian, the veins were formed either before or during the early stages of emplacement of the granite.

Rawdon Gold District

References:

Brunton, Stopford: Central Rawdon Gold District; Report on the Mines, *N.S. Dept. Public Works and Mines,* pt. II, pp. 403-409 (1927).

Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156, pp. 70-72 (1929).

N.S. Dept. Mines, Ann. Repts.: 1928, p. 485; 1932, p. 98; 1933, p. 82; 1934, pp. 103-105; 1935, pp. 66, 68; 1936, p. 131; 1937, p. 138; 1938, p. 125; 1939, p. 74.

Rawdon gold district is 6 miles southeast of Mosherville, a station on the Dominion and Atlantic Railway (*see* Figure 1). The district, known locally as Centre Rawdon, is accessible by good gravel roads.

The gold-bearing veins of the district occur in dark grey, fissile slates of the Halifax formation which have been folded into a set of parallel anticlines and synclines striking approximately N50°E. These folds form part of the linear ridge known as the Rawdon Hills. The gold deposits are about a mile south of the contact between the Halifax slates and the overlying Horton sediments. The gold-bearing veins occur on the south limb of an anticline, whose axis lies parallel to the Halifax-Horton contact. Rocks in the vicinity of the deposits have been cut by numerous faults which strike almost at right angles to the bedding of the strata, and these faults have played an important role in the deposition of the gold-bearing veins.

Practically all major production has been from three main veins, namely:

(1) The Cope vein (*see* Figure 1), which averages 4 feet in width, dips east at an angle of 77 degrees, and strikes N40°W.

(2) The West vein, which lies close to the Cope vein for some distance and then diverges at a strike of S23°E.

(3) The East (or Church) vein, which is about 1,300 feet east of the Cope vein, dips east at 68 degrees, and strikes about N20°W.

The two faults along which the Cope and West veins lie converge and strike northwest as a single fault. The two veins, however, do not merge, but remain separate and lie against the hanging-wall and foot-wall, respectively, of the main fault. The line of junction of the two faults plunges south at an angle of 32 degrees for a minimum of 265 feet. Displacement on the east side of the fault is towards the north and downward at an angle of 48 degrees. Very little information concerning the East vein is available.

Operations in the Rawdon gold district began about 1887. A 10-stamp mill was erected and crushing commenced the following year. The property remained active for several years, with production mainly from the Northup mine and the Cope and West veins. By 1890 an additional mill of 15 stamps was in operation to handle material from the Centre Rawdon mine, which had been opened on the East vein.

In 1893 the Withrow mine was opened about 1½ miles southeast of the Northup property on a series of gold-bearing veins, and a 5-stamp mill erected.

Appreciable returns were recorded from the district until 1897. Since then only minor development of an intermittent nature has been attempted, and only a few ounces of gold have been produced.

To date the total production from the three properties is given as 6,744.921 ounces of gold from 5,335.18 tons[1] of rock crushed.

Most of the development was carried out prior to 1897 on the Cope vein. Five main shafts, the deepest of which was 405 feet, were sunk on that part of the vein lying south of its junction with the West vein (*see* Figure 1). A shaft was sunk on the East vein to a depth of 107 feet. In 1897 a tunnel was driven southwest from Little River to intersect the East vein, but at a distance of 450 feet drifting was stopped and work on the property ceased. In 1904 drifting was resumed on the tunnel and the East vein was intersected at a distance of 926 feet from the portal. Development was then discontinued until 1923, when a few ounces of gold were produced. Since that date, development has been little and intermittent. At present all workings are caved but the tunnel on Little River may be entered for a short distance.

[1] N.S. Dept. Mines, Ann. Rept. 1954, p. 98.

East Rawdon Gold District

References:

Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156, pp. 78-79 (1929).

N.S. Dept. Mines, Ann. Repts.: 1928, pt. 2, pp. 31-32; 1929, pt. 1, p. 98; 1931, p. 116; 1934, p. 105; 1935, pp. 66, 109; 1936, p. 95; 1938, p. 126; 1945, p. 76; 1946, p. 61; 1948, p. 59; 1949, p. 56; 1950, p. 57.

East Rawdon gold district is 5½ miles southeast of Clarksville, a station on the Dominion and Atlantic Railway. The workings are about a mile southeast of the village of Rawdon Gold Mines.

The first recorded gold mining in this district took place in 1884, when several leads were opened. A 10-stamp mill was erected and put into operation. By 1887 two major mines were in operation and this district was the leading gold producer in Nova Scotia. Thereafter production dropped rapidly, and by 1890 only 256 ounces of gold were produced. Since that time only intermittent development, consisting mainly of surface exploration with a small amount of underground work, has been attempted. In 1929 a 5-stamp mill was erected and the following year 24 tons of ore were crushed, yielding 6 ounces of gold. At present the property is inactive and all shafts caved and/or flooded.

Total production from the East Rawdon district was 13,494.48 ounces of gold from 14,788 tons[1] of ore crushed.

The gold deposit at East Rawdon occurs in massive, grey-green quartzites of the Goldenville formation, which in this district forms an anticline with its axis striking N47°E. The gold-bearing veins follow the stratification planes of the bedding and are found along the north limb of the anticline, which locally dips north at about 45 degrees. In order north from the crest of the anticline are the following leads: Mill (6 inches), Big (36 inches), Richardson (5 inches), Barn (8 inches), No. 1 (Sims) (7 inches), North (2 veins, 30 inches), Mason, McIntosh, and five other leads cut in a crosscut driven to the north.

The most productive veins lie 600 or 700 feet north of the anticlinal axis. The Mason, McIntosh, North, and No. 1 (Sims) leads have been the best producers. On the No. 1 (Sims) lead, 12 shafts with a total depth of 2,920 feet were sunk over a horizontal distance of 2,000 feet, the deepest shaft attaining a depth of 510 feet. On the McIntosh lead, 6 shafts with a combined depth of 345 feet were sunk. On the North lead, one shaft was sunk to a depth of 190 feet and a few others to shallow depths.

[1] N.S. Dept. Mines, Ann. Rept. 1954, p. 98.

Renfrew Gold District

References:

Brunton, S.: A Survey of Certain Gold Districts in the Province of Nova Scotia; *N.S. Dept. Mines,* Ann. Rept. 1927, pt. 2, pp. 652-677.

Faribault, E. R.: *Geol. Surv., Canada,* Ann. Rept. 1899, new ser., vol. XII, pp. 169A-175A.

Hind, H. Y.: Report on the Mount Uniacke, Oldham, and Renfrew Gold Mining District; Halifax, 1872.

Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv.,* Canada, Mem. 156, pp. 159-165 (1929).

N.S. Dept. Mines, Ann. Repts.: 1929, pt. 1, p. 96; 1930, pp. 120-121; 1931, p. 112; 1932, p. 105; 1933, p. 87; 1934, p. 108; 1935, pp. 66, 99; 1936, p. 134; 1937, p. 140; 1938, p. 127; 1939, p. 88; 1940, p. 54; 1950, p. 58; 1952, p. 43; 1953, p. 60; 1954, p. 53.

Renfrew gold district is in Hants county, 4 miles southwest of Nine Mile River village. The district is accessible by secondary gravel roads.

Gold was first discovered in this locality in 1861 and development began on a small scale the following year. Production was small until 1866, when larger crushers were erected. During 1867, 9,401 ounces of gold were recovered from 7,770 tons of rock crushed. The following year, however, production dropped to less than half this figure and continued to decrease gradually thereafter until, for several years, mining remained almost at a stand-still in the Renfrew district and only a few ounces of gold were produced annually. Limited operations were carried out until the turn of the century, but in the year 1900 a revival of mining interest in the district resulted in an output of 4,450 ounces of gold. Production remained high until 1903 and then began gradually to decline once more to an annual output of less than 50 ounces. The years 1911 and 1912 saw a brief recovery with a yield of 2,609 ounces. Since that time production has been small and development intermittent. The total recorded production during the period 1862 to 1954 was 51,770.5 ounces of gold from 66,417.5 tons of ore crushed. Since 1912, about 3,000 ounces have been produced.

At the time of the writer's visit to the district, all shafts were caved and/or flooded. A stamp mill, last operated by Horne Gold Mines Limited in 1954, was in a fair state of repair. A small hydro-electric plant, erected by the same company in 1940, was partly demolished. Many of the older mine dumps have been partly or completely grown over.

Renfrew gold district is underlain by hard, grey-green quartzites of the Goldenville formation. Erosion has been extensive and at least 8,700 feet of the overlying Halifax formation has been removed.

The district lies on an unsymmetrical anticlinal dome which strikes N47°E (*see* Figure 2). The axial plane of the dome dips north at 75 degrees. Near Three Cornered Lake, at the western end of the district, the

anticline plunges southwest at about 20 degrees, and at the eastern end, near Nine Mile River, the plunge is 20 degrees northeast.

The position of the crest of the dome is difficult to determine, but is believed to be somewhere near the head of Number Eight Brook, northeast of the right-angled bend in that stream. Three anticlinal undulations radiate from the centre of the dome, the central, which is the main one, striking westerly through Three Cornered Lake. The strata on this undulation and on the one to the north dip westerly at angles of less than 35 degrees.

To date, all mining has taken place on the south undulation, most of the workable leads occurring along the southeast limb and at the southwestern terminus of the fold. The undulation widens out as it recedes from the main dome, and plunges south at an angle that increases from zero degrees at the crest of the dome to 50 degrees at the western limit. The axial plane of the undulation dips northwest at about 70 degrees.

All developed veins are of the interbedded type and most of the mining operations have been carried out along the south limb of the fold. The most recent operations were conducted on the group of veins concentrated at the southwestern terminus of the undulation, near the east end of the pond at the outlet of Three Cornered Lake.

The extent of the development in the Renfrew gold district can be seen from an examination of Faribault's map, which has been reproduced in part in Figure 2. Shafts were sunk down-dip on the veins but, according to reports, few crosscuts were driven and according to local residents, the maximum depth of any shaft was about 500 feet, few exceeding 400 feet.

Malcolm (1929) was of the opinion that many of the pay shoots were not worked out, and suggested that deeper mining of the veins lying between the McLeod and McClure leads might prove profitable. West-dipping shoots of the Ophir leads were also reportedly not worked out. The group of veins between the Paper Collar and McLeod leads were abandoned at shallow depth, and Malcolm suggested working these leads by crosscutting from the 400-foot level of the Foundation lead.

Gold is undoubtedly still present in many of the abandoned veins at depth, and surface exploration would probably uncover additional gold-bearing leads. However, with the present high cost of labour, it is doubtful if a large-scale operation would prove remunerative.

South Branch Gold Mine

References:

Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156, p. 184, (1929).

N.S. Dept. Mines, Ann. Repts.: 1928, pt. 2, p. 223; 1934, p. 103; 1936, p. 281; 1941, p. 48.

South Branch gold mine is on South Stewiacke River, 11 miles east of Stewiacke and 5 miles northeast of Middle Musquodoboit. Good gravel roads linking these villages pass within 2 miles of the property.

Gold was first discovered in this district in 1865, and a crusher built shortly thereafter. Ore totalling a few tons was milled intermittently until 1907. Since that time development has consisted of prospecting and trenching. Total production is given as 43.9 ounces of gold from 181 tons[1] of rock crushed.

The gold occurs in milky quartz in interbedded and cross-veins in grey-black slates and quartzites of the Halifax formation. The veins are on or near the crest of an anticline, whose axial plane strikes about N65°E. Several auriferous veins of quartz have been located along the anticline on either side of the deposit.

