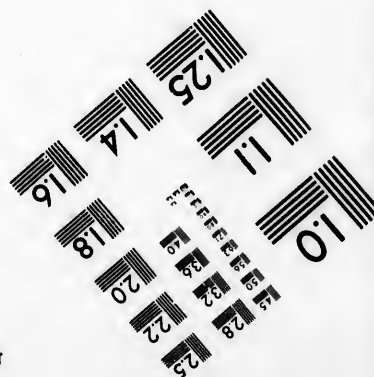
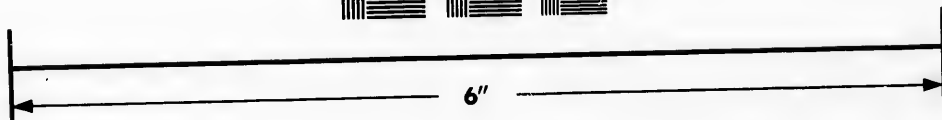
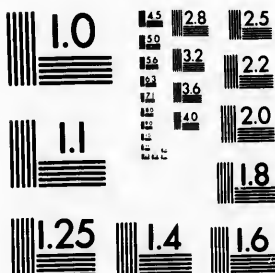


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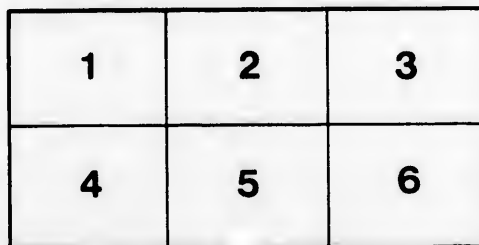
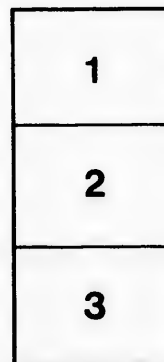
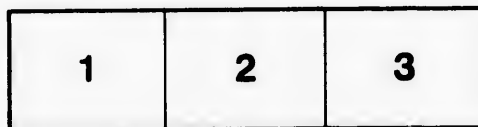
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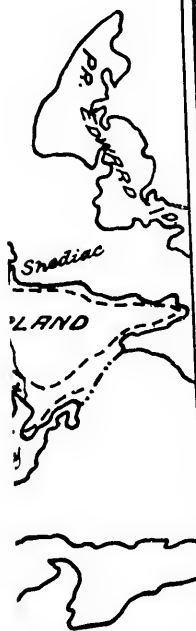
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ARTICLE I.

ABRAHAM GESNER.

A REVIEW OF HIS SCIENTIFIC WORK.

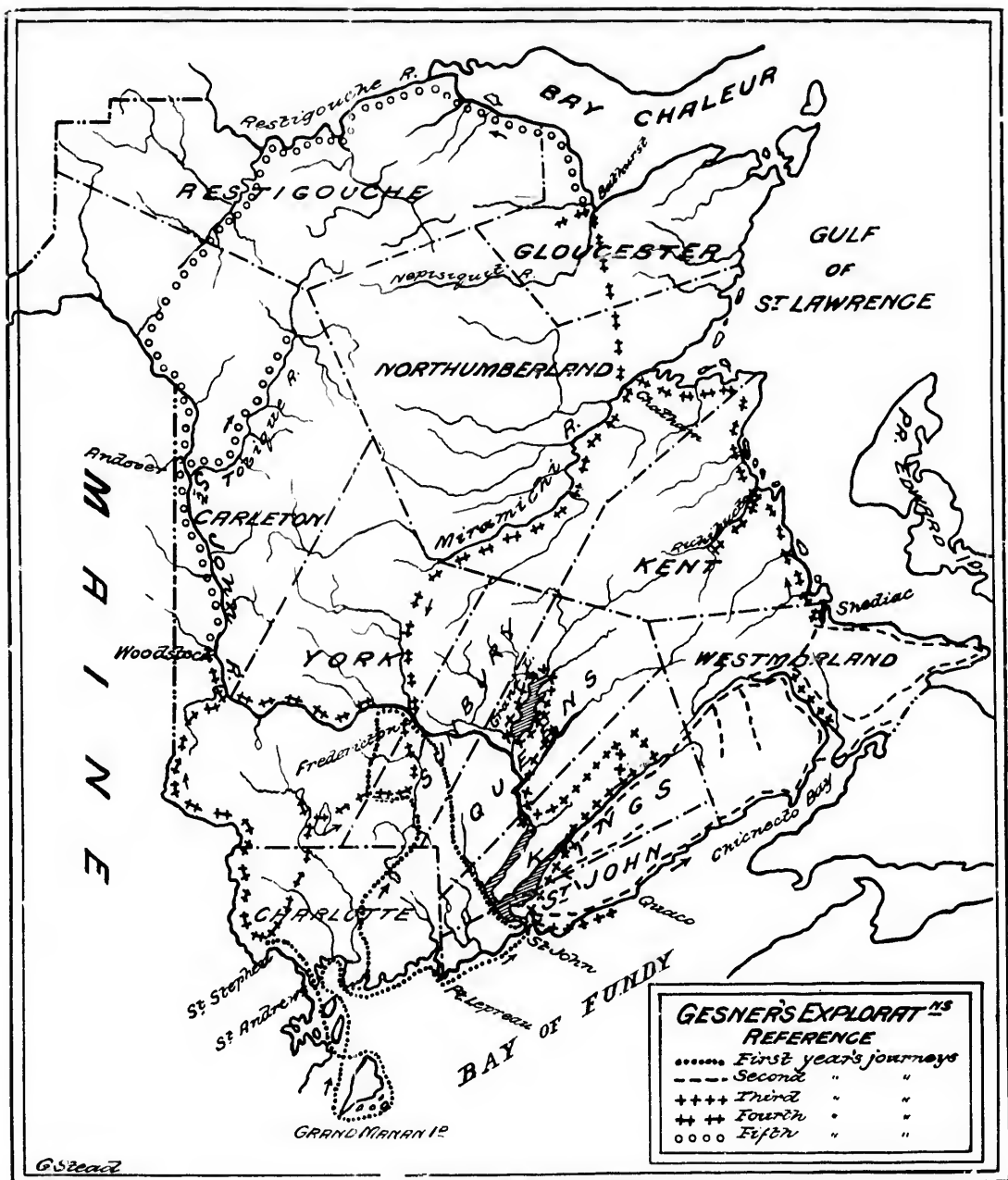
BY G. F. MATTHEW, D. Sc., F. R. S. C.

Read November 1st, 1892.

About half a century ago the name of Abraham Gesner became widely spread in the Maritime Provinces of Canada, from his efforts to make known the mineral wealth and great natural resources of his native province of Nova Scotia: and from his zeal in proclaiming the truths of the new science of Geology.

Born in the midst of a district famed for its natural beauty and its fertility—the land of *Evangeline*—he was within easy reach of some of the most prolific mineral localities, and some of the most remarkable natural geological sections to be seen in the Maritime provinces of Canada. It is not surprising, therefore, that he should have been filled with enthusiasm for the new science, and should have endeavored by tongue and pen to make known the natural wealth of the Acadian land.

A knowledge of the early life and character of Gesner will naturally be sought for by those who are interested in his scientific work. Fortunately this has been supplied by his surviving sons, now living in New York; and a biographical sketch of his father written by G. W. Gesner has been published in the fourteenth Bulletin of this Society (1896).



G. S. GARDNER

The following sketch of Dr. Gesner's scientific work was read before this society some years ago but was held over from publication, awaiting a more detailed account of his early life and education than was then available. This account has been furnished by the Messrs. Gesner in the sketch of his career given in Bulletin No. XIV, and to this will naturally succeed the account of his literary labors.

GEOLOGY AND MINERALOGY OF NOVA SCOTIA.

The earliest important work of Dr. Gesner of which the writer has any knowledge is one on the Geology and Mineralogy of Nova Scotia published in 1836.*

In the preface to this work, Dr. Gesner claims for Nova Scotia that abundance of useful and important minerals which she has since been shown to possess, and this at a time when her coal industry was in its infancy, and her gold mines unknown: and he says that she will maintain her pre-eminence in this respect unrivalled by any country of equal size.

The author tells us that this work was written for the "perusal of the general reader," and in accordance with this intention it is prefaced with a short introduction to the science of geology and mineralogy, drawn from the works of eminent writers of the first half of the present century. Among the writers frequently quoted in this book are Mohs, Brongniart, Buckland, Cuvier, Lyell and Cleveland. An outline such as Dr. Gesner gave was the more necessary in those days because scientific text-books on the science of Geology were few, and difficult of access in a new country.

Gesner acknowledges receiving some information from the writings of Messrs. Jackson and Alger, two Boston chemists, and from Mr. Haliburton's history of Nova Scotia. On comparison with the work of the two former the reader will perceive that Dr. Gesner has drawn largely for information from this source, but at the same time he does not show a slavish adherence to the opinions of these authors.

* Remarks on the Geology and Mineralogy of Nova Scotia by Abraham Gesner, Surgeon, 313 pp., 2 pt., 1 map. Halifax 1836.