Gays River Gold Deposit

References:

Cole, E. J.: Investigation of Gays River Conglomerate; *N.S. Dept. Mines,* Ann. Rept. 1948, pp. 112-120.
Dawson, W.: "Acadian Geology", 4th ed., p. 277 (1891).
Faribault, E. R.: *Geol. Surv., Canada,* Ann. Rept. 1891, vol. V, pt. A, p. 58.
Fletcher, H.: *Geol. Surv., Canada,* Ann. Rept. 1891, vol. V, pt. A, p. 61.
Honeyman, D.: *Trans. N.S. Inst. Nat. Sci.,* vol. II, pt. 1, p. 76.
How, H.: "Mineralogy of Nova Scotia", p. 45 (1868).
Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156, pp. 3, 223-225, 240 (1929).
Messervey, J. P.: Gays River Gold District; *N.S. Dept. Mines,* Ann. Rept. 1928, pt. 2, pp. 42-46.
N.S. Dept. Mines, Ann. Repts.: 1938, p. 140; 1949, p. 55; 1950, p. 140.

Gays River gold district is 5 miles east of Shubenacadie and 4 miles northeast of the village of Gays River. The property, which is situated on McLean (formerly known as Corbett) Brook, is readily accessible by good secondary roads.

Gold was first discovered on this property in 1862 and mining commenced the following year. Several tunnels were subsequently driven and connected by shafts to the surface. Numerous prospecting pits and trenches were sunk through the drift to bedrock. Between 1862 and 1880 the property was moderately active and at least three stamp mills were erected and operated at various times. Returns were not as remunerative as originally expected, however, and shortly after 1880 work on the property ceased. A brief attempt was made to re-open the mine in 1900 and a 50-stamp mill was erected. The results are not recorded.

[1] N.S. Dept. Mines, Ann. Rept. 1954, p. 99.

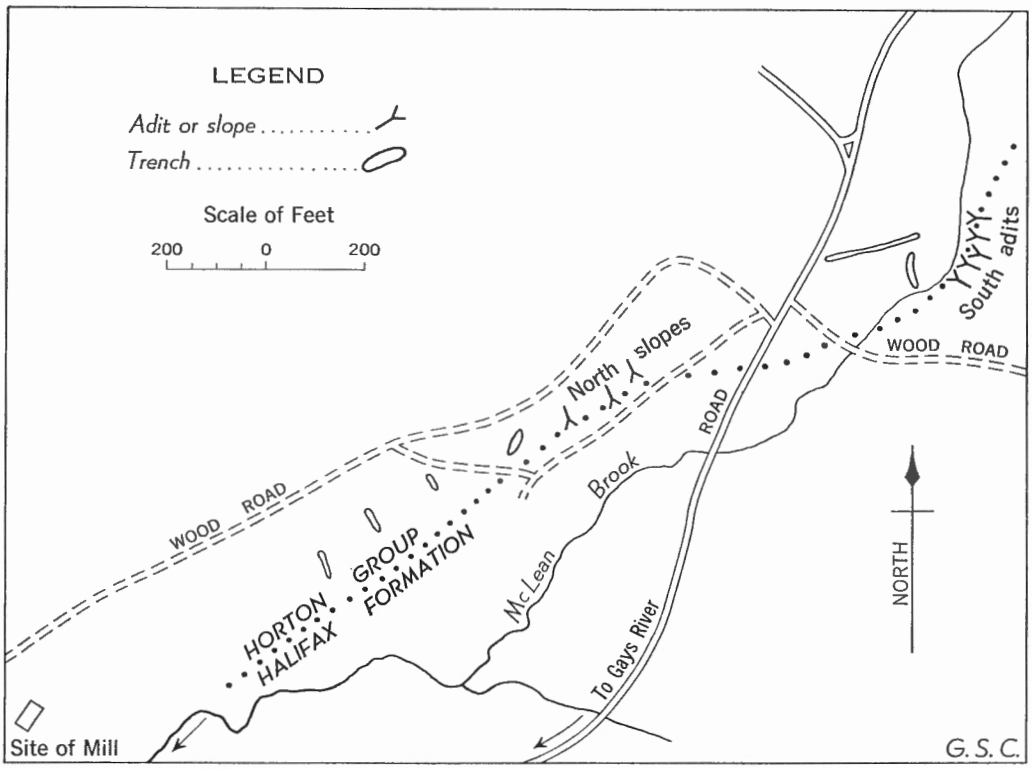


Figure 3. Surface plan showing position of main workings in Gays River fossil placer gold deposit, McLean Brook, a mile north of Coldstream, Colchester county, N.S.

In order to assess the economic possibilities of the deposit some of the old workings were re-opened in 1946 by the Nova Scotia Department of Mines. Numerous bulk samples were taken and surface and underground surveys were made. Sampling results indicated that mining could not be carried out profitably and the project was abandoned. Since 1946 the property has remained dormant and underground workings are at present flooded.

The gold occurs as an ancient fossil placer deposit in a coarse, greyish brown conglomerate at the base of the lower Carboniferous. The conglomerate is believed to form part of the Horton group, of lower Mississippian age. This conglomerate, which is composed of detritus from the underlying slates and quartzites of the Halifax formation, bears evidence of extensive attrition by stream action. Individual fragments that vary in size from pea-sized pebbles to boulders several feet in diameter are well rounded and aligned in a general northwest-southeast direction. The heavier ends of

the fragments generally point to the southeast, thereby indicating a parent source in that direction. The matrix consists of a mixture of slate and quartz.

In the vicinity of the deposit the Halifax slates dip southeast and are overlain with marked angular unconformity by the Horton conglomerate, which has a gentle regional dip to the north. The conglomerate, in places 30 feet or more thick, outcrops in a narrow band that has been traced 4 miles northeast and 2 miles southwest from the workings. It lies in a valley at the base of a northeast-striking ridge composed of slates and quartzites of the Halifax formation. This ridge rises steeply southward until it attains a maximum elevation of about 400 feet above the surrounding Carboniferous lowlands.

The gold occurs at the base of the conglomerate in the matrix, and also in crevices in the underlying slates. Those crevices lying at right angle to the cleavage planes and stratification in the slates were found to be the most remunerative. A small amount of gold was found free in the glacial drift, as well as in the form of a thin coating on pebbles in the conglomerate.

The gold evidently occurs in the now consolidated gravels of ancient streams, and undoubtedly originated in the quartz veins and stringers that cut the gold-bearing series to the south. Upon erosion and subsequent disintegration of the veins the free gold was transported to its present position by north-flowing streams.

Although all of the old workings were not sampled in the latest examination (1946), the highest value obtained was $1.57 a ton, the average of all samples being $0.40 a ton. The price of gold at that time was $36.75 a fine ounce. The milling returns indicated a very low gold content, indeed the total returns from 1862 to 1928 inclusive amounted to only 1,878 oz 16 dwt 15 gr of gold from 11,877 tons of rock crushed. It is possible that additional gold deposits of mineable grade are present in the Horton stream-gravel conglomerate, but they could be found only by extensive and expensive drilling.

Alluvial Gold Deposits

Reference:

Faribault, E. R.: *Geol. Surv., Canada,* Ann. Rept. 1899, new ser., vol. XII, p. 182A.

Insignificant amounts of gold have been panned from surficial material at various localities in the map-areas. The gold evidently originated in auriferous quartz veins cutting the Meguma gold-bearing rocks and was carried in suspension by the streams that originated on the upland surface

of the resistant Meguma rocks. Upon reaching the relatively flat-lying Carboniferous lowlands, the decreased gradient resulted in the deposition of the auriferous debris.

Gold has been panned along Meander River and at one or two places along the northern base of Wittenburg Mountain.

LEAD

Gays River Lead Deposit

References:

Alcock, F. J.: *Geol. Surv., Canada,* Econ. Geol. Ser. No. 8, p. 61 (1930).
Dawson, W.: "Acadian Geology", 1st ed., p. 275 (1868).
Campbell, C. O.: Report submitted to Gays River Lead Mines, Limited, 1952.
How, H.: "Mineralogy of Nova Scotia", pp. 74-77 (1868).
N.S. Dept. Mines, Ann. Repts.: 1928, pp. 402-403, 427-430; 1951, p. 56; 1952, p. 44.
Wilson, M. E.: *Geol. Surv., Canada,* Sum. Rept. 1926, pt. C, p. 83.

The Gays River lead-zinc property is located a half mile southwest of the village of Gays River and 5 miles southeast of Shubenacadie, from which it is accessible by a good gravel road. A north-flowing branch of Gays River bisects the property and provides an adequate supply of water for diamond drilling (*see* Figure 4).

The deposit is believed to have been discovered by early settlers in 1824; Dawson and How made brief references to it in 1868. Some prospecting was done in 1873 and 1874, consisting of trenching along the outcrops. In 1928 further trenching was done and several small pits sunk, but no underground work or diamond drilling was attempted.

The property remained inactive until 1952, when Gays River Lead Mines Limited carried out an extensive diamond-drilling program on the deposit. A total of 9,435 feet of drilling was done, of which 8,263 feet was by diamond drill and 1,172 feet by churn drill. Over 900,000 tons of material ranging from 1.1% to 3.0% combined lead-zinc were proved.

Outcrops in the vicinity of the deposit are scarce because of a covering of glacial moraine, in places 250 feet thick. The mineralization occurs in dolomitized, fossiliferous limestone of lower Windsor age resting with marked angular unconformity upon metamorphosed and folded quartzites and slates of the Goldenville formation of the Meguma group. The Windsor limestones are conformably overlain by beds of anhydrite, gypsum, and red shales of the Windsor group. The limestone beds are very massive and, together with the other Windsor sediments, are relatively undisturbed as compared with the underlying, closely folded Goldenville rocks. The maximum true thickness of limestone in the vicinity of the deposit is about 125 feet.