The essay of Messrs. Jackson and Alger* was written in 1831, and gave the first full and accurate account, that had been published, of the minerals of the "North Mountain" of Nova Scotia. In connection with the principal topic of their work they gave also an outline of the geology of the province as a whole.

Considering the time at which it was written, this work was an excellent digest of information on the minerals of Nova Scotia, but it was too technical for the ordinary reader, and Gesner's book, written in a more popular style, and from the stand-point of the colonist, had a wider circulation, and served to diffuse more generally among the provincials a knowledge of the resources of Nova Scotia.

Gesner found four geological districts in the province, these he called the Primary District, the Clay Slate District, the Red Sandstone District and the Trap District.

A division into four districts had been adapted by Messrs. Jackson and Alger, but while Gesner classed all the red sandstones together, the above authors, on their map, distinguished the red sandstones of the Annapolis valley from the others and described them in connection with the trap rocks—a more natural arrangement.

Of the *primary district* extending along the Atlantic coast from Canso to Shelburne, Dr. Gesner observed that the "clay slate" succeeded the granite, except where the gneiss and mica schist are interposed. He thus recognized the antiquity of the slates of this tract as contrasted with those of the district next to be described. How little the mineral wealth of this district was suspected at this time, may be gathered from another remark wherein he says (in speaking of the country east of Halifax) that no indications of ores were seen on any part of this coast.

In the country west of Halifax Dr. Gesner found a variety of quartzites, mica schists and clay slates, with hills and masses of granite interspersed. He lays special stress on the rocking

* Remarks on the Mineralogy and Geology of Nova Scotia by Chas. T. Jackson and Francis Alger. Published by the American Academy of Science, 1831.

stones and perched boulders observed in this district, as curious objects of much interest. In this district also he found deep fissures in the granite, and supposes that there have been violent earthquakes and volcanic explosions, which had rent the rocks asunder and thrown these boulders to the tops of the highest hills.

This primary district of Dr. Gesner corresponds to the quartz rock and slate district of Messrs. Jackson and Alger, but the boundaries given by Gesner are more natural than those of the Boston authors. Also it corresponds to the Lower Silurian of Sir Wm. Dawson's map* but is much narrower.

In his account of the second, or *Clay slate district*, Dr. Gesner, while remarking upon the occurrence of granite, gneiss and mica schist in this district, found it to contain also graywacke and the "old mountain limestone" with remains of marine animals and plants. The boundaries of this district as given by Gesner nearly correspond with those of the "Transition" clay slate of Messrs. Jackson and Alger, but where they differ Gesner's boundaries are more correct and natural.

Gesner's description of the iron ores of Clements and Nietau also agree very nearly with that of the authors above named, and both also describe in somewhat similar terms the fine quartz crystals of Paradise river and the bog iron ore of Aylesford.

There is a difference in condition between the iron ores of Clements and Nietau, for while the former are converted into magnetite, the latter are still hematitic ores. The Boston chemists thought the alteration of the Clements ore due to heat from the mass of trap in the North Mountains on the opposite side of the Annapolis valley; Gesner on the contrary attributed it to the vicinity of intrusive granite.

An interesting account is given by Dr. Gesner of the discovery of a fossil of the zoophyte family† and of dendritic markings in the grey slates at Beech Hill in Horton. Fossils (enerinites and trilobites) were also discovered in the clay slate formation at New Canaan. Several pages are devoted to a description of the iron.

*In *Acadian Geology*. 2nd Ed. London 1868.

† Now known as *Dictyonema Websteri*.

ore beds of the Pieton district, which also had attracted the attention of Messrs. Jackson and Alger.

In explaining the transportation of large masses of rock in this district which are found far removed from their parent beds, and are found on the surface of the newer rocks or promiscuously scattered over the ground, Dr. Gesner invokes the aid of powerful currents. From his further remarks it is evident that he supposed these currents to have been ocean currents and to have been those of a general deluge.

All the western part of this district is spoken of as the South Mountain, and the rocks are said to be generally of transition age, and are "among the most ancient of the secondary strata."

This slate district, both as defined by Gesner and by the two Boston authors, comprises the Silurian and Devonian rocks of the province,* (except such as appear in the Cobequid range) and the interior or northern part of the Cambrian belt of the Atlantic coast.

In the sheltered and fertile valley of Annapolis, Dr. Gesner found the new red sandstone, a comparatively recent deposit, and inferred that the red sandstones to the northeast of it were of the same age. Hence he described all the northern area of Nova Scotia as the *Sandstone district*. In this district the soils are more fertile than in other parts of the province, and Dr. Gesner had a high opinion of its marl as a fertilizer. He does not fail to describe the extensive deposits of limestone, gypsum and calcareous marl which are formed here. The extensive tracts of marine alluvium formed in the northern part of Nova Scotia are said to be laid down on these red sandstone rocks.

The account given of the Wilmot spring is an interesting bit of local history, in view of the extensive use now being made of its waters:—

"In the town of Wilmot, about three miles from Gibbon's Inn, there is a mineral spring possessing medicinal properties of considerable importance. When the discovery was first announced to the public, numerous were the persons who, being afflicted with different diseases, hastened to the waters, then supposed to

* In a work written thirteen years later Gesner classes these slates as Silurian.

be the *divar vita* and quite sufficient to remove all the ills that flesh is heir to. Without reference to the nature of their diseases, and at every stage of their complaints they hoped and vainly hoped to obtain relief. In the midst of the forest the little village near the pool of this modern Bethesda was all bustle and confusion, while many for want of accommodation were obliged to depart not healed. * * * Many were the cures reported to have been made at this spring. Newspapers teemed with its praises. But experience soon proved that its powers were not sufficient to remove all the ailments of its visitors; hence Wilnot spring is already abandoned and its name is seldom spoken. "So changeable and unsteady is public opinion." * * *

"The waters of the spring have been analyzed by Dr. Webster and are found to contain sodium, lime, sulphuric acid and magnesia. They will doubtless be beneficial in all serophulous and glandular diseases. They are generally aperient and cannot fail to be serviceable in dyspepsia and other diseases of the digestive organs."

Dr. Gesner found various classes of marine organisms in the limestones of Windsor, Shubenacadie and Gay's river connected with the red sandstones and shales. These he at first referred to the Lias of Great Britain in accordance with his view that the sandstones were New Red, but in a later work stated that these rocks were Carboniferous.

Dr. Gesner mentions the occurrence of salt springs at several places in the red marl or shale group in Cumberland county, and infers from this the presence of important beds of salt beneath the surface. Both he and Messrs. Jackson and Alger take the salt springs as an indication that these sandstones are "New Red" or Triassic.

The districts that Dr. Gesner included in the new Red Sandstone have been since divided by geologists into New Red or Trias and Lower Carboniferous. In later years Dr. Gesner accepted this assignment of the red marls and gypsum beds to the Carboniferous, as may be seen by consulting his later work, *Industrial Resources of Nova Scotia* (1849) p. 236.

While Dr. Gesner found only *four districts* in Nova Scotia, his Red Sandstone district included also the *Coal formation*,

which he regarded as underlying the red sandstones and so did not distinguish on his map. His map in this respect does not differ from that of Jackson and Alger. He devotes considerable space to a description of the various coal basins in the northern part of the province; and to the Cobequid Mountains. He claims to have discovered the importance of this chain as a natural division between the various coal basins there. This chain, says he, contains primary rocks, but is in general composed of gray wacke and has enormous ridges of porphyry.

The coal mines at Pictou had been opened at this time. The Albion mine was being operated by the General Mining Association, but only to a moderate extent, and coal mining elsewhere in Nova Scotia was then scarcely pursued at all. Dr. Gesner mentions that he found a few men at work on the "King Vein" at the Joggins. No work had been done at Springhill, although a good seam of coal had been found there. The locality was not at that time within the reach of profitable mining owing to its isolated situation.

We find that Dr. Gesner with many of the geologists of his day, held the opinion that the coal flora in its "tropical luxuriance indicated the presence of a very hot climate at the time when it flourished. Lofty palms, cacti, Araucarian pines, ferns and enormous rush-like plants" then covered the ground. These, on account of the perfect preservation of their most delicate parts, he conceives to have lived, died and been buried before the Noachian Deluge.

Among the fossils occurring at the Joggins Gesner enumerates the following:—*Lepidodendron aculeatum* Sternb. *Sphenopteris trifoliata* Brongt. Flag-like leaves [*Corchaites borassifolia* Sternb.]. Cacti = *Variolaria* Sternb. [= *Stigmaria* of modern authors.] Conifers [= *Daloxylon*] *Syringobendron* [probably *Sigillaria* sp.] *Palmitis sulcatus* [probably a *Sigillaria*]. *Phytolithus transcursus* Steinhaur, possibly a *Sternbergia*. Other plants are referred to in general terms. Gesner estimated that half of the plants he found were ferns.