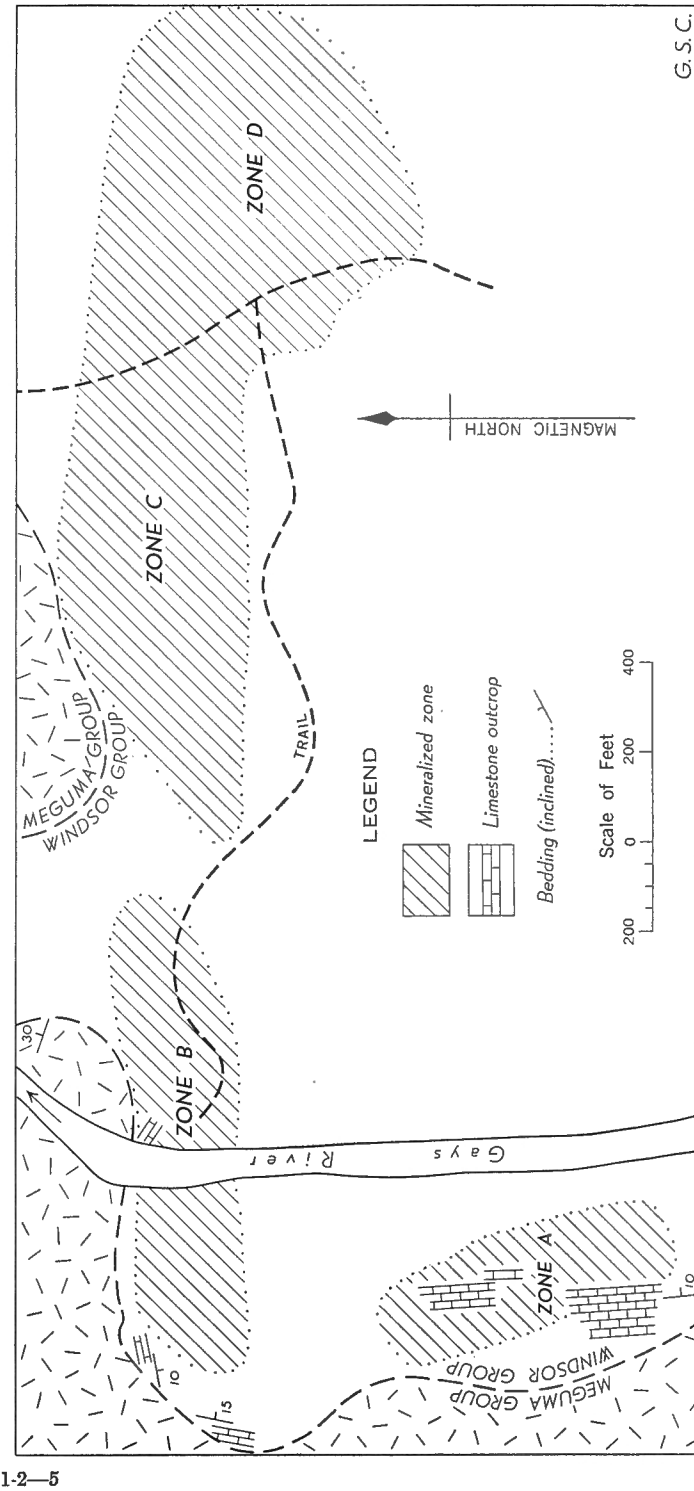


Figure 4. Surface map showing position of mineralized zones of lead-zinc deposit at Gays River, Halifax county, N.S.

61511-2—5

The metamorphosed Meguma sediments forming the basement rocks are folded into northeast-striking dome-like anticlines which plunge northeast and southwest. During pre-Windsor time, the Meguma rocks were extensively eroded and the Windsor sediments, consisting of alternating beds of limestone, gypsum, and shales, were laid down unconformably on the erosion surface by the advancing sea. In post-Windsor time tectonic forces affected both the basement rocks and the Windsor sediments alike, with subsequent faulting at the contact between the competent quartzites and the less competent Windsor limestone.

Many of the Windsor sediments have been removed by erosion, and outliers of the Meguma quartzites and slates protrude through the covering of Windsor rocks. The best outcrops of the mineralized limestones are found on the west side of Gays River, where exposures may be traced along the edge of the Windsor-Meguma contact for a distance of about 2,000 feet.

Lead and zinc are present as galena and sphalerite. The sphalerite varies in colour from a honey-yellow to a dark, amber-brown, with the former predominant. Galena is the more abundant mineral in outcrops possibly as a result of surface leaching of the sphalerite. Analyses show 5.6 ounces of silver a ton of lead. A small amount of marcasite is present but pyrite is rare. Fluorite was noted in a few core samples. Manganese in the form of MnO_2 is present in small but constant amounts.

The sequence of mineralization was probably as follows: fluorite, dolomite, galena, sphalerite, and finally calcite. Marcasite was introduced either before or after the galena and sphalerite.

The mineralization was probably controlled by structure. The deposit is on the north limb of a northeasterly plunging anticline in the Goldenville formation and near its axis. The anticline originated in pre-Windsor time and has undoubtedly been subjected to post-Windsor folding movements. The ore-bearing solutions, either late Carboniferous or Triassic in age, probably ascended along regional faults and moved laterally to deposit their load in the limestone strata, the loci of deposition being governed by the folding.

For descriptive purposes, the deposit has been divided into zones A, B, C and D. Except for a possible gap between zones B and C, the mineralization is believed to have been continuous from one zone to the next.

Zone A is west of the river and limestone outcrops over much of it. Eleven holes were drilled in this zone within an area roughly 500 feet long by 200 feet wide. The average width of mineralized rock intersected was 22 feet, the highest assay being 1.87 per cent combined lead and zinc across 12 feet. The mineralized area is restricted to the top edge of the

strata and does not extend far down the dip. Within the area drilled 100,000 tons of material averaging 1.10 per cent lead-zinc were proved.

The area drilled in Zone B measured 600 feet long by 150 feet wide and the thickness of mineralized rock averaged 18 feet. The assays from different holes varied from 0.46 to 12.83 per cent combined lead and zinc. The weighted metal content over the 18-foot mineralized zone was found to be 0.43 per cent Pb and 1.86 per cent Zn. Within the drilled area in Zone B there are 100,000 tons of material averaging 2.29 per cent lead-zinc.

Zone C is estimated to contain 200,000 tons of rock with an average lead-zinc content of 1.5 per cent.

Zone D, which has the thickest mineralized layer, is southeast of and continuous with Zone C. Both the Windsor and Meguma rocks have been cut by several faults, some of which are post-ore. The average thickness is 48 feet and the average grade 3.0 per cent combined lead and zinc. The estimated amount at this grade is at least 500,000 tons.

Exploratory holes drilled some 2,300 feet south of Zone A were barren. Holes drilled a half mile southeast from Zone D were also barren, with a single exception which showed a small amount of sphalerite over a width of 10 feet.

Walton River Lead Prospect

On the north branch of Walton River, about 1¼ miles east of the mouth of Salty Brook, scattered galena crystals were noted in poor exposures of dark grey, massive Windsor limestone in the bed of the river.

ANTIMONY

West Gore Antimony Deposit

References:

Askwith, W. R.: The West Gore Antimony Deposits; *Trans. Min. Soc. N.S.,* vols. 6-7, p. 80, 1900-1-2.

Douglas, G. Vibert: *N.S. Dept. Mines,* Ann. Rept. 1939, pt. 2, pp. 37-49.

Geol. Surv., Canada, Ann. Repts.: vol. IV, 1886, pt. S, p. 12; vol. IV, 1887, pt. S, p. 10; vol. IV, 1888, p. 11 S; vol. V, 1891, p. 16 S; vol. VI, 1892, pp. 10 S, 12 S, 58A; vol. XI, 1898, p. 181 S.

Haley, D. F.: The Auriferous Antimony at West Gore, N.S.; *Eng. Mining J.,* vol. LXXXVIII, p. 723, 1909.

Malcolm, W.: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156, pp. 28, 41, 44, 234-237 (1929).

Messervey, J. P.: N.S. Dept. Mines, Ann. Rept. 1931, pt. 1, pp. 215-238.

N.S. Dept. Mines, Ann. Repts.: 1937, p. 157; 1938, p. 142; 1939, pt. 1, p. 34; 1940, pp. 39, 56; 1943, p. 38; 1944, p. 41; 1945, p. 76; 1951, p. 43.

The West Gore antimony mine is about 2½ miles southeast of Clarksville, Hants county, and a mile southwest of the village of West Gore (*see* Figure 5). The property is readily accessible by good secondary roads.

61511-2—5½

Antimony was first discovered in the area about 1880, in the form of float. Subsequent trenching disclosed a fissure vein on which a shaft was sunk late in 1883. Production immediately followed, the principal ore consisting of stibnite and native antimony. Some 2,000 tons were mined and shipped to England before the auriferous nature of the ore was recognized.

The mine was operated more or less continuously until the outbreak of the first world war, when the demand for antimony led to a marked increase in production. Shipment losses due to enemy action were so high, however, that before the end of the war the mine ceased operation.

The property remained inactive until 1928, when a small amount of development work was carried out. The mine then remained dormant until 1936, when the old workings were unwatered and development was again undertaken on a small scale. Shortly thereafter production ceased and, apart from intermittent exploration work, there has been no further production or development.

At the time of the writer's examination all shafts were caved and/or flooded and the area in the vicinity of the workings was overgrown by second growth. As a result, the description given here is largely a compilation of the work of previous writers who were able to examine the underground workings.

The rocks in the vicinity of the deposit consist entirely of black slates of the Halifax formation, which locally contains a few narrow layers of grey quartzite. Outcrops in the immediate vicinity of the deposit are few and are confined mainly to the beds of nearby brooks. The numerous short, precipitous falls on Glen and McInnis Brooks are caused by either structural folds or the difference in resistance to erosion of the slates and the quartzite bands. The slates have few internal structures but the quartzites are extensively crossbedded. The regional dip of the Halifax formation in the vicinity of the deposit is about 45 degrees southeast.

Two main fault systems are present in the vicinity of the deposit. The main system strikes northwest and dips from 70 degrees southwest to vertical. The other system is of less importance and strikes slightly north of east. In the main system the beds on the northeast side of the faults have been displaced to the southeast relative to those on the southwest side, but the amounts of displacements could not be ascertained. Slates in the immediate vicinity of the faults have been extensively sericitized. Drag-folds, generally present near the faults, have undoubtedly contributed much towards the sericitization of the slates.

The ore occurs in three fissure veins that occupy northwest-striking faults of the main fault system. The main vein is the middle one and is

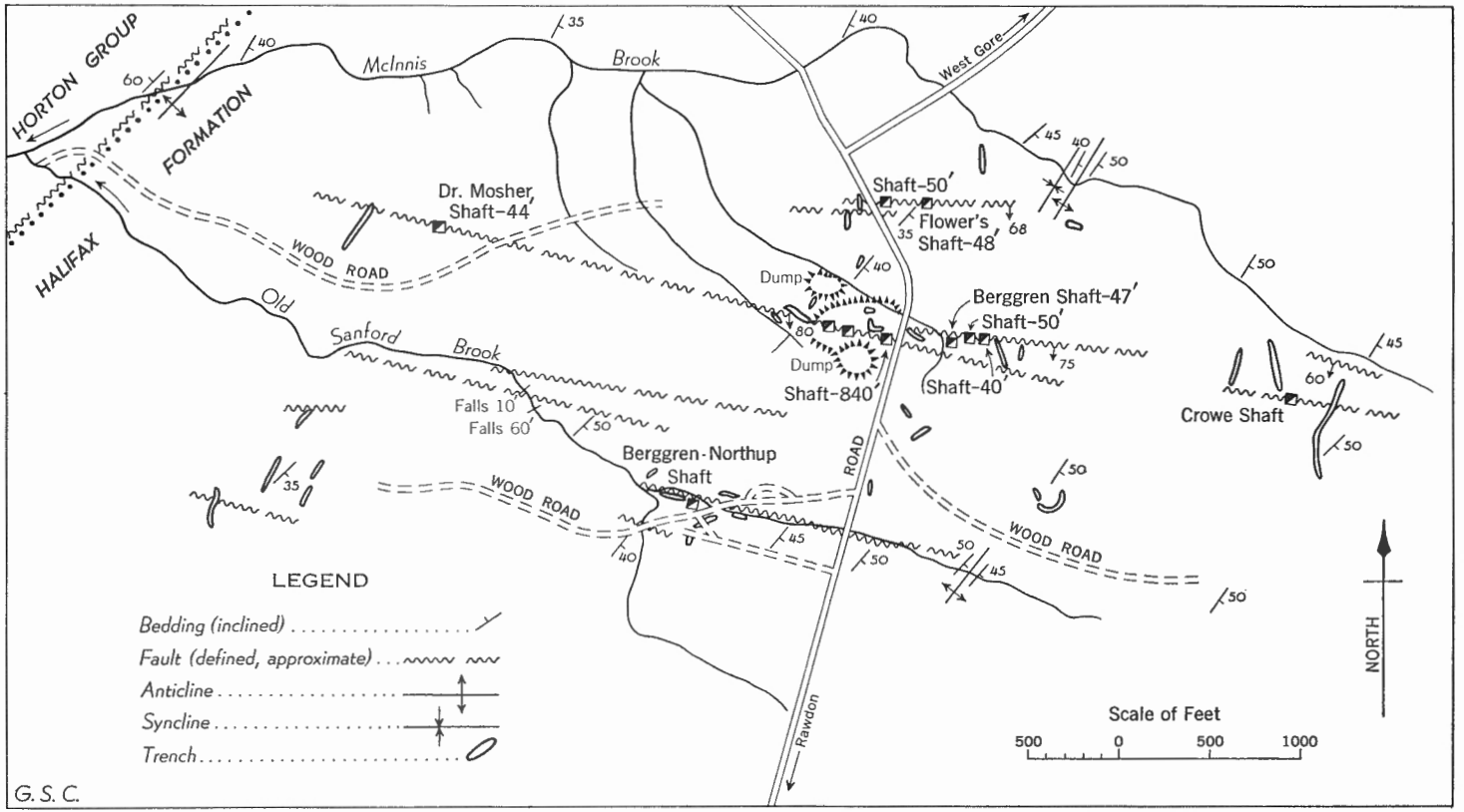


Figure 5. Surface map of antimony mine at West Gore, N.S. showing position of main workings.

about 700 feet from the vein to the northeast and 1,000 feet from the vein to the southwest. The ore in this vein is in lenses 50 to 60 feet in diameter and 6 to 24 inches thick. Ore minerals consist of stibnite, native antimony, gold, mispickel, pyrite, and coatings of valentinite and kermesite. The gangue consists of calcite, quartz, and crushed slate.

The individual ore shoots are poorly defined but dip approximately with the strata. The average thickness of the southwest vein is 4 inches and of the northeast vein is 5 inches.

Mineralization was probably associated with igneous activity during Devonian time, when the major granitic intrusions to the south of the area were emplaced. No outcrops of igneous rocks have been found within a radius of several miles of the deposit, but specimens from the main dump show dykelets of quartz and feldspar cutting the slates.

The surface deposits of iron oxide in marshy areas along the extensions of the main northwest-striking faults are of interest. The iron oxide evidently originates from iron sulphides associated with the stibnite and is brought to the surface and deposited by solutions that ascend along the fault planes. Those marshy areas rich in iron oxide perhaps overlie additional, undiscovered areas of mineralized rock.

Production of Antimony

Year	Tons of Concentrate	Yield of Gold oz.	Dwt.	Gr.
1884	600			
1885	758			
1886	645			
1887	400			
1888	308			
1889	55			
1890	26			
1891	10			
1905	527	1,232	16	23
1906	782.6	1,031	13	11
1907	1,403.0	1,319	18	12
1908	132.6	179	5	
1910	203.3	364	1	14
1911	191.0	291	16	21
1915	683.5	1,698	5	
1916	855.7	662	18	
1917	180.3	141	2	
1939	232.9	187		

BARITE

Middle Stewiacke Barite Deposit

References:

Cole, E. J.: *N.S. Dept. Mines,* Ann. Rept. 1948, pp. 60, 77-85.
Dawson, W.: "Acadian Geology", 4th ed., p. 276 (1891).
Fletcher, H.: *Geol. Surv., Canada,* Ann. Rept. 1891, pt. P, p. 192.
How, H.: "Mineralogy of Nova Scotia", p. 160 (1868).

The Middle Stewiacke barite deposit is 2,000 feet north of the Brookfield-Middle Stewiacke highway, on the east bank of the second small brook west of Putnam Brook. The property may be reached by a wood road impassable to motor vehicles in wet weather.

Twelve hundred tons of ore were taken from a shaft 40 feet deep prior to 1868. The ore occurred in three veins cutting grey argillaceous limestone. The veins consist of white to greenish barite with traces of graphite, and average 18 inches in thickness.

In 1948 Maritime Barytes Limited carried out extensive exploration on the deposit, consisting of a geophysical survey followed by diamond drilling. Ten holes, with a total footage of 1,362.5 feet, were drilled in an effort to block out an orebody. Numerous faults were found to cut the brecciated limestone-conglomerate containing the barite. Although the drill intersected some ore of good marketable grade, an insufficient tonnage was found to warrant further development and the project was abandoned.

The deposit occurs in brecciated limestone-conglomerate at or very near the Horton-Windsor contact in a manner similar to that in the mine at Brookfield. A few blocks of barite debris were also found along a small creek about 1¼ miles west of the Middle Stewiacke deposit.

As all large deposits of barite in this part of Nova Scotia are on or near the Horton-Windsor contact, prospecting should be concentrated along this contact.

MANGANESE

The presence of several small manganese deposits in Kennetcook map-area has long been known. The ore minerals are pyrolusite (MnO_2) and psilomelane (MnO_2, BaO, H_2O, etc.) and the deposits occur at or near the Horton-Windsor contact, generally in the red limestone-conglomerate of the Pembroke formation and the underlying laminated limestone of the Macumber formation. Small veinlets of manganese are also found in a few joints cutting arenaceous shales and sandstones of Horton age. The main mineral zones are, however, in the basal Windsor formations, where the manganese occurs as a coating on fragments of the limestone-conglomerate and as veins filling joints.

Known prospects in the map-area appear to be of little economic interest, and will be briefly described.

Hibernia Manganese Mine

References:

Smitheringale, W. V.: "The Manganese Deposits of the Maritime Provinces"; unpublished report, 1928.
Geol. Surv., Canada, Ann. Rept., vol. XV, 1907, pt. S, pp. 155, 156.
Geol. Surv., Canada, Sum. Rept. 1893, p. 64A.
Geol. Surv., Canada, Econ. Geol. Ser. No. 12, p. 45 (1932).

The Hibernia manganese mine is situated at long. 63° 55′ 30″, lat. 45° 14′, about 3½ miles east of the village of Walton. The deposit may be reached by a very poor wood road that runs east from the head of Whale Brook.

Very little is known about the history of the deposit. About 1885, J. Stephens opened several cuts in bedrock and from these is said to have removed about 2 tons of ore. The old workings are now overgrown and the pits caved.

The deposit occurs in red limestone-conglomerate of the Pembroke formation, at or near the contact with the underlying Horton sandstone and shale. The limestone is in turn overlain by gypsum. Outcrops are lacking in the immediate vicinity of the deposit and exposures are poor even in the open-cuts. The regional strike of the strata is said to be N70°E, with a 50 degree dip to the south. The mineral zone, which consists of pyrolusite with a small amount of psilomelane, occurs as veinlets filling cracks and joints in the Horton shales and as a lining on pebbles and joints in the Pembroke conglomerate.

A manganese prospect three quarters of a mile northeast of the Hibernia mine is said to have been investigated, but the open-cuts were badly overgrown when visited by the writer and no evidence of manganese minerals was found.

Whale Brook Prospect

References:

Smitheringale, W. V.: "The Manganese Deposits of the Maritime Provinces"; unpublished report, 1928.
Geol. Surv., Canada, Sum. Rept. 1893, p. 62A.
Geol. Surv., Canada, Econ. Geol. Ser. No. 12, p. 68 (1932).

About a mile northeast of Walton, on the east side of Whale Brook and about 300 feet north of the road, a tunnel said to have been between 70 and 80 feet long was opened many years ago in a hill of sandy limestone of the Macumber formation. Local residents claim that a few tons of manganese were removed from the tunnel, which is now caved.

Small veinlets of pyrolusite were noted in outcrops on the south side and crest of the hill and in a somewhat similar limestone on the west bank of Whale Brook just north of the bridge.

Small veins of pyrolusite were also reported to occur in Horton shales in the sea-cliffs on the north, but none could be found.

Other Occurrences

References:

Smitheringale, W. V.: "The Manganese Deposits of the Maritime Provinces"; unpublished report, 1928.
Geol. Surv., Canada, Econ. Geol. Ser. No. 12, p. 68 (1932).
Geol. Surv., Canada, Sum. Rept. 1893, p. 62A.
J. Can. Min. Inst., vol. 1, p. 225 (1896).

Manganese float is reported to have been turned up by the plough near Kennetcook, McPhee Corner, and Rawdon, but no manganese has been reported in place from these localities.

A fragment of very pure psilomelane, about 5 pounds in weight, was recently found 1½ miles west of Roulston Corner, on the farm of Warren MacPhee. The specimen was angular and had apparently broken from a larger boulder of manganese. A diligent search of the area, however, produced no additional evidence of manganese minerals and it is thought that the manganese probably originated as a bog deposit.

COAL

The existence of narrow seams of low-grade coal in both Shubenacadie and Kennetcook map-areas has long been known. Dawson (1891, p. 276) mentioned that "indications of coal have also been observed in the Coal measure band extending from Lower Stewiacke toward and along Kennetcook River. These measures are not well exposed, and I believe that nothing definite is known as to their real value. The occurrence of coal in this central district would, however, be of so great importance to the province, and to the success of its main line of railway, that the subject merits a thorough investigation."

In Kennetcook map-area the most promising prospects are in sandstones and shales of the Horton group, in close proximity to and parallel with the contact between the Horton and older Halifax slates. There is no record of coal being found in Horton rocks in Shubenacadie map-area.

The Scotch Village formation, of probable Pennsylvanian age, contains abundant plant remains, which, after becoming carbonized, form narrow seams and streaks of shiny, low-grade coal that rarely exceed an inch in thickness.

The main prospects are briefly described.

Upper Kennetcook Prospect

References:

Fletcher, H.: *Geol. Surv., Canada,* Ann. Rept., vol. V, 1891, pt. 2, pp. 97P, 172P.
N.S. Dept. Mines, Ann. Rept. 1901, pp. 74-75.

This prospect is in the village of Upper Kennetcook, near the mouth of Hennigar Brook.

Although a diligent search was made in this area, the writer was unable to find evidence of either coal or old workings. The following description is, therefore, quoted directly from Fletcher (1891, p. 97): "Near the mouth of this brook, an opening was made from the road in black, carbonaceous shale, containing small traces of coal, and on the opposite side of the road are several pits in one of which streaks of bright clean coal, one inch thick and downward are exposed, and also, it is said, a seam one foot thick. Gypsum and limestone underlie it at no great distance. On the north side of Kennetcook River immediately below the shop and house of Mr. Nelson Weir, the best of these small coal seams was opened in several shallow pits on opposite sides of the river; but it appears to have been only a few inches in thickness and an extension of the coal seen both up and down the river."

In 1901, two drill-holes were sunk with a total footage of 382 feet in order to test the coal. In the first hole, 49 inches of slaty coal were encountered at a depth of 62 feet from the surface. The results of the drilling were discouraging and the prospect was abandoned.

Stanley Prospect

References:

Fletcher, H.: *Geol. Surv., Canada,* Sum. Rept., vol. XV, 1903, p. 171.
N.S. Dept. Mines, Ann. Rept. 1904, pp. 87, 88.

Intermittent outcrops of Scotch Village sandstone, rich in carbonaceous plant remains and narrow seams of coal, are exposed along Kennetcook River between Clarksville and Stanley. In 1903, two exploratory drill-holes were put down, one on the north bank of Kennetcook River about a mile east of Stanley, and the other on Tomcod River at a point 2½ miles northwest of Clarksville. The former reached a depth of 491.5 feet, the latter 370 feet. No coal was encountered.

East Gore Prospect

References:

Fletcher, H.: *Geol. Surv., Canada,* Sum. Rept., vol. XVI, 1904, pp. 298A, 299A.
N.S. Dept. Mines, Ann. Repts.: 1922, p. 77; 1923, pp. 144, 145.