In describing the *Trap district* Dr. Gesner began at the western end, at Brier Island, and as Messrs. Jackson and Alger began at the same point the two descriptions are very similar as far as Peters Point, eastward of Digby Gut, where the exploration of the last named writers ceased, so far as the Bay of Fundy is concerned. East of this at French Cross Dr. Gesner had the good fortune to discover the red sandstone cropping out from below the amygdaloid and trap at low water mark. Along this shore as far as Black Rock, Dr. Gesner found beautiful crystals of calcareous spar, heulandite, laumontite, stilbite, analcime and other zeolites. Here also he found prehnite [a rare mineral in the Nova Scotian trap].

In the vicinity of Parrsboro, where Dr. Gesner appears to have spent some time, more careful explorations were made and a variety of rocks and minerals were observed. From this convenient centre he made excursions in various directions; visiting the high cliffs of Blomidon, along whose base a variety of agates and zeolites are found; in a westerly direction he visited the broken shore by Spencer's Island and Cape d'Or, collecting native copper, etc., from the trap; he did not find at Cape Chignecto the large area of trap rocks described by Jackson and Alger; in the opposite direction he explored the north shore of Minas Basin, studded with small islands and projecting points of trap.

Our author was greatly impressed by the noble scenery along the northwestern coast of Nova Scotia, and takes great delight in describing the peculiarities of this basaltic range—the columns of the trap and the step-like successive layers; the crumbling cliffs of amygdaloid and the varied and beautiful minerals it contains. He supposes these minerals to have been introduced into the amygdaloid by the agency of heat, either by igneous fusion,* or by sublimation.† These views would hardly be accepted at the present day, especially as regards the zeolites.

The theories presented in this work by Dr. Gesner show an extensive acquaintance with the writings of the earlier geologists. We find him quoting the geological works of Buffon, Werner,

* Pp. 180, 192 and 236.

† Pp. 218, 241.

Hutton, Burnet and Conybeare and Philips as well as Buckland. He displays considerable acquaintance with the "Principles" of Lyell but of course knew nothing of Lyell's later works, consequently his reasoning in this book on Nova Scotia is all based on the opinions of the early writers.

All through this work there are very sanguine opinions expressed as to the mineral wealth of Nova Scotia, especially in coal and iron. As regards the former mineral these opinions have been fully borne out by later developments, and it is probable that as time goes on the large deposits of iron ore which Nova Scotia possesses will also be more fully utilized.

TITLES, SUBJECTS, AND ITINERARY* OF DR. GESNER'S
GEOLOGICAL REPORTS.

*First Report on the Geological Survey of New Brunswick, by
Abraham Gesner, Provincial Geologist, etc., 1839, St. John,
(81 pp).*

PAGE.	PAGE.	PAGE.
1 Introduction.	47 Magaguadavic.	72 Iron Ore.
12 Mountain Range along the South Coast.	48 L'Etang	74 Carboniferous Lime- stone.
15 St. Andrews.	49 Beaver Harbor.	75 Old Red Sandstone, Ar- gillaceous slate and Granite.
23 St. Stephen.	51 Peelogan and Leproe	77 Coal Measures.
27 Islands of Passama- quoddy Bay.	54 Musquash.	78 Diluvial collections.
29 Deer Island.	58 Lancaster.	81 Concluding remarks.
30 Campobello.	63 St. John.	83 Glossary of Geological terms.
31 Grand Manan.	65 Nerepis Road to Fred- erickton.	
32 Passamaquoddy.	68 Magaguadavic to Oro- mocto.	

*Second Report on the Geological Survey of the Province of New
Brunswick, by Abraham Gesner, Provincial Geologist,
St. John, 1849 (i. to vii. and 1-76 = 88 pp.)*

PAGE.	PAGE.	PAGE.
i. Introductory.	33 Fossils of Chignecto Bay Coal Field.	72 Shediac
1 General Remarks.	38 Action of the Sea on the coast.	74 East coast of Westmor- land.
6 St. John	40 Exploration of the Interior.	55 Baie Verte.
13 Black River.	40 Hammond River.	56 Sackville
15 Quaco.	45 Hampton.	59 Dorchester.
23 Hopewell.	46 Sussex.	60 Westmorland Coal Field.
24 New Horton.	49 Petitcodiac.	73 Glossary of Geological terms.
25 Grindstone Island.		
26 Shepody.		
29 Cape Maranguln.		

* See Map of his journeys opposite the title-page.

Third Report on the Geological Survey of the Province of New Brunswick, by Abraham Gesner, F. G. S., Provincial Geologist, etc., St. John, 1841 (i. to xv., 1-88 = 103 pages.

PAGE.	PAGE.	PAGE.
1. Letter, v. Introduction.	28 New Red Sandstone.	51 Iron Ore.
1 County of St. John.	31 Smith's Creek.	55 Wickham.
6 Mispec.	32 Mill Stream.	59 Washademoak.
10 Black River.	34 General view of New	62 General Remarks on
12 Emericson's Creek.	Red Sandstone of	New Brunswick Coal
13 Ten Mile Creek.	Westmorland and	field.
15 Porphyry.	Kings Counties.	63 Grand Lake.
16 Observations on the	38 Mineral Contents, Lead,	70 Salmon River.
State and Graywacke	Rock Salt, Iron, Gyp-	77 Alluvium of the St. John
of the Coast.	sium.	River.
17 Elevated Coast, Raised	42 Valleys of Denudation.	80 Portion of a Jaw-bone.
Beaches, etc.	45 Agricultural Character	81 Record of Borings at
21 Tertiary Formations.	of New Red Sand-	Salmon River.
22 Animal Remains.	stone District.	84 Glossary of Geological
24 Hammond R. Westmor-	46 Kingston.	terms.
land Coal Field.	50 Springfield.	

Fourth Report on the Geological Survey of the Province of New Brunswick, by Abraham Gesner, F. G. S., Provincial Geologist, etc., St. John, 1842 (101 pp.)

PAGE.	PAGE.	PAGE.
3 Letter.	50 Northampton. South-	78 Fossils of the Coal Field
5 Introduction.	ampton, etc.	80 Plants of the Coal Field
18 Graywacke and Slate.	51 Mineral Springs.	84 Topographical Details.
24 Coal Field South of the	51 Terraces.	84 Tidnish River.
St. John River.	63 General Description of	85 Cocagne.
25 Exploration of Scodie	Great Coal Field of	87 Richibucto.
and Cheputneticook	New Brunswick.	89 Coal.
Rivers and Lakes.	70 Physical Features of the	91 Bog Iron Ore.
Red Paint.	Great Coal Field.	92 Kouchibougnac.
Limestone.	71 Peat.	99 Nashwaak.
74 Woodstock.	72 Rocks and Minerals of	
	the Coal Field.	

Report on the Geological Survey of New Brunswick, with a topographical account of the Public Lands (and the district explored in 1842), by Abraham Gesner, F. G. S., Provincial Geologist, etc., St. John, 1843 (88 pp).

PAGE.	PAGE.	PAGE.
3 Letter.	61 Red Sandstone, Gyp-	76 Various Alluviums.
5 Introduction.	sium, etc.	77 Marl, Clay, Sand.
12 Topographical Report.	63 Coal Formation.	78 Salt, Gypsum, etc.
25 Tobique River.	63 Silurian System.	79 Water Limestone, etc.
34 Exploration of the	67 River Saint John.	80 Flagstones, Grindstones,
Restigouche River.	69 Silurian Rocks of Bay	Slate, etc.
47 Public Lands.	Chaleur.	81 Coralline Marbles, Ser-
51 Geological Report.	72 Cambrian System.	pentine, Granite.
55 Recent Alluviums.	73 Granite, Syenite.	83 Coal, Iron, Lead.
56 Ancient Alluvium.	74 Trap, Serpentine.	84 Manganese, Copper.
59 Tertiary Deposits.	75 Economic Geology.	86 Lime in Agriculture.

N. B.—Of the 467 pages of texts of these reports, 85 are devoted to a description of the coal fields and their products.

GEOLOGICAL SURVEY OF NEW BRUNSWICK.

It would appear that immediately after the publication of his work on the geology and mineralogy of Nova Scotia, Dr. Gesner turned his attention to the neighboring province of New Brunswick, for in his first report on the geology of this province he stated that in 1837 he had obtained an outline of the geographical features of that part of the province which borders the Bay of Fundy; and it would seem that before he began exploration for the provincial government he had (by request of private individuals?) visited the lead mine at Lubec in Maine.

At the close of his first season's work he was able to give the following general sketch of the geological structure of the southern part of New Brunswick:

"The southeast side of New Brunswick, or that part which reaches near the coast, extending from Shepody Bay in the county of Westmorland (now Albert) to the American boundary line in the county of Charlotte, is occupied by an extensive and moderately-elevated chain of mountains, composed principally of granite and other primary rocks. This range is situated at an average distance of fifteen miles from the shore of the Bay of Fundy, and includes the highlands eastward of the river St. John. Westwardly, it embraces Bald, Eagle, Douglas, Pleasant and other mountains. The course of this mountainous district is from southwest to northeast.