The East Gore prospect, on Mill Brook, was located in 1904 on a narrow seam of coal in sandstones and shales of Horton age. A small

amount of coal was mined and used locally in stoves and forges. Old workings are still visible in the form of open-cuts on the banks of the stream.

An analysis of the coal, made in 1904, yielded the following results:

	%
Moisture lost at 110°C.	1.90
Volatile bituminous matter	23.90
Fixed carbon	49.40
Ash	24.80
	100.00
Sulphur	0.15

The coal burns with a long, luminous flame, gives a compact coke, and leaves a grey ash.

In 1922 the economic possibilities of the region were tested by drilling. Four holes were drilled with a combined footage of 1,597 feet. No coal of value was encountered. The following year a fifth hole was drilled to a depth of 652.8 feet, also with unpromising results. The property has remained inactive since that date.

East Brook Prospect

References:

Fletcher, H.: *Geol. Surv., Canada,* Ann. Rept., vol. V, 1893, pt. 1, p. 60A.
N.S. Dept. Mines, Ann. Rept. 1902, p. 77.

The East Brook coal prospect is about a mile upstream from the mouth of East Brook, about 9 miles northeast of Stewiacke. The only evidences of the old workings remaining today are a few scattered pieces of shaly coal along the west bank of the stream. Of the prospect, Fletcher said (1893, p. 60A): "In the East Brook . . . a seam of coal, apparently not exceeding 18 inches in thickness, of mixed coal and carbonaceous shale was lately opened. A boring sunk about 80 feet at Johnson Brook, not far distant, is said to have cut black gypsum, and the coal is probably about the same horizon as that at Kennetcook."

In 1903 three bore-holes were sunk, the deepest being 445 feet. No coal of economic value was encountered. The prospect is evidently in sandstones and shales of probable Pennsylvanian age.

Alton Prospect

About 3½ miles northeast of Alton, on the east side of a small stream draining south into Stewiacke River and near the abandoned road-bed of the Midland Railway project, a shaft was sunk in a search for coal. Small fragments of black, fissile, coaly shales are found on the dump but no coal is believed to have been raised.

GYPSUM

References:

Alger, F.: Notes on the Mineralogy of Nova Scotia; *Am. J. Sci. and Arts,* vol. XII, pp. 227-232 (1827).

Bell, W. A.: Horton-Windsor District, Nova Scotia; *Geol. Surv., Canada,* Mem. 155, pp. 81-88 (1929).

Branson, E. B.: Origin of Thick Gypsum and Salt Deposits; *Bull. Geol. Soc. Amer.,* vol. 26, pp. 231-242 (1915).

Cole, L. H.: The Gypsum Industry of Canada; *Canada Dept. Mines,* Pub. No. 714 (1930): The Story of Gypsum in Canada; *Bull. Can. Min. Met.,* No. 221, pp. 1206-1229 (1930).

Gesner, A.: "Remarks on the Geology and Mineralogy of Nova Scotia"; Halifax, 1836.

Goodman, N. R.: Gypsum and Anhydrite in Nova Scotia; *N.S. Dept. Mines,* Mem. No. 1 (1952).

Haliburton, T.C.: "An Historical Statistical Account of Nova Scotia"; Halifax, 1829.

Jackson, C. F., and Alger, F.: A Description of the Mineralogy and Geology of a part of Nova Scotia; *Am. J. Sci. and Arts,* vol. XV, pp. 132-160, 201-217 (1829).

Jennison, W. F.: Report on the Gypsum Deposits of the Maritime Provinces; *Canada Dept. Mines,* Pub. No. 84 (1911).

Messervey, J. P.: Gypsum in Nova Scotia; *N.S. Dept. Mines,* Monograph Pamphlet No. 13 (1926).

Wright, W. J.: Report on Cheverie, Windsor and Shubenacadie Basins; *N.S. Dept. Mines,* Ann. Rept. 1930, pt. 2, pp. 117-142.

The gypsum beds of Nova Scotia form part of the marine Windsor group of sediments of late Mississippian age. The gypsum deposits are normally underlain by beds of anhydrite which limit the depth of the workable gypsum and, in many instances, large deposits of gypsum are rendered entirely worthless for commercial use by large pods and lenses of anhydrite enclosed within the gypsum beds.

Chemically, gypsum is hydrated calcium sulphate ($CaSO_4 2H_2O$) and anhydrite consists of anhydrous calcium sulphate ($CaSO_4$). Impurities such as clay, silica, limestone, etc., are commonly present. Normally, gypsum and anhydrite are white, but the various impurities imprint varicoloured hues to the rock.

Gypsum occurs in five varieties:

1. Selenite: a transparent, colourless, crystalline variety with a flexible, laminated structure.
2. Rock gypsum: a compact, scaly, or granular variety, generally impure.
3. Gypsite: an impure earthy, or sandy variety.
4. Alabaster: a fine-grained, massive variety, generally white
5. Satin spar: a fibrous variety with a silky lustre.

Most of the gypsum quarried in Nova Scotia is used in the manufacture of wall board and plaster. Lesser amounts are used in the manufacture of

insulating wool Portland cement, plaster of Paris, paints, fertilizers, explosives, matches, chalk, inks, linoleum, glass, jewellery, medicine, cloth, and insecticides.

Very few gypsum products are manufactured in Nova Scotia, the bulk of the gypsum being exported to other countries for processing. This unfortunate situation was instigated by high tariff costs placed on gypsum products by the United States. Since 1872 less than one per cent of the total crude production has been calcined in the province.

The gypsum deposits of Nova Scotia are the largest known in Canada. The earliest writings of Jackson and Alger (1829) refer to deposits of "gypsum of practical worth" at the head of Minas Basin, which were undoubtedly those exposed along Shubenacadie River and elsewhere. That gypsum is rapidly becoming the most important mineral in Nova Scotia is shown by the rising yearly production. In 1955, 4,668,901 short tons were produced in Canada, of which 3,838,847 short tons were quarried in Nova Scotia.

Both Shubenacadie and Kennetcook map-areas contain large deposits of gypsum and anhydrite that have, until the present, been largely unexploited. Only the deposits that lie on or close to tidewater have been mined, and these only in a limited manner. An exception is the large quarry at Walton from which gypsum has been shipped for more than a century. Smaller quarries were also operated on the west bank of Shubenacadie River in the days of the sailing ships.

Origin of Gypsum Deposits

Much detailed work has been carried out in investigating the origin of gypsum deposits in Nova Scotia. In order to avoid repetition, the reader is referred to the most comprehensive of these reports (Goodman, 1952; Bell, 1929). It will suffice to say here that the generally accepted opinion is that the calcium sulphate beds were deposited from concentrations of sea water in lagoons that were rhythmically replenished by marine waters. A delicate balance of temperature conditions resulted in the deposition of alternate layers of limestone and calcium sulphate. In the area under consideration, the bulk of the calcium sulphate was probably deposited as anhydrite and the upper beds altered to gypsum soon after the removal of the lagoonal waters with an attendant lowering of temperature.

The expansion of anhydrite upon its alteration to gypsum is about 44 per cent. It is thought that much of the severe structural deformation of the gypsum beds and of the overlying host rocks has been caused by this (volumetric) expansion of the anhydrite upon its conversion to gypsum. Much of the folding and crumpling has also undoubtedly been caused by diastrophism.

Although gypsum has been quarried at numerous localities throughout both Kennetcook and Shubenacadie map-areas, only those quarries in operation are dealt with here.

Dutch Settlement Quarry

The Dutch Settlement gypsum quarry is situated 2½ miles south of Milford Station, which is on the Canadian National Railways and is linked to the quarry by a mile-long spur. The property was opened early in 1954 by National Gypsum Limited and production began the following year. At present the quarry is the largest single producer of gypsum in Canada, employing about 100 men.

The gypsum beds, probably of lower Windsor age, have been proved to an average depth of 200 feet. Overburden ranges from 10 to 50 feet in depth. The property has one billion tons of marketable gypsum blocked out and an additional estimated four billion tons in reserve. The plant is designed for a capacity of 5,000 tons per 8-hour shift operating 12 months a year.

After being broken from the quarry face by blasting, the gypsum goes to a primary, 36″ × 72″ Pennsylvania roll crusher, which reduces the rock to 12″± size. From there it is carried by a 500-foot-long, 48-inch-wide conveyor belt to a screening plant equipped with two double-deck screens. Then it is passed to a secondary 36″ x 60″ Allis Chalmers roll crusher, where the rock is reduced to 4-inch diameter and stock-piled. The stock-pile feeds to the car-loader by endless belt. After being loaded, the crude gypsum is shipped by rail about 30 miles to Burnside, on Bedford Basin, where it is loaded on freighters.

The major part of the gypsum is shipped to various points along the American sea-board from New York to New Orleans for processing. A small amount is also shipped to Montreal.

Fry's Mountain Quarry

Fry's Mountain quarry, 3 miles east of Walton, is being operated by B. A. Parsons Limited under contract to the National Gypsum Company.

Original quarry operations in the vicinity began in North quarry, 2½ miles west of Fry's Mountain quarry. Quarrying moved successively eastward; first to the New quarry, next to Phineas Mountain quarry, and finally to Fry's Mountain quarry. With the exception of the last, all quarries are at present inactive and largely mined out.

The average yearly production of Fry's Mountain quarry is about 200,000 short tons. Operations are conducted for 8 months of the year.

After blasting, the crude gypsum is trucked to Walton where it is crushed and loaded onto freighters for shipment to National Gypsum at Portsmouth, New Hampshire. A small amount is also sent to Dragon Cement Company at Rockland, Maine.

Maynard Quarry

The Maynard quarry is situated 2 miles southwest of Upper Newport. Although this is a small operation, with a daily output of 75 tons, the gypsum is extremely pure. The crude gypsum is hauled to the nearby town of Windsor by truck, where it is used in the manufacture of hardwall and bondwall plasters, plaster of Paris, and insecticides.

One-half mile northeast of Maynard quarry, gypsum was produced until recently from a relatively large quarry on the farm of Kenneth Porter.

FIRE-CLAY

References:

Mason, F. H.: Potters Clay at Middle Musquodoboit; *Trans. Min. Soc. N.S.,* vol. VI, p. 88 (1901).

Ries, Heinrich: The Clay and Shale Deposits of Nova Scotia and Portions of New Brunswick; *Geol. Surv., Canada,* Mem. No. 16-E, pp. 73-87 (1911).

Clay suitable for the manufacture of fire-bricks, pottery, etc., is found at Shubenacadie and several other places in the valley of Musquodoboit River, from Middle Musquodoboit eastward for several miles. The clay beds are known to cover a considerable acreage but exposures are so few and the mantle of glacial drift so thick that the details of individual beds are unknown.

Borings and excavations have proved that the clay deposits consist of alternate beds of silt, sand, and clay, rather than solid masses of pure, high-grade clay. Narrow bands of lignite, rich in concretionary pyrite are present in some deposits. The clay varies in colour from light grey to a mottled red and grey, and upon exposure soon weathers to a much lighter colour. The inherent red is due to a high iron content which renders the clay less valuable economically.

The origin of the clays is not clear. They probably originated from the feldspar-rich igneous rocks that lie east of the map-area and were transported to their present position by west-flowing streams. Individual fragments in the clays are extremely fine, indicating deposition in a shallow, calm body of water. During floods, however, the swollen streams carried sands and plant material which, upon deposition, formed the present-day sand and lignite beds.