"At the southern base of this elevated region the slates and limestones of the transition series, and the sandstones and conglomerates of the secondary formations, are placed in their usual order of succession, wherever they have not been broken up and buried by extensive eruptions of volcanic matter. All these rocks have been penetrated by large and numerous dykes of trap, basalt and porphyry, and the surface of the country * * * exhibits the clearest evidence of having been the theatre of violent earthquakes and intense volcanic action.

"The granite entering into the structure of this mountain chain is also succeeded on its northern side by slate and graywacke * * * then follow the rocks of the great coal formation which extends from the head of the Oromocto river in a north-east direction to Northumberland Straits."

Such is the outline which Dr. Gesner gives of the geology of southern New Brunswick; and this his various journeyings during the first three years that he was engaged on the survey of New Brunswick served to complete and extend. His fourth year's work took him beyond the district covered by this outline and in his fifth year he was engaged in exploring the wild lands and thinly settled districts in the northern part of the Province.

Dr. Gesner began his exploration in Charlotte County by making an examination of the St. Croix river and the islands off the coast of that county. On the river he found two mineral springs, of one of which, at St. Stephen, he gives an analysis; on the islands he found indications of various metals, at Campobello veins of galena, in the bold trap cliffs of Grand Manan, zeolites and other minerals similar to those of the traps of the North mountains in Nova Scotia; a remarkable discovery here was that of an extensive tract of sunken ground off the south-eastern coast of the island, where the anchors of vessels become entangled in the roots of trees imbedded in the bottom of the sea near the shores.*

At Lepreau he found the coal formation with coal-measures containing various fossils, some of which were like those of the fir tribe, others were ferns, and others stigmarie. The coal basin, however, was of very limited extent, as it was found to terminate about three miles inland. Further along the coast, at Musquash, he found verd-antique marble and alum slates.

Dr. Gesner now made traverses of the interior for the purpose of obtaining a knowledge of the strata on both sides of the granite axis of the Nerepis hills. He first passed across the granite ridge by way of the Nerepis road as far as Oromocto, and then made a traverse further west along the Magaguadavic and Oromocto rivers to the same point, intersecting the metamorphic and igneous rocks, and a part of the central Carboniferous area of the province. In these traverses he discovered some iron ore, roofing slates and a granite quarry. During these journeys he had excellent opportunities of observing the southward move-

* First Rep. p. 40.

ments that had occurred in the loose surface deposit or "diluvial collections." These he attributes to the effects of a "general deluge that swept over the country from north to south," and to this cause also he refers the glacial striae: "these are seen to cross each other at different angles, and this affords evidence that the course of the current was not always uniform."

In his second year he first made a voyage along the coast eastward of St. John to the head of the Bay of Fundy. He then returned to St. John and made a parallel traverse of the country along the valleys of the Kennebecasis and Petitecodiac rivers, and examined the eastern coast of Northumberland.

In going eastward along the coast Dr. Gesner found a small coal field at Quaco, where excavations had been made upon an impure seam of coal, and at Quaco Head he examined the intrusive trap and deposit of manganese that exists there. Following the coast eastward he found some remarkable conical hills of serpentine and trap at Great Salmon river. At Hope-well he again met the coal formation and the valuable freestone and grindstone beds of that parish, and this formation was found to extend across the Petitecodiac river.

In his traverse of the interior Dr. Gesner found another coal basin, which he called the Westmorland coal field. This was found to extend from Sussex, where he examined a bed of coal, to the eastern shore of the province at Shediac. He found coal also on the Pollet River and Turtle Creek, and further east. These last were probably cannel coal, or highly bituminous slate. The ash varied from twelve to twenty-five per cent.*

In his third year he re-examined a part of the coast east of St. John, and then the "new red sandstone" district in Kings county. Afterward he made excursions on various branches of the St. John river, among the rest Belleisle Bay, and Washademoak and Grand Lakes.

In the report on this year's explorations Dr. Gesner summed up the result of his three years work in this difficult region, whose complicated geology has exercised the minds of many

*Second Report, p. 66.

investigators since then. His work was so far advanced that he now prepared a geological map of this southern part of the province, the first that had been made. This map, which has never been published, is now in the hands of the Natural History Society of New Brunswick, and is complete for the work of these three seasons.* *See page 38*

In the first report, Dr. Gesner had announced the occurrence of Carboniferous limestone and Old Red sandstone among the "secondary" rocks north of the granites, and now in this third report gives a somewhat extended account of raised beaches and estuarine deposits. These raised beaches with their shells he refers to the *Newer Pliocene* of Sir Chas. Lyell.

Following this is an account of the Westmorland coal field and of the New Red sandstone of Westmorland and Kings counties: the minerals of the latter formation are said to be lead, iron, gypsum and rock salt. It is probable that if Dr. Gesner had worked long enough in this "New Red sandstone" tract, he would have referred it to the Carboniferous System, as he subsequently did that of Nova Scotia, similarly characterized by gypsum and salt springs. Dr. Gesner observed several valleys of denudation in this district. The report closes with an account of the Grand Lake coal field and of the alluvium of the St. John river.

In this report it will be observed that Dr. Gesner had made an advance in his knowledge of the "transition" rocks in the southern part of the province, for while he had previously spoken of the Graywacke as one system, he now finds that there are two. One he calls the upper, or newer, having found it to rest unconformably on the other, and to be characterized by the remains of marine shells and land plants. The older Graywacke did not contain organic remains. A figure is given of one of the moluscous animals of the newer Graywacke (which he compares to the *Silurian* of Mr. Murchison) and as Dr. Gesner mentions

* An amended copy is on file in the Crown Lands Office at Fredericton. See description of the original map on a later page.

† They are now regarded as Post-Pliocene.

the locality from which it came we know it to have been obtained from the shales of Division 1, Band *c*, of the St. John Group. In the fauna of this band, the only fossil that will answer to Dr. Gesner's "terebratulite" is *Orethis Billingsi*, Hartt. Examples of this fossil, in which the ears are broken off or concealed in the matrix, would resemble the terebratulite.* Dr. Gesner also found this formation to contain plant remains in the form of a "cactus" (or *Stigmaria*).

Fig. 1



A *Terebratulite*
Slate of St. John.

In an upper set of beds other plant-remains were found. These were discovered at Little River and consisted of trunks of trees, *conifera*, a calamite, impressions of leaves, and a plant called a *Phytolithus*†, which probably was a *Sigillaria*. From the description of the locality it is evident that these plants came from the *Dadoxylon* sandstone, of the Little River group. Dr. Gesner was thus the pioneer in making known the fauna of the Cambrian and the flora of the overlying pre-carboniferous rocks in New Brunswick. That he did not reach the full significance of his discoveries is not at all surprising, for the district where these two classes of remains are found is a very complicated one; and the study of its geology for half a century past has hardly yet resulted in the unravelling of its complicated structure.

Dr. Gesner's older Graywacke group is exemplified in the Huronian schists of the Coastal group and the altered schistose rocks between Cape Mispec and Emerson's Creek along the shore of the Bay of Fundy.

In his fourth report we find that Dr. Gesner revised his reference of the Graywacke system, and upon the ground of the scarcity of organic remains, a few *terebratula* and some land plants only having been found, he classes it with the Cambrian system of Professor Sedgewick. This classification he carried out in a more systematic way, as regards the northwestern part of New Brunswick the next year, when he made his final report.‡

* Second Report, p. 8. † Second Report, p. 12. ‡ Fifth Report, p. 51.

During the fourth year of his survey, Dr. Gesner was engaged in extending the work of previous years to the United States boundary and Woodstock, on the one hand and to the mouth of the Miramichi on the other. He traced a belt of "primary" rocks (granite, etc.) from the Cheputnecticook Lakes to the sources of the Miramichi, marked the boundaries of a large forked area of Cambrian rocks, and located the western and northern bounds of the large central carboniferous area of New Brunswick.

At this time, apparently, Dr. Gesner became acquainted with the Glacial theory, and refers to the inquiries of Agassiz, Buckland, Lyell and others into facts connected with the glaciers of Switzerland, Scotland and Ireland,* and he thinks it probable that many parallel ridges of sand and gravel in New Brunswick have been produced by the operations of ice; but we do not find that he used this theory subsequently in accounting for grooved surfaces on the rocks, which he still attributes to diluvial floods from the north. "The Glacial Period," says Gesner, "introduces the opinion that between the period of the enormous animals, the bones of which are buried in diluvial districts, and the present epoch, there was a period of intense cold."†

The fifth report (entitled "Report on the Geological Survey of New Brunswick with a topographical account of the Public Lands and the district explored in 1842) describes the country of the Upper St. John and the wilderness and forest country on the headquarters of the Tobique and Restigouche rivers. In this area Dr. Gesner found an extensive area of Silurian slates and overlying tracts of red sandstones with limestone and gypsum deposits.