Middle Musquodoboit Deposit

The most important deposit of fire-clay is found at Middle Musquodoboit, a few yards east of the road running north to Glenmore. There the clay is light grey, very plastic, and relatively pure. For many years annual shipments have been made from Middle Musquodoboit to Saint John, N.B., where the clay is utilized by the Foley Pottery Company Limited.

Paint Brook Deposit

A deposit of fire-clay of workable size outcrops near the mouth of Paint Brook, a mile west of Centre Musquodoboit. The clay is excessively rich in iron, however, and is of poor grade for fire-bricks or ceramics. Locally, the red clay has been used as a paint for barns.

Shubenacadie Deposit

In 1956 a pit was opened in a bed of clay in Shubenacadie, at a point just east of the Canadian National Railways on the southern outskirts of the village. The bed of clay, about 40 feet thick, is overlain by a 15-foot mantle of glacial debris. Near the top of the clay is a 1-foot layer of carbonized plant remains that form a low-grade lignite (*see* Plate IV). Individual fragments of wood several inches long on which the bark striae are perfectly preserved, are present in the lignite. Much of the coaly material contains concretionary pyrite. In a few places the lignite is overlain by a bed of siliceous, impure sand that contains comminuted gypsum. The sand is overlain by glacial drift.

These clays are believed to be of Cretaceous age for reasons given on page 35.

LIMESTONE

Limestone outcrops at numerous localities and underlies probably a quarter of the part of the map-areas occupied by Windsor sediments. The deposits are of two general types:

(1) Bedded limestones of various degrees of purity.

(2) Shell limestones with a very high calcium content.

The deposits are entirely of Windsor age and occur in lenticular beds rarely more than 50 feet thick and a few miles long. Normally they are overlain and underlain by beds of shale and calcium sulphate of Windsor age except where the basal formation of the Windsor, which is usually a sandy limestone, rests directly upon the nonmarine sediments of the Horton formation. Throughout much of the area, however, Windsor beds lie directly upon strata of the gold-bearing series.

Bedded limestones are normally well stratified and may or may not be fossiliferous. They are of all degrees of purity, high-calcium limestones being more abundant than those with a high magnesium content. According to Goudge (1934, p. 1), the rock is classed as a calcium limestone when the magnesium carbonate content is less than 10 per cent. When the magnesium carbonate content varies between 40.0 and 45.65 per cent, the rock is classed as a dolomite. Magnesian limestones are of intermediate composition between these two classes.

Shell limestones consist almost entirely of coral fragments and marine shells cemented by fine-grained limestone. The rock is normally very drusy, but in a few instances the cavities have been filled with calcite, resulting in a hard, compact stone. Shell limestone always occurs in the form of ridges and mounds, indicative of reef structures.

The limestones vary greatly in colour. Shell limestones are commonly grey or light brown and the bedded types are black, grey, red, or brown. Dolomites are mostly buff coloured.

The economic importance of a limestone deposit depends primarily on three factors: (1) depth of soil mantle, (2) degree of purity of the limestone, and (3) transportation facilities.

A large percentage of the available limestone in the map-areas is rendered practically worthless by one or more of these factors. At present, the demand for limestone in the region is for agricultural purposes only, and is not large. Only one quarry is in operation. Only those deposits of possible economic interest will be dealt with in this report.

Admiral Rock Deposit

References:

Goudge, M. F.: Limestones of Canada, Maritime Provinces; *Dept. Mines, Mines Branch, Canada,* Pt. II, p. 76 (1934).
N.S. Dept. Mines, Ann. Repts.: 1940, p. 75; 1944, pp. 97-105.

Two deposits of very pure limestone occur near the village of Admiral Rock; the first, which is presently being quarried, is three quarters of a mile northwest of the village, and the second, which has been operated in the past, is on the west bank of Shubenacadie River, a mile below the village.

The inland quarry, situated on the properties of William Webb and Robert Kennedy, was first opened about 1940. A Forano hammermill pulverizer with a capacity of 5 tons an hour was installed and a storage shed of 300-tons capacity built. The quarry was first opened on the west side of the road and extended westward for several hundred feet.

61511-2—6

The limestone, which is red, grey, brown, and yellow, contains many marine fossils. Although porous, the rock is not crumbly. Most of the shell cavities contain only a film of minute calcite crystals. The limestone beds appear to be underlain by gypsum, which outcrops a short distance west of the deposit. The quarry is at present inactive.

In 1944 a drilling program was carried out on a ridge of limestone that outcrops east of the road, immediately opposite the Webb quarry. The ridge, which is about 200 feet wide, is almost vertical on the north side and slopes gently southward. Five test holes were drilled with a combined footage of 343.0 feet. The results were disappointing as the limestone was found to be interbanded with clay. Two quarries were opened, however, in the steep north face of the ridge, at distances of about 200 and 700 feet, respectively, from the road. The fossiliferous limestone from these pits has an average purity of 97.0 per cent calcium. The quarries are owned and operated by George Grant of Milford Station and the crushed product is used as a fertilizer within a 40-mile radius of the quarry.

The limestone quarry on the west bank of Shubenacadie River has been inoperative for many years. The deposit consists of two knolls of shell limestone, each about 50 feet high, separated by a brook valley. The south knoll is well exposed where it fronts on the river. The limestone is underlain by gypsum, which is exposed in the river bank. Several abandoned kilns nearby indicate that the stone was formerly burned for lime.

Latties Brook Deposit

References:

Goudge, M. F.: Limestones of Canada, Maritime Provinces; *Dept. Mines, Mines Branch, Canada,* Pt. II, p. 73 (1934).
N.S. Dept. Mines, Ann. Rept. 1947, pp. 167-170.

The Latties Brook limestone deposit is 1.5 miles east of Burton, parallel with and 150 yards north of the railway track. The deposit forms a hill 200 feet high on the property of Allan Lawrence.

During the summer of 1947 nine drill-holes were put down to test the grade and available tonnage of the deposit. The stone is buff to grey, and contains much interbedded shale and sandstone. The deposit contains an estimated 330,000 tons of easily quarried limestone averaging 85.0 per cent $CaCO_3$, with bands of interlayered dolomite.

Middle Musquodoboit Deposit

References:

Goudge, M. F.: Limestones of Canada, Maritime Provinces; *Dept. Mines, Mines Branch, Canada,* Pt. II, p. 63 (1934).
N.S. Dept. Mines, Ann. Rept. 1946, pp. 148-150.

About 2 miles north of Middle Musquodoboit, and a few hundred feet east of the road leading to Glenmore, a quarry has been opened on the west side of a hill of buff-coloured dolomite. The quarry, operated about 1915 as a source of fertilizer, is at present inactive. In 1945 the rock was sampled as a possible source of limestone for the manufacture of rock-wool.

A 10-foot band of limestone-conglomerate containing pebbles of slate and quartzite from the underlying gold-bearing group is exposed in the north wall of the pit. Additional limestone outcrops were found 300 feet north and 300 feet east of the quarry. Both the north and south walls of the quarry are extensively fractured, but the main east wall is relatively undisturbed.

This dolomitic limestone is of lower Windsor age and is found at various localities along the Meguma-Windsor contact east of the quarry on both sides of Musquodoboit River valley.

Riverside Corner Deposit

References:

N.S. Dept. Mines, Ann. Rept. 1943, pp. 82-87.

The limestone deposit at Riverside Corner outcrops along the railway 3 miles southwest of Kennetcook. In 1942 the deposit was investigated with two diamond drill-holes. A small available tonnage under a heavy overburden was indicated.

The deposit consists of grey, porous, highly fossiliferous limestone in the form of a small anticline with its axis striking at right angles to the railway. The limestone outcrops for a distance of about 175 feet along the north bank of the railway. A small fault with unknown displacement is exposed at the east end of the outcrop. Kennetcook River covers the possible extension of the deposit to the south, but limestone outcrops on the banks of a small stream 500 feet north of the railway.

Thirty years ago, a small quarry for the production of fertilizer was operated near the railway.

Anthony's Nose Deposit

On the east bank of Shubenacadie River, a half mile downstream from the mouth of Greens Creek, a vertical band of limestone 50 feet thick juts out into the river in a cliff about 75 feet high. It is overlain and underlain by red shales associated with gypsum. That part of the limestone in contact with the shales is sandy, but most of it is fossiliferous, dark grey to light brown, reasonably pure limestone. This limestone is readily accessible, and could be quarried without difficulty and loaded on to scows at high tide.

Brentwood Deposit

A deposit of pure shell limestone one mile south of Brentwood was worked about 60 years ago, and the limestone was used as a flux in the blast furnace at Londonderry. The deposit is said to have been almost worked out, and the quarry is at present flooded.

Other Occurrences

Large tonnages of limestone suitable for agricultural purposes are available at various other places, the chief of which are:

(1) Along Herbert and Meander Rivers, in the southwest corner of Kennetcook map-area.
(2) Along Hennigar Brook, southeast of Upper Kennetcook.
(3) Along Gays River, in the vicinity of the lead-zinc deposit.
(4) On either bank of Shubenacadie River, at various localities.
(5) Along Little River and its tributary Field Brook.
(6) In the vicinity of Newcomb Corner.
(7) On Putnam Brook, northwest of Middle Stewiacke.

SALT

References:

Wright, W. J.: Reports on Cheverie, Windsor and Shubenacadie Basins; *N.S. Dept. Mines,* Ann. Rept. 1930, pp. 123-142, pt. 2.

Numerous springs of brine and brackish water are present in Kennetcook map-area, but only one salt spring is known in Shubenacadie map-area. All known springs occur in areas underlain by sediments of the Windsor group or of the Scotch Village formation. Where springs do occur in the latter, they are believed to originate in the underlying marine sediments of Windsor age, because salt is not indigenous to rocks of Pennsylvanian age elsewhere in Nova Scotia.

Wright (1930, p. 135) was of the opinion that moderately extensive salt beds exist at depth throughout Kennetcook map-area in the lower measures of the Windsor group. In Shubenacadie map-area, salt beds may also be present in the lower Windsor, but are sealed in by the overlying upper Windsor beds.

SLATE

References:

How, H.: "Mineralogy of Nova Scotia", p. 174 (1868).
N.S. Dept. Mines, Ann. Rept. 1946, p. 80.
Piers, H.: "Economic Minerals of Nova Scotia"; King's Printer, Halifax, p. 60 (1906).

Slates suitable for roofing purposes were quarried many years ago at various localities in both Kennetcook and Shubenacadie map-areas. The slates, dark grey to black and of excellent quality, occur entirely in beds of the Halifax formation.

More than 50 years ago about 2,500 cubic yards of slate were removed from a quarry on the west side of the road, about a half mile south of East Gore. The quarry is at present almost filled with water. Slates exposed on the face will split into exceedingly thin sheets and cleavage is almost vertical. Very little fracturing is in evidence, so that large sheets may be obtained. The slate was used locally for roofing, and several buildings still retain their original shingles put on prior to the turn of the century. A typical example was the old Court House, near East Gore, built more than 60 years ago, on which the slate roof was still intact and in good repair, until destroyed by fire in 1956.

Several smaller quarries are present in the map-areas, the largest occurring on Whittier Brook and on McLean Brook, northeast of Coldstream.

SAND AND GRAVEL

Deposits of glacial sand and gravel are present at numerous localities in both Shubenacadie and Kennetcook map-areas, providing a readily available source of material for road building.

A large deposit of excellent gravel just north of the Dominion and Atlantic Railway on Fivemile River provides an accessible supply of gravel for road ballast on that railway.