Through the information on the geology and natural products of the province which these reports contained, a great deal of interest in her mineral wealth was excited, and the popular mind was filled with large expectations of the development of her mines. A number of mining adventures were undertaken, some of which were successful, but many the reverse. In Albert

* Fourth Report, p. 59. † Fourth Report, p. 12

county, especially, large amounts were invested in the Albertine mine (discovered soon after Gesner completed his surveys) and in the sandstone quarries on the coast and the Petitcodiac river. The mining of coal in Queens county was prosecuted with vigor, and iron furnaces were started at Woodstock. But the returns from these sources did not prove so valuable as from the mines of the neighboring province, and discredit was thrown on the work of Dr. Gesner. He had committed the error of expressing an opinion on the mineral wealth of the province more favorable than the after results justified, and hence a reaction came which probably helped to terminate his engagement with the provincial government. This, however, hardly justified the withholding of his salary for the last year, which was not paid for some time after the work of exploration terminated.*

In judging of Dr. Gesner's work, I think sufficient allowance has not been made for the imperfections of the science of geology in his time. He lived, or at least his training was obtained in the formative period of the science, almost before its general principles and laws were formulated. From his earlier works it will be noticed that he interpreted geological phenomena by the theories of Werner and Hutton; in later years he decides the age of the several terranes which he found in the metamorphic hills of southern New Brunswick on the tests and data of Sir Roderick Murchison and Professor Sedgewick, and finally he became acquainted with the theories of Agassiz and Lyell, relative to the glacial period. We are not to expect from a geologist living in that early period, the exact methods of the modern trained specialist.

The limestone beds in the Narrows of the St. John river to which Gesner drew attention, have been largely quarried for lime of late years, and that a similar result has not flowed from the discovery of deposits of iron ore and gypsum described in his reports, is in part due to the modern conditions of trade, and

*The following is an extract from a letter from Dr. Gesner to Hon. G. S. Hill, St. Stephen, dated Cornwallis, N. S., 7th August, 1844: "I need scarcely add that so far I am unable to obtain a whole year's salary due from the province for services ordered and duly authorized by Sir William [Colebrooke, the Lieut. Governor] * * * and I can hardly express my dissatisfaction and mortification."

especially to facilities for transportation in recent years which shuts out from commercial competition all but the purest and most extensive mineral deposits.

PALEONTOLOGY OF DR. GESNER'S REPORTS.

Dr. Gesner appears not to have been deeply versed in the science of Paleontology, which in his day was going through the formative process. Its foundation principles were generally known, but the means of its special application were not always at hand. Authentic specimens of typical forms were not easily accessible on this side of the Atlantic, and the photographic camera and other appliances of which the modern artist can avail himself, were not within reach of the engraver half a century ago.

From these and other causes the paleontological references and figures in Dr. Gesner's reports are crude and often difficult to comprehend. Any errors into which the writer may have fallen in the interpretation of this part of Gesner's work, may perhaps, on this account, be excused.

The following outline references will enable the reader to determine how far it will be necessary for him to study the original reports. The marginal references are to the number of the report quoted, and the page.

- I. 20. Johnston's and Simpson's Cove, Charlotte Co. Marl with clam, mussel and scollop shells. [Post-pliocene, Champlain.]
- I. 10. Grand Harbor, Grand Manan. Sunken forest in the harbor. Pine, hemlock, cedar. [Recent.]
- I. 52. Lepreau, St. John Co. Fossils of Fir tribe, ferns, stigmaria. [Little River Group.]*
- I. 70. Hartt's Mills, Oromocto. Conifera, Calamites in Carboniferous conglomerate. [Millstone Grit.]
- I. 71. Otnabog L., Queens Co., one mile south of. Limestone with ammonite [Nautilus] encrinite, trilobite, ostrea [some other genus], Mya [Edmonia?], area [Macrodon?], are common. [Lower Carboniferous.]
- II. 7. "The Valley," [City of St. John], Mya, Pecten, Mytilus, and other shells in clay, eighteen feet above level of the sea. [Post-pliocene.]

* The plants from this terran have been determined by Sir Wm. Dawson.

- II. 8. Valley, north side of, opposite Jeffrey's Hill [Garden street.] Slate with remains of shells, Terebratulite. [Supposed to be *Protorthis Billingsi*, Hart, of the Paradoxides Beds on Seely street. [Cambrian.]
- II. 12. North side of Little River, near the bridge, in compact Grauwacke. Trunks of two large fossil trees, belonging to the Conifera. [Trees similar to these have been determined by Sir J. W. Dawson as *Dalmanella Ontonagoniana*.] Other smaller plants and impressions of leaves, species of *Phytolithus** and a calamite [*Archaeocalamites* (= *Boralia*) *caulatus*.] Little River Group.
- II. 12. City of St. John, near the residence of "His Worship," [i. e., the Mayor, on the south side of King Square.] Remains of a cactus. [Probably a worm-pitted flagstone. Cambrian.]
- II. 15. Quaco Head, St. John Co. In grey sandstone. Two species [i. e., varieties] of cactus [i. e., *Stigmario* *flexoides*] and a calamite. [Carboniferous.]
- II. 25. Grindstone Island [Albert Co.] In sandstone. Fossil trees two feet across and forty feet long exposed on the side of a cliff. It is branched and belongs to the Dicotyledonous order. [Carboniferous.]
- II. 31. Chignecto Bay. Coal formation. *Conifera*, *Syringodendron*, [i. e., decorticated *Sigillaria*] four species. At Cape Marenguin, *Phytolithus*, one species. Calamites are numerous— $1\frac{1}{2}$ inches across. [Carboniferous.]
- II. 35. Same district. *Sigillaria*, two species. [The figures seem to represent *S. lessellata*, Brongn.] *Carla* [i. e., *Stigmaria*.] Ferns [*Aethopteris touchilica*?] and other plants. [Carboniferous.]
- II. 59. Tantramar Marsh, Westmorland Co. Large trees of different kinds, collections of shells and bones of fishes found buried at different depths in the marsh. [Recent.]
- II. 63. Sussex, Kings Co. In sandstone and shale. Large cacti [i. e., *Stigmariae*] and calamites, and leaves of other plants. [Carboniferous.]
- III. 5. Kennebecasis to Cape Mispec [near St. John]. In clay slate frequently ferruginous, Marine animals and land plants [?] alternately [Cambrian]. At Little River, in arenaceous beds, Fossil trees [Little River Group].
- III. 7. St. John, near Jeffrey's hill, remains of marine animals, and land plants [?] [Cambrian].
- III. 14. Ten Mile Creek, St. John Co. Sandstone and shale. Calamites, common, also fossil trees [Carboniferous].

* *Phytolithus* was a generic term used very indefinitely by Steinbaur, it might mean any fossil stem not a calamite or a *stigmaria*. See notes on Gesner's Geological map, p. 31.

- III. 17. Various localities in St. John County. In marl and marly clay; over thirty specimens of testacea and crustacea, *Mya mercenaria* [*i. e. arenaria*], *Pecten* [*islandicus*] *macra*, *Solen cassis* [doubtful if these two occur] *mytilus*, two species, [probably *M. edulis* and var. *elegans*.] Claws of crab, bones of fishes [*Post-pliocene*].
- III. 30. Butternut Ridge, Kings Co. In limestone encrinites ammonites [Nautili] and several species of bivalve shells [Brachiopods]. [Lower Carboniferous.]
- III. 56. St. John River, east side of head of the Reach, farms of Mosses, Carpenter, Queen's Co. In Carboniferous limestone, ammonites [*i. e. Nautilus*], encrinites, astrea [?], orthis [extinct in Carboniferous time, probably *Productus*] pectenite [perhaps *Aviculopecten*] several species of terebratula [*T. sacculus* and varieties].
- III. 60. Long Rapid of Washdenoak River, Queen's Co. In sandstone, etc. Large trees, cacti [*i. e. Stigmaria*], calamites, etc.
- III. 61. Grand Lake coal field. Point between Young's Cove and Cumberland Bay. Reddish calcareo-argillaceous deposit with remains of marine plants like *Laminaria saccharina*.
- III. 68. Grand Lake, Long Point, south side of. Fossil trees 69. [Conifera], a *phyllocladus* and a *calamite*.
- III. 74. Grand Lake, Salmon River mines. Cacti [*i. e. Stigmaria*], scarce; ferns more numerous.
- IV. 49. Graywacke and Slate. Same fossils as are referred to in Report II, pages 8-12.
- IV. 80. Richibucto, *sigillaria* 2 ft. 4 in. in diameter. Bathurst, Gloucester Co. Two species ferns different from any figured European species.
- IV. 95. Chatham, Northumberland Co. In sandstone. Ferns and coniferous plants, no cactacea [*i. e. Stigmaria*] observed.
- V. 60. Jaquet River, north of, Nash's Creek. In clay beds. *Mya mercenaria* [= *arenaria*], valves of *Balan* [*B. crenulatus* and *B. Hameri* occur here], two species of *Mytili* [*M. edulis* and var. *elegans*] *pecten concentrica* [probably *Cyprina Islandica*].
- V. 64. Point La Nim. Soft shales. Restigouche Co. *Stigmaria* [perhaps *Psilophyton*.]
- V. 64. Escuminac Bay, east of, Restigouche Co. In sandstone and shale. Remains of a small fish [perhaps *Phanacaphuron*] and a small species of tortoise [fish, *Pterichthys Canadensis*], also fossil foot marks.
- V. 67. Presqueisle River, Flammagan's Hill, Victoria Co. In impure limestone *Cyathophyllum basalliforme* [?] columns of encrinites, casts of producta. Elsewhere called *producta depressa*, [*i. e. Leptaena rhomboidalis*] of the Wenlock Limestone.