Early in 1954 a pit was opened by Hubley's Sand and Gravel Company of Halifax in a large deposit of sand and gravel lying between the villages of Shubenacadie and Nine Mile River. A 1,000-ton daily output of crushed, washed, and screened gravel is trucked to Shubenacadie and thence to Halifax by railway. The company, which has 335 acres under contract, hopes eventually to connect to the Canadian National Railways with a spur line.

Additional noteworthy deposits of sand and gravel are found in the vicinity of Gays River, Crossgill Lake, Stewiacke East, and Upper Rawdon.

BUILDING STONE AND SCYTHESTONES

Sandstones suitable for building purposes are found at several localities in Kennetcook map-area. Locally, the stone was used in the construction of bridges and culverts on the Dominion and Atlantic Railway. Prior to 1868 stone from quarries in the Kennetcook area was used in building the library at King's College, Windsor.

Scythestones of excellent quality were formerly produced from the grey, siliceous sandstones that occur so abundantly in the drift near East Brook 4 miles southwest of Middle Stewiacke.

PETROLEUM

References:

N.S. Dept. Mines, Ann. Repts.: 1945, pp. 23, 87; 1946, pp. 10, 78.

In 1944 an investigation of the petroleum possibilities of the Kennetcook map-area was undertaken by the Nova Scotia Oil and Gas Company. Geological surface mapping was carried out by M. F. Bancroft of Acadia University. Three churn-drill holes, with a combined footage of 4,099 feet, were sunk a half mile northwest of Kennetcook[1]. Salt water only was encountered in all three holes. The geological logs of the three drill-holes, known as Anthony Nos. 1, 2 and 3, are given below.

ANTHONY No. 1

Depth (feet)	Lithology	Thickness (feet)
0– 20	Dull red, fine-grained sandstone	20
20–260	Dull red, gritty shale	240
260–280	Light salmon-red, marl shale	20
280–300	Grey sandstone and grey shale	20
300–360	Light grey shale	60
360–440	Light grey shale tinged with red	80
440–500	Fine, grey sandstone and grey shale	60
500–540	Light salmon-red, marl shale	40
540–638	Dull red, fine-grained sandstone	98
	Total	638

Completed February 15, 1945.

[1]Bancroft, M. F.: personal communication.

ANTHONY No. 2

Depth (feet)	Lithology	Thickness (feet)
0– 20	Red, arenaceous, gritty clay	20
20– 30	Red, arenaceous, gritty shale	10
30– 40	Red, coarse sandstone	10
40–110	Red shale and rounded pebbles	70
110–120	Red shale	10
120–150	Red shale with ½"angular pebbles	30
150–170	Red sandstone with ½" pebbles	20
170–180	Red shale with ¾" pebbles	10
180–200	Coarse pebbly to fine sandstone	20
200–210	Red sandstone with rounded pebbles	10
210–220	Red sandstone with angular pebbles	10
220–230	Fine (quicksand) sandstone	10
230–250	Argillaceous, red sandstone with pebbles	20
250–260	Coarse, red sandstone	10
260–290	Grey shale	30
290–340	Dark grey, fine-grained sandstone	50
340–380	Light, fine, grey sandstone	40
380–390	Argillaceous, grey sandstone	10
390–400	Grey shale	10
400–410	Fine sandstone	10
410–420	Red, arenaceous shale	10
420–450	Red, pebbly shale	30
450–470	Grey, pebbly shale	20
470–480	Red shale	10
480–490	Red to chocolate shale	10
490–520	Red shale	30
520–640	Red shale and sandstone (?)	120
640–660	Grey shale	20
660–680	Mottled grey to red sandstone with chocolate shale fragments	20
680–700	Light grey, marl shale	20
700–830	Light red, marl shale	130
830–840	Dark, brick-red, marl shale	10
840–850	Light red, marl shale	10
850–860	Dark red, sandy, marl shale	10
860–870	Light red, sandy, marl shale	10
	Total	870

Completed December 29, 1945.

ANTHONY No. 3

Depth (feet)	Lithology	Thickness (feet)
30	Unconsolidated drift	30
40	Red, arenaceous shale	10
82	Red sandstone with clay matrix	42
107	Red, arenaceous shale	25
139	Red shale	32
159	Red shale with angular pebbles	20
194	Red, coarse pebbly, to fine sandstone	35
210	Red shale, full of small cavities	16
214	Light brown sandstone	4
224	Red shale full of small cavities	10
286	Red, coarse, arkosic sandstone	62
306	Grey, fine sandstone	20
322	Grey shale with angular pebbles and grit, including feldspar	16
327	Light red, coarse, pebbly, argillaceous sandstone	5
344	Mottled red and grey shales	17
365	Grey, fine shale	21
555	Mottled red and grey shales	190
572	Grey, calcareous shale	17
606	Greyish red shale	34
621	Mottled red and grey arenaceous shale	15
677	Mottled red and grey shale	56
687	Greyish red, fine, calcareous shale with coal fragments	10
715	Grey, fine, calcareous shale with coal fragments	28
760	Grey, calcareous shale (strong smell of petroleum)	45
770	Light brown, calcareous shale	10
787	Red, arenaceous shale	17
803	Red, fine sandstone	16
866	Red shale	63
871	Red, coarse, argillaceous sandstone	5
877	Red, sandstone with crusts of gypsum	6
1,020	Red shale	143
1,035	Greyish red, coarse, argillaceous sandstone	15
1,081	Greyish red and brick-red shales	46
1,090	Greyish red, arenaceous shale	9
1,105	Grey, fine sandstone	15
1,165	Grey, fine, argillaceous sandstone (salt encrusted)	60
1,217	Red shale (salt encrusted)	52
1,221	Light red shale with sandstone pebbles (salt encrusted)	4
1,309	Grey, calcareous sandstone (salt encrusted)	88
1,327	Grey, calcareous sandstone with anhydrite and some salt	18
1,343	White to buff salt and anhydrite with black dolomite fragments (salt 7%)	16
1,389	White to buff salt with some anhydrite (up to 88% salt between 1,365′ and 1,393′)	46
1,401	White to buff salt mixed with grey shale	12
1,453	White to buff salt with anhydrite (in excess of 7% salt up to 50%)	52
1,591	White to buff anhydrite (slightly calcareous)	138
1,770	White to buff calcareous anhydrite	179

ANTHONY No. 3—*Concluded*

Depth (feet)	Lithology	Thickness (feet)
1,781	White to black limestone	11
1,793	White to buff calcareous anhydrite	12
1,818	Dull grey limestone	25
1,844	Brown, fine, silty, calcareous sandstone	26
1,878	Red, sandy, calcareous shale, mottled with fine grey sandstone (shale approaching maroon colour)	34
1,885	Brown, calcareous sandstone	7
1,892	Red, sandy, calcareous shale, mottled with fine, grey sandstone	7
1,913	Light chocolate-coloured, calcareous, arenaceous siltstone	21
1,934	Dark chocolate-coloured, calcareous, arenaceous siltstone	21
1,944	Greyish red, calcareous, arenaceous siltstone	10
1,962	Brown, calcareous sandstone	18
2,030	Chocolate-coloured siltstone with bands of grey siltstone	68
2,040	Greyish brown siltstone	10
2,090	Brownish grey siltstone	50
2,118	Brownish grey, calcareous siltstone with pebbles up to ⅛" diameter	28
2,128	Chocolate-coloured siltstone	10
2,154	Grey to brownish grey, calcareous siltstone	26
2,174	Grey, calcareous siltstone with anhydrite	20
2,230	Grey siltstone with thin beds of mottled grey and red shales	56
2,257	Greyish brown, calcareous sandstone with lenses of algal conglomerate 15 inches thick	27
2,269	Mottled red and greyish green shales	12
2,342	Grey siltstone with lenses of algal conglomerate 15 inches thick	73
2,433	Red and grey mottled shales and thin lenses of algal conglomerate	91
2,452	Grey shale	19
2,471	Grey, micaceous, sandstone with pellets of a smooth red and white, clay-like matter	19
2,491	Grey sandstone with thin-bedded, grey shales	20
2,524	Mottled dark and light grey sandstone with limonite stains	33
2,578	Mottled, dark grey and light grey shales	54
2,591	Mottled grey and red shales	13
	Total	2,591

Completed 1955.

BIBLIOGRAPHY

Bailey, L. W.
1898: Report on Geological Investigations in Southwestern Nova Scotia; *Geol. Surv., Canada,* Ann. Rept. 1896, pt. M, vol. IX, pp. 1-154.

Bell, W. A.
1929: The Horton-Windsor District, Nova Scotia; *Geol. Surv., Canada,* Mem. 155.
1944: Carboniferous Rocks and Fossil Floras of Northern Nova Scotia; *Geol. Surv., Canada,* Mem. 238.

Campbell, J.
1863: "Nova Scotia Gold Fields"; Halifax.

Chalmers, R.
1895: Surface Geology of Eastern New Brunswick, Northwestern Nova Scotia, and a portion of Prince Edward Island; *Geol. Surv., Canada,* Ann. Rept. 1894, pt. M, vol. VII, pp. 1-149.

Crosby, D. G.
1951: The Wolfville Area, Nova Scotia; doctorate dissertation, Stanford University, California, U.S.A.
1952: Wolfville, (East Half), Hants and Kings Counties, Nova Scotia; *Geol. Surv., Canada,* Prelim. map, Paper 52-18.

Daly, R. A.
1901: The Physiography of Acadia; *Bull. Mus. Com. Zool., Harvard College,* vol. XXXVIII, geol. ser., vol. V, No. 3, pp. 73-106.

Dawson, Sir W.
1855: "Acadian Geology", First Edition.
1891: "Acadian Geology", Fourth Edition, pp. 613-640.

Douglas, G. V.
1938: The Deposition of the Halifax Series; *N.S. Dept. Mines,* Ann. Rept., pt. 2, pp. 34-46.

Dunbar, C. O.
1949: "Historical Geology"; John Wiley and Sons, New York.

Faribault, E. R.
1886: *Geol. Surv., Canada,* Ann. Rept., new ser., vol. II, pt. P, pp. 144-148.
1891: *Geol. Surv., Canada,* Ann. Rept., new ser., vol. V, pt. 1, p. 55A.
1899: *Geol. Surv., Canada,* Ann. Rept., new ser., vol. XII, pp. 169A-187A.
1908: *Geol. Surv., Canada,* Sum. Rept. (1907), p. 152.
1913: The Goldbearing Series of Nova Scotia; *Geol. Surv., Canada,* Guide Book No. 1, pt. I, pp. 158-205.

Fletcher, Hugh
1891: Report on Geological Surveys and Explorations in the Counties of Pictou and Colchester, Nova Scotia; *Geol. Surv., Canada,* Ann. Rept., new ser., vol. V, pt. 2, pp. 41, 73, 76-77, 92-94, 96-98, 145, 172.

Gesner, A.
1836: Remarks on the Geology and Mineralogy of Nova Scotia; Gossip and Code, Halifax.
1849: "The Industrial Resources of Nova Scotia"; Halifax.

Goldthwait, J. W.
1924: Physiography of Nova Scotia; *Geol. Surv., Canada,* Mem. 140.

Goodman, N. R.
1952: Gypsum and Anhydrite in Nova Scotia; *N.S. Dept. Mines,* Mem. 1.

Goudge, M. F.
1934: Limestones of Canada, Maritime Provinces; *Dept. Mines, Mines Branch, Canada,* pt. II.

Gussow, W. C.
1953: Carboniferous Stratigraphy and Structural Geology of New Brunswick, Canada; *Bull. Am. Assoc. Petrol. Geol.*, July, vol. 37, No. 7, pp. 1713-1816.

Haliburton, T. C.
1829: "An Historical and Statistical Account of Nova Scotia"; Halifax, vol. II, pp. 414-453.

How, Henry
1868: "The Mineralogy of Nova Scotia"; A Report to the Provincial Government; Halifax.

Hughes, O. L.
1957: Surficial Geology of Shubenacadie Map-Area, Nova Scotia; *Geol. Surv., Canada,* Paper 56-3.

Jackson, C. T., and Alger, F.
1828: A Description of the Mineralogy and Geology of a part of Nova Scotia; *Am. J. Sci. (Silliman's J. Sci.)*, vol. 14.
1832: Remarks on the Mineralogy and Geology of Nova Scotia; *Mem. Am. Acad. Arts Sci.,* new ser. vol. 1.

Jenness, S. E.
1954: Geology of the Gander River Ultrabasic Belt, Newfoundland; Ph. D. thesis, Yale University, pp. 43-48.

King, P. B.
1951: "The Tectonics of Middle North America"; Princeton-University Press, Princeton, New Jersey, pp. 94-116.
1955: Orogeny and Epeirogeny Through Time; Crust of the Earth; *Geol. Soc. Amer.,* Special Paper 62, pp. 733-734.

MacNeil, D. J.
1946: Investigation of Basal Conglomerate; *N.S. Dept. Mines,* Ann. Rept., pp. 233-240.
1947: Geological Studies of the Horton Conglomerates in South-Central Nova Scotia; *N.S. Dept. Mines,* Ann. Rept., pp. 182-186.

Malcolm, W.
1929: Gold Fields of Nova Scotia; *Geol. Surv., Canada,* Mem. 156.

Mathew, G. E.
1908: Geological Cycles in the Maritime Provinces of Canada; *Trans. Roy. Soc. Can,* Ser. 3, sec. IV, vol. 11, pp. 121-143.

McLeod, R.R.
1903: Markland or Nova Scotia; Its History, Natural Resources, and Native Beauties; Halifax.

Messervey, J. P.
1929: Post Carboniferous Mineralization of Nova Scotia; *N.S. Dept. Mines,* Pamphlet.

Moore, R. C., Lalicker, C. G., and Fischer, A. G.
1952: "Invertebrate-Fossils"; First Edition, McGraw-Hill Book Company, p. 722.

Pettijohn, F. J.
1943: Archean Sedimentation; *Bull. Geol. Soc. Amer.,* vol. 54, pp. 925-972.
1949: "Sedimentary Rocks"; Harper Brothers, New York.

Ries, H.
1911: The Clay and Shale Deposits of Nova Scotia and Portions of New Brunswick; *Geol. Surv., Canada,* Mem. 16E, p. 87.

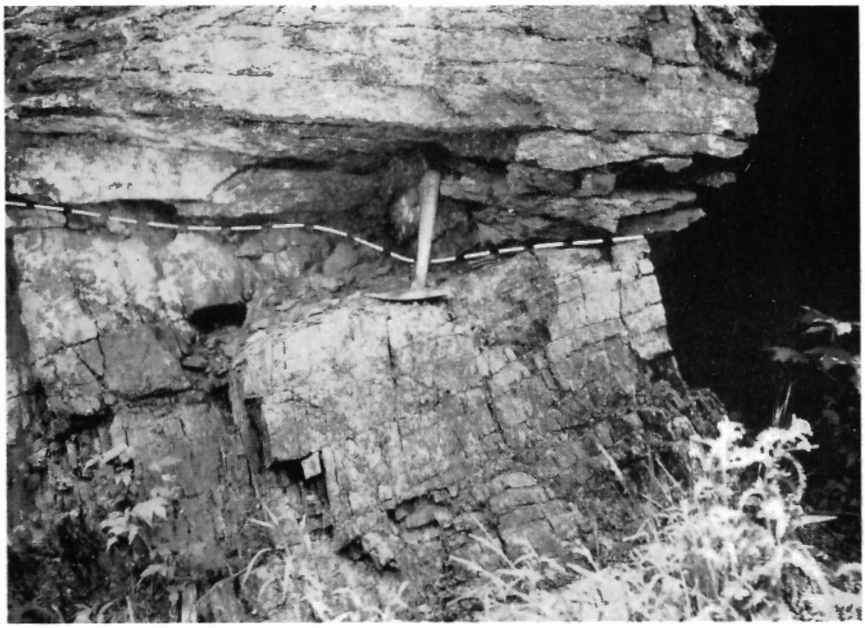
Stevenson, I. M.
1954: Geology of the Truro Map-Area, Colchester and Hants Counties, Nova Scotia; Ph. D. thesis, McGill University, Montreal.
1956a: Shubenacadie, Nova Scotia; *Geol. Surv., Canada,* Paper 55-27.
1956b: Kennetcook, Nova Scotia; *Geol. Surv., Canada,* Map 1-1956.
1957: Geology of the Truro Map-Area, Colchester and Hants Counties, Nova Scotia; *Geol. Surv., Canada,* Mem. 297.

Weeks, L. J.
1948: Londonderry and Bass River Map-Areas, Colchester and Hants Counties, Nova Scotia; *Geol. Surv., Canada,* Mem. 245.
1954: Southeast Cape Breton Island, Nova Scotia; *Geol. Surv., Canada,* Mem. 277.

Weston, T. C.
1891: Notes on Concretionary Structures in various Rock Formations in Canada; *Trans. N.S. Inst. Sci.,* vol. VIII, pp. 137-142.

Woodman, J. E.
1899: Studies in the Gold-bearing Slates of Nova Scotia; *Proc. Boston Soc. Nat. Hist.,* vol. 28, No. 15, pp. 375-407.
1904a: Nomenclature of the Gold-bearing Metamorphic Series of Nova Scotia; *Am. Geologist,* vol. XXXIII, pp. 364-370.
1904b: The Sediments of the Meguma Series of Nova Scotia; *Am. Geologist,* vol. XXXIV, July, pp. 13-34.
1904c: Geology of Moose River Gold District, Halifax County; *Proc. and Trans. N.S. Inst. Sci.,* vol. XI, pt. 1, pp. 18-88.
1908: Probable Age of the Meguma (Gold-bearing Series) of Nova Scotia; *Bull. Geol. Soc. Amer.,* vol. 19, pp. 99-112.

Wright, W. J.
1930: Reports on Cheverie, Windsor, and Shubenacadie Basins; *N.S. Dept. Mines,* Ann. Rept., pt. 2, pp. 123-142.



IMS, 5-12-56

Plate II A—*Unconformable contact between basal conglomerate of the Horton formation and underlying older slates of the Halifax formation. Note cleavage-bedding relationship in the slates. Pictures taken at mouth of drift in old gold workings on McLean Brook, on east side of road three quarters of a mile north of Coldstream.*

IMS, 2-9-56

Plate II B—*Flat-lying Triassic conglomerate unconformably overlying steeply dipping Horton shales and sandstones. Picture taken just east of the mouth of Whale Brook. View looking south.*

61511-2—7

IMS, 5-4-56

Plate III A—*Surface manifestation of karst topography in gypsum beds, Dutch Settlement gypsum quarry, Nova Scotia.*

IMS, 4-5-56

Plate III B—*Stratification in glacial sand deposit. Nine Mile River, N.S.*

IMS, 11-6-56

Plate IV—*Bed of lignite in clay pit at Shubenacadie, N.S.*

IMS, 8-6-56

Plate V—*Contact between conglomerate of the Horton formation and underlying black slates of the Halifax formation. Glen Brook, one and one-quarter miles south of Clarksville, N.S.*

INDEX

PAGE

Admiral Rock deposit 71
Alluvial gold deposits 53
Alton Prospect 65
Anhydrite 30
Annapolis formation 34
Anthony's Nose 24
  deposit 73
Antimony 42, 57, 58

Bancroft, M. F. 1, 76
Barite 61
"barrel" quartz 44
Bell, W. A. 1
Blanchard, J. E. 1
Breau, G. 1
Brentwood deposit 74
Brine springs 23
Building stones 42, 75

Calcium sulphate beds 30
Cameron, C. 1
Carbon datings 36
Cave formation 4
Centre Rawdon 44, 46
  mine 47
Chisholm, R. 1
Churn-drill holes 76
Clarksville 48, 57
Clay 34
Cleavage 41
Coal 63
  samples 35
Cobequid Mountains 36
Conglomerate 17
Cretaceous deposits 34

Dawson, W. 2
Dutch Settlement 42
  gypsum quarry 68

East Brook prospect 65
East Gore prospect 64
East Rawdon gold district 48
Economic geology 42
Economy Mountain 36

Faribault, E. R. 2
Faults 39
Fire-clay 69
Fivemile River 15
Fletcher, Hugh 2
Folds 38
Fossil placer deposit 52
Fry's Mountain quarry 68

PAGE

Gays River 42
  gold deposit 51
  gold workings 37
  lead deposit 54
General geology 6
Gesner, A. 2
Glen Brook 16, 17
Gold 42
Goldenville formation 11
Gourley, C. 1
Gravels 42
Gypsum 30, 42, 66, 68
  origin of deposits 67

Hacquebard, P. 35
Halifax formation 13
Harker, P. 1
Harvey, H. 1
Hennigar Brook 64
Hibernia manganese mine 20, 62
Horne Gold Mines 49
Horton group 14
Hume, Bruce 1

Karst topography 31
Kennetcook River 5

Latties Brook deposit 72
Lead 54
Lead-zinc 42
Lignite 34
Limestone 42, 70
Little River 47
Lower Windsor limestones 23

MacIntosh, W. 1
McLean Brook 17, 51
MacNeil, J. 1
Macumber formation 16, 19, 39
Manganese 61
Marine limestones 23
Maynard quarry 69
Meguma group 8
Middle Musquodoboit 34
  deposit 70, 72
Middle Stewiacke barite deposit 61
Mosherville 46
Musquodoboit River 5, 34

Northeast faults 40
Northup mine 47
Northwest faults 39

61511-2—8

PAGE

Origin of gypsum deposits 67
Otter Brook 29
Ox-bow 5

Paint Brook deposit 70
Pembroke formation 20, 39
Petroleum 76
Physiography 3
Pleistocene deposits 36
Psilomelane 63

Rawdon gold district 46
Rawdon Gold Mines 48
Rawdon Hills 9, 38, 46
Red shales 29
Renfrew gold district 38, 45, 49, 50
Riverside Corner deposit 73
Rock salt 23, 28
Ross, D. 1

"saddle-reef" deposits 45
Salt 74
  springs 28
Sand and gravel 75
Scotch Village formation 31
Scythestones 75
Shubenacadie 34
  deposit 70
  River 5

PAGE

Slates 42, 74
South Branch gold mine 50
Stanley prospect 64
Stewiacke River 5
Structural geology 37

Table of formations 6
Taylor, G. 1
Terasmae, J. 35
Thomas, D. E. 10
Triassic conglomerates 16
Triassic rocks 34

Unconformities 37
Upper Kennetcook prospect 64
Upper Windsor limestones 25

Walton River lead prospect 57
West Gore 42
  antimony deposit 57
Whale Brook 15, 21
  prospect 62
Wilson, A. E. (Miss) 11
Windsor group 18
Withrow mine 47
Wittenburg Mountain 8, 38, 41
Woodman, J. E. 8
Wright, W. J. 28