c

t/m/

- V. 70. Bellefleur Point, Gloucester Co. Impure limestone containing spirifer [S. *cygloptera*?] producta [*i. e.* *Leptaena rhomboidalis*], Encrinites, *Favosites Gotthardica*, *Cyathophyllum turbinatum* [?] a coral like *Syringopora geniculata*.
- V. 70. River Charlo, south side of Restigouche Co. In limestone, a shell like *Atrypa reticularis*.
- V. 71. Bathurst, J. W. Herwood found *Favosites Gotthardica*, *Producta depressa* [= *Leptaena rhomboidalis*] *Atrypa aspera*, crinoides, *Leptaena* [*Strophomena*] *cygipha* and *Spirifera* [S. *cygloptera*]. Besides these, I [A. Gesner] observed several shells, whose species have not been determined.

GESNER'S GEOLOGICAL MAP OF NEW BRUNSWICK.

The absence of a geological map is greatly felt by the reader who attempts to obtain a knowledge of early geological exploration in New Brunswick from the reports of Dr. Abraham Gesner. From time to time in the text of these reports references to a map in course of preparation are met with; but no complete map of his exploratory work is extant, and the one he made to show the result of his first three years' work has never been published. This map for many years has been in the possession of the Mechanic's Institute at St. John, and has lately been acquired by the Natural History Society of New Brunswick. A copy of the map was lodged with the Crown Lands Department at Fredericton.* Dr. L. W. Bailey, of the University of New Brunswick at that place, has never seen any other map by Dr. Gesner, and does not know of any there. The original map in the possession of the Natural History Society, therefore, seems to be the one to which we must look to primarily for a representation of Dr. Gesner's work in New Brunswick.†

* See Report on the Agricultural Capabilities of New Brunswick, by J. F. W. Johnston, F. R. S., Fredericton, 1850, p. 6.

† The first reference to this map will be found in the Second Report, page xii, where Dr. Gesner says, "The geological map of the province has been commenced and is advancing towards completion." Again, in the Third Report, page iii, he says that the report "is accompanied by a geological map of that part of New Brunswick which has been examined." In the Fourth Report, page 4, he states that "a geological map will be with this report laid before your Excellency, the labor of past season being added to that which was before completed." Also at page 18, "Each of the different classes of rocks has been laid down on the geological map of the province, now in course of preparation." In the Fifth Report he adds, "an incomplete geological map of the province is submitted for your Excellency's consideration." I have not been able to discover that this "incomplete map" is any other than the one described in the previous report.

To Mr. Geoffrey Stead, C. E., the author is indebted for the copy of Gesner's map in black-line hatching which accompanies this paper. (See page 39).

It has been thought that Dr. Jas. Robb's geological map of New Brunswick embodies that of Dr. Gesner, but on a comparison of the two I find that this is not the case. It seems, therefore desirable that this first geological map of the province should be published so that those who wish to read Dr. Gesner's reports may do so with a map before them.

The publication of the map is also desirable, as no opportunity has heretofore been given to compare it with the geological map of New Brunswick published some years later by Dr. Jas. Robb.* It also affords the means of comparison with the geological map of New Brunswick, etc., published by the Dominion Geological Survey.

Dr. Gesner's original map represents only the first three years of his explorations, but from the one filed with the Crown Lands Department at Fredericton, a copy of which I received through the kindness of Mr. Loggie, I have added the results of his fourth year of exploration. This extends the map as far as Woodstock on the western side of the province, and to Shippegan on the eastern.

There is no index to the several geological formations on the original map, but the colors used by Gesner are easily understood from his reports, and from the index on the copy of the map in the Crown Lands Office.

Eight divisions are indicated by the colors on the original map, and are as follows :

- Lias Limestone.
- New Red Sandstone.
- Coal Formation.
- Mountain Limestone.
- Old Red Sandstone.
- Graywacke System.
- Syenite, Trap, etc.
- Granite.

* Published with Johnston's Report on the Agricultural Capabilities of New Brunswick. But many copies of this report were issued without any geological map. At page 6, Dr. Robb tells us that his map was to a great extent based on the reports of Dr. Gesner.

The Intrusive Rocks.

Dr. Gesner at an early date recognized the granitic range of the Nerepis hills as the key to the geological structure of southern New Brunswick. He noticed also that the sedimentary beds resting on the flanks of the granite hills were more or less broken up, and to some extent buried by extensive eruptions of volcanic matter, and had been penetrated by numerous trap dykes. This was the generalization he made at the end of his first year's work. But in the second year of his survey, he found that the true granite terminated at Belleisle Bay on the river St. John; and he also discovered (or thought he did) that the ridge of the crystalline rocks curved southward from there, and as a belt of syenite, etc., extended westward along the south side of the granite range, and eastward through Kingston, the Loch Lomond hills and along the Shepody road to Shepody mountain in Westmorland County.

In the fourth year of his survey he traced another granitic axis, extending from the Cheputnecticook Lakes, northeastward toward Bathurst on the Gulf of St. Lawrence. The western end of this axis is shown on the map, but the eastern lies beyond its limit.

In comparing this old map of Dr. Gesner's with that of Dr. Robb, who was his successor in the study of the geology of New Brunswick, one may observe that in some respects the former is more accurate than the latter, as, for instance, in the boundary of the granitic area of the Nerepis hills; and theoretically more correct in other respects, as, for instance, in the distribution of the syenite and trap rocks, which by Dr. Robb are represented as round isolated masses in many cases, but by Dr. Gesner as occupying elongated areas. Among the metamorphic tracts these intrusive rocks have usually come out through long fissures parallel to the general trend of the several bands of sedimentary rock. Only within the Carboniferous area, and at Grand Manan, are there broad sheets of eruptives undisturbed.

Later studies on the "trap rocks" of southern New Brunswick show that in many cases the rocks represented as intrusive-

are really old lavas and ash-rocks, both of Post-Cambrian and Pre-Cambrian systems, originally spread out in broad sheets, but which, now, owing to the folding of the strata with which they are interbedded, exhibit their worn edges at the surface, and thus have the elongated out-crops which Dr. Gesner represented on his map.

Gesner's "New Brunswick"* gives the latest view which that author has expressed on the extent and arrangement of the intrusive rocks in that province. The *granite* in this work is described in much the same terms as in his reports above cited.

But in this work he divides the syenite ridge of his Second Report† into two parts: one of syenite extending from the Kennebecasis through St. John County to Albert County‡, corresponding in its western part to the syenite of the Laurentian axis of the Dominion Survey Reports, and in its eastern part to the syenites, etc., of the Huronian (Coldbrook) rocks of St. John County.

The other division of the syenite ridge is its western part and is called "trap." The places mentioned as being on the§ course of this band, except Red Rock Lake, || show that its western part is composed of the bedded traps which cap the (Upper) Silurian system in Charlotte County; its eastern part consists of the bedded traps of the Kingston series.

Dr. Gesner was thus by degrees learning to distinguish the differences which exist between the effusive rocks and the intrusive rocks forming the core or axis of the metamorphic range traced by him in southern New Brunswick. His divisions may be interpreted as follows:

Granite.—The Devonian granite of the Nerepis range.

Syenite.—The intrusive Syenites of the Laurentian and eastern Huronian (Coldbrook) areas.

Trap.—The old lava flows and intrusive dykes of the Silurian (Upper) and the Kingston series (Huronian).

* New Brunswick, with Notes for Emigrants, by Abraham Gesner, F. G. S., etc. London, 1847.

† Second Report, p. 2. ‡ "New Brunswick" p. 342 § Op. cit. p. 343.

|| Red Rock Lake is among the intrusive granites.

The Graywacke System.

In classifying the rocks in the southern part of New Brunswick, Dr. Gesner at first divided them into the three simple classes recognized by the earlier geologists, viz.: The Granite and other crystalline rocks; the Transition series; and the Secondary formations. Thus the transition rocks are the more or less altered rocks of the metamorphic *massif* or complex of southern New Brunswick; and include all the terranes from the Laurentian to the Devonian. Dr. Gesner, however, proceeded to improve his classification year by year as his survey progressed. In the second year of his survey he made some important discoveries of fossils near St. John which led him to conclude that the slates and graywacke of the transition rocks crossing the harbor of St. John, and at the entrance of the river of that name, were to be classed with the "Silurian group of Mr. Murchison."* This remark certainly applies to the slates and graywacke, and appears also to include the limestones north of them, for he asserts that the fossil shells found in the slates were afterwards met with in the limestones.† His opinion of the age of the plant-bearing beds is very clearly expressed (page 12) where he says "these plants belong to the first classes of vegetables that ever flourished on the earth. They * * are evidently far more ancient than those which afford bituminous coal."

Still extending his observations on the rocks along the coast, Dr. Gesner, in the third year of his work, found reason for a further division of the strata of the transition complex. In examining the rocks from Cape Mispec eastward he found an older and more altered set of beds, which, in relation to the Silurian rocks above mentioned, were *primary*,‡ and further he found that this older set had a reversed dip§ as contrasted with the "Silurian." In these apparently older and lower strata, no organic remains were found, and further they were harder, were more replete with quartz veins, and talc and chlorite were associated with them. Dr. Gesner therefore concluded that though

* Second Report, p. 3.

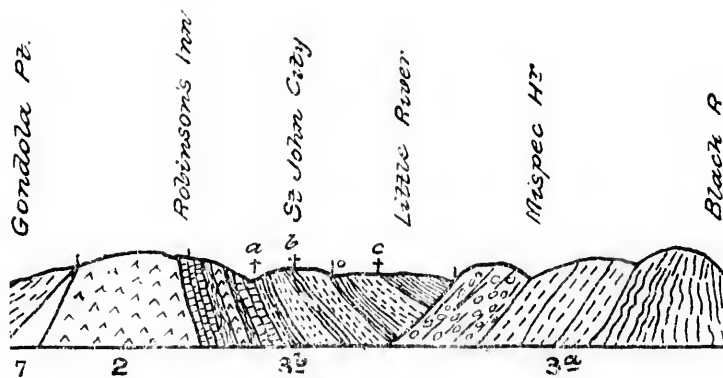
† Second Report, p. 8. This observation, however, is open to question, as these limestones are older than any rocks in which mollusca or molluscoïda have been found.

‡ Third Report, p. 3.

§ Third Report, p. 7.

the whole of these rocks belonged to the Graywacke group, the upper only bore a close resemblance to the Silurian rocks of Europe.

For the purpose of making plainer Dr. Gesner's brief statements of the age of the two series of the Graywacke system, and to show its relation to the intrusive and the secondary rocks, the author has constructed the following section.



EXPLANATION OF SECTION.—2, Intrusive Syenite, etc., (of Pre-Cambrian age.)
3a, Older Graywacke System. 3b, Newer Graywacke. 7, Red Conglomerate and Sandstone. a, Fossil "tribratula." "Cactus." o, Anthracite coal seam. c, Fossil coniferous trees.

This section will convey Dr. Gesner's conception of the structure of the peninsula between the Kennebecasis river and the Bay of Fundy. On the south-east, at the base of his "older Graywacke group" is a mass of hard contorted slates, and schists with beds of volcanic ash rock; the middle of the group consists of Graywacke with some clay slate, and the upper part is a mass of coarse conglomerate.

Resting on these unconformably is his "newer Graywacke group;" having at the base limestones with beds of Graywacke and intrusive trap; then the series of slates and Graywacke on which the city of Saint John is built; and finally compact Graywacke with fine grained clay slates. Dr. Gesner compared the newer Graywacke group to the Silurian of Murchison, but he does not appear to have given any name to the lower group, or to have compared it with any European system.*

* They are called *Metamorphic rocks* in his "New Brunswick," 1847.

A casual reading of Dr. Gesner's reports would leave the impression that he continued to class his Upper Graywacke group with the Silurian; but no such classification is shown on his map, and if we examine his Fourth Report it will appear that this was not his final conclusion. There, in speaking of the Graywacke and slates of St. Stephen, which are colored as being of the same terrane as those of St. John, he calls them *Cambrian* system of Professor Sedgwick,* and if his language be carefully examined I think it will be plain that he intended this remark to apply also to the Graywacke of St. John. By placing together the paragraphs from the different reports, the basis for this inference will be seen.

2nd REPORT.	3rd REPORT.	4th REPORT.	LAST REPORT.
<p>P. 3, l. 12.—Since we have discovered the remains of <i>molluscons animals, fossil trees, and anthracite</i> among these slates, † * * they may be classed with the <i>Silurian</i> group of Mr. Murchison.</p> <p>P. 8, l. 21.—A few strata of slate meet the chert and in them we found the remains of shells. They are all <i>terebratula</i>.</p>	<p>P. 5, l. 50.—Clay slates * * containing <i>marine animals and land plants</i> alternately, appear</p> <p>P. 7, l. 28.—In the upper series * * the remains both of <i>marine animals and plants</i> were found, * * * and it appears that the <i>Silurian</i> group of Mr. Murchison is clearly developed in New Brunswick.</p>	<p>P. 19, l. 7.—The only fossils found * * * consist of a few impressions of <i>terebratula</i> and plants analogous to those of the <i>coal period</i>. * * † I am inclined to believe that they may be properly classed with the <i>Cambrian</i> system of Professor Sedgwick.</p>	<p>P. 73, l. 13.—<i>Cambrian System</i>.—The few organic remains found in this group are sufficiently characteristic * * * The strata consist of graywacke, graywacke slate and clay slate.</p>

Dr. Gesner carefully gave the localities for the fossil shells and plants referred to in the second and third reports, but in his fourth report he does not mention any locality for shells or plant remains near St. Stephen; hence it may be inferred that the remarks quoted are of general application and based on the discoveries at St. John.

From these extracts, especially when taken in connection with the context, in the several reports, it appears to me plain that in his later reports, Gesner intended to refer to the Cambrian, the strata which in the second and third reports he had compared with the Silurian. This classification was adopted by Dr. Robb for the districts described in the fourth and last report, *but not for those of previous reports*, which on his map are colored as Upper Silurian.

* Fourth Report, p. 19.

† There are really several.

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We thus find that while Dr. Gesner had first spoken of the Graywacke or transition rocks as one system, he soon discovered that there were two series † included in it, and that of these two series the upper one was characterized by the remains of marine shells and of land plants, and that the older series had no organic remains. Subsequently when he came to explore the Graywacke system in other parts of the province and could find no organic remains in it he came to the conclusion that the whole should be called Cambrian on account of the *scarcity of organic remains*. So far as the geological reports are concerned, he made this his final statement of the age of these rocks, they being in this way contrasted with the Silurian (Upper) of the northern part of the province in which he met with evidences of a more abundant marine life.

The description of the locality near St. John where the marine animals of the Cambrian system were found by Dr. Gesner is as follows: "On the north side of the ravine, not far from the pottery, and directly opposite Jeffrey's Hill (Garden street) there is a bed of chert extending some distance in an east and west direction, a few strata of slate meet the chert and in them we found remains of shells."

The pottery above mentioned was situated in the valley at the foot of Garden street, and the ravine opposite would be the hollow extending up from the west end of Wright street to the west end of Seely street. Here we find the quartzite or hard sandstone of Band *a* in Division I of the St. John group, and immediately in front of it the Paradoxides shale (Band *c*, of the same division). There is no chert in this neighborhood, and the rock so called by Dr. Gesner, I suppose to be the quartzite of the St. John group, Division I, Band *a*. The "few strata" of slate in this case would be the shales of Band *c*. At this point they yielded to Dr. Gesner's hammer the remains of "molluscous animals." A figure of one of these is given and is called by him a "*tephrotulite*."*

We find greater difficulty in dealing with the "cactus"

*Second Report, p. 8. See page 17, *super*.

found by Dr. Gesner in the City of St. John, near the residence of the mayor [Robert F. Hazen, at the corner of King Square and Charlotte street.] Being found here it must have come from the flags of Division 2 of the St. John group. The strata of this locality are of such an age as to give to the cactus or *Stigmaria* an antiquity far greater than any fossil of this genus known up to the present day. I therefore conclude that this object was some imitative form, and not a true *Stigmaria*. In the beds of Division 2 there are numerous burrows of *Arenicolites*: such burrows occurring in crumpled slates or flags would readily take on the appearance of *Stigmaria*. Many of the markings in Cambrian sandstones have been mistaken for plant remains, notably the varieties of *Eophyton* in the Swedish Cambrian rocks described by O. Torrell, and his *Corhalites Nilsoni*: even so cautious an observer as Linnarsson took *Eophyton* to be a plant.

But while we should be loath to admit of the presence of land plants in the St. John group without the strongest proof, there can be no doubt that Dr. Gesner did discover remains of plants at Little River near St. John, in beds now known to be much newer than the flags of King Square.* These plant remains were found in compact Graywacke, and consisted of "large fossil trees, *Canifera*, with other smaller plants and impressions of leaves." This locality, which is well known, is in the *Dadoxylon* sandstone of the Little River group and the trees are similar to others from this sandstone which Sir Wm. Dawson has described as *Dadoxylon ontarioamericanum*. Of the smaller plants mentioned, one is said to be a calamite, this probably would be *Archaeocalamites radiatus* (= *Bornia radiata*) which occurs commonly with this *Dadoxylon*. Another of the smaller plants is called a *Phytolithus*. *Phytolithus* was a genus very loosely used by Steinhaur, having been applied by him to species of *Lepidodendron*, *Stigmaria*, *Sigillaria* and *Ulodendron*.† Gesner appears to have had access to Steinhaur's article, and I think he intended under *Phytolithus* to indicate here a species of *Sigillaria*. Badly preserved stems of species of this genus are

* Second Report p. 12. † Coal Flora of Pennsylvania, Lesqueroux, 1881.

quite common in the Dadoxylon Sandstone in some places, and Sir Wm. Dawson has described one from the extension of these beds on the opposite side of the harbor, under the name of *S. palpebra*.

In connection with the plant remains (but not in the same beds) Dr. Gesner speaks of having discovered two small veins of *anthracite coal* in soft, fine grained clay slate. These slates were divided into layers of from half an inch to four inches in thickness, and were found at a small creek near the new Penitentiary. He speaks of the slate rock appearing in cliffs on the shore where the strata readily decompose. From these indications I conclude that this "anthracite" came from the fine black shales of the St. John group, which are well exposed in a low cliff on Courtenay Bay, in front of the County Alms House; the brook which discharges here comes past the Penitentiary. Much of the slate is black and highly carbonaceous, and layers of it might resemble anthracite; but the existence of true anthracite here is improbable, as the deposit is of marine origin and of Cambrian age; and its natural connection is not with the Devonian sandstone containing plant remains, but with the beds in which Dr. Gesner found the "terebratulite."

This author found the fine slates to be devoid of quartz veins, and for this reason, as well as because they contained anthracite, he associated them with the plant-bearing Graywacke sandstone, rather than with the slates and Graywacke of the St. John group, to which they properly belong, and which he found had numerous quartz veins. Dr. Gesner laid much stress on the presence of quartz veins as showing the antiquity of strata, and considered the great abundance of quartz veins in the older Graywacke group as a proof of its great antiquity.

Dr. Gesner was thus the pioneer in the discovery of Cambrian and other pre-Carboniferous fossils in the terranes at St. John; that he did not reach the full significance of his discoveries is not surprising, when we consider how little was known in those early days outside of the great centres of geological investigation, of the distinctness of the several faunas and floras included in the transition rocks.

Dr. Gesner's *older* Graywacke group also contained strata of various ages. To him, the distinctive features of this group, were its incipient metamorphism as shown by the innumerable quartz veins mixed with talc and chlorite, that traverse the rocks, and the absence of organic remains. Of the three masses of strata associated by Dr. Gesner in this lower Graywacke group, the lowest consists of the schists of the Coastal (Huronian) group, the middle of the southern basin of Dadoxylon sandstones of the Little River group and the upper part of the conglomerate beds to the north of them. The unusual hardening of the Paleozoic and older rocks at Mispec give to this "older Graywacke" group of Dr. Gesner an appearance of greater antiquity than that possessed by the strata further north.

Four years after closing his engagement with the government of New Brunswick, Dr. Gesner published a general work on that province, describing its topography, resources, etc., and giving an outline of its geology. In this there is a later expression of Dr. Gesner's views respecting the age of the schistose rocks of the southern coast. Here he classes the Lower Graywacke group with gneiss and the elastic schists under the head of *Metamorphic Rocks** and states that these rocks skirt the shores of the Bay of Fundy from Salisbury Cove to Chamcook Bay. He says that no fossils have been discovered in these rocks, and evidently they are his Lower Graywacke group.

As regards the Upper Graywacke group, it would appear that Dr. Gesner at this time was disposed to assign a part of them to a higher horizon than he had previously. In one of his geological reports he had remarked that several of these vegetable relics were discovered in slate and Graywacke, which agree in their general characters with the sandstones and shales of the upper coal series.† The thought here foreshadowed seems to have governed Dr. Gesner in his final remarks upon the plant-bearing and shell-bearing beds at St. John, for he says that the sandstones containing the fossilized remains of coniferous trees.

* New Brunswick, p. 343. † Second Report, p. 12.

and those having a variety of terebratula, evidently belong to the imperfect coal measures, of which there are several instances in the province.*

One basin of such imperfect coal measures is that of Lepreau described by Dr. Gesner;† another is that of Quaco.‡ Dr. Gesner believed that both of these basins were of Carboniferous age.

If my interpretation of Dr. Gesner's views of the age of the Upper Graywacke group is correct, he expressed successively the following opinions of the age of these rocks :

In the First Report — Transition.

In the Second and Third Reports — Silurian.

In the Fourth and Fifth Reports — Cambrian.

In the "New Brunswick," — † Part of them are called imperfect coal measures.

One more phase of opinion is that expressed in Dr. Jas. Robb's geological map of New Brunswick, where these rocks are colored as Upper Silurian. In all this time, from 1838 to 1860, no actual progress had been made in determining the true age of these strata. The first important step in this direction was taken when Sir Wm. Dawson, by the study of the plant remains, showed that the upper part of the group was at least as old as the Devonian; and the second, when Prof. C. F. Hartt found, by comparison of the mollusca with those of the Primordial Zone, of Barrande, in Bohemia, that the lower part was Cambrian.

The unravelling of this complex Pre-carboniferous *massif* of southern New Brunswick has not only shown that it contains the plant-bearing terrane and the Primordial terrane above mentioned, but three others in addition, besides the "fundamental gneiss," so that there is ample room for deposits of all the eras to which Gesner and Robb referred it.

*New Brunswick, p. 343. †First Report, p. 53. ‡Second Report, p. 15.

Old Red Sandstone.

On this map the narrow strip of measures which Dr. Gesner has called old red sandstone will not easily catch the eye. The "mountain limestone," which immediately overlies it, was no doubt the occasion for referring this belt of measures to the Old Red Sandstone. To Dr. Gesner, if we may judge by the glossary of geological terms attached to his reports, the Old Red Sandstone was a "stratified rock belonging to the Carboniferous group." This glossary is extracted from one in Lyell's Principles of Geology, a book which Dr. Gesner seems to have used a great deal, and in which the term Old Red Sandstone is similarly defined.* It would appear that, at this time at least, the term Old Red Sandstone did not convey to Dr. Gesner's mind the idea of a system different from the Carboniferous, but rather that of a Lower or Sub-carboniferous Sandstone. However, some years later (in 1847) he refers to the Old Red Sandstone as Devonian.

The Coal Formation.

The compiler of this map rightly considered this system of rocks as one of the most important in the province; and he had less difficulty in recognizing it than in telling the age of the others. Abundant plant-remains furnished the test necessary for the determination of these rocks. Though Dr. Gesner's palaeobotany belongs to the earliest years of geological science, and some of his names are now obsolete, we are able from his descriptions, and sometimes from his figures, to recognize most of the plants he mentions. They are the commoner species of the Carboniferous age, but sufficient to determine the kind of flora which flourished in New Brunswick in those times, and thus to assure Dr. Gesner that the rocks were Carboniferous.

The limits of the coal formation, as given on this map, do not differ greatly from those obtained by more recent explorations.

* See Lyell's Principles, Ed. 1835, London; Vol. I, p. 396; Vol. IV, p. 313.

The numerous outcrops of coal which he found, led Dr. Gesner to infer the presence of valuable beds of this mineral within the Carboniferous area ; but the examinations made since in all parts of this tract by the Dominion Geological Survey, and through private enterprise, have not resulted in the discovery of any seams of considerable thickness. Although Dr. Gesner made a rapid traverse across the Carboniferous rocks in Gloucester county, he claims that he did not survey this county, except in the vicinity of Bathurst ; and the large wilderness district at the junction of Sunbury, Northumberland and Kent counties was not visited by him. The coloring which he placed on this area expressed his opinion of its probable age, and later explorations have confirmed his surmise that the area was occupied by coal-measures.

That Dr. Gesner attached great importance to the minerals of the coal measures as a source of wealth to the Province of New Brunswick is clear from many statements in his reports. Of the whole of these reports at least one-sixth is devoted to the Coal Measures. Not only did he believe in the existence of valuable beds of coal in the areas where the coal measures were visible, but his error in regard to the Red Sandstone of King's County also led him to infer the existence of valuable coal seams where we now know none such can exist.

New Red Sandstone.

In Dr. Gesner's time the earlier results in the study of geology in England had not been checked or corrected by comparisons with a wider field. The lithological aspect of the rocks, as the Chalk, the New Red Sandstone, the Oolite, were largely depended upon for determining the age of strata. In England the New Red Sandstone was a saliferous formation, and for this reason the saliferous sandstones which Dr. Gesner found in Nova Scotia and New Brunswick were by him referred to the New Red Sandstone or Trias ; and being such, of later age than the coal measures.

One belt of these sandstones, however, he referred to their proper position under the name of "Old Red Sandstone," and a

few years after his survey closed (1847) he said that the [red] conglomerates along the south side of the coal field might be so classed. This is stated in his book on "New Brunswick," in which he also inclines to defer to the opinion of Sir Charles Lyell, who was "disposed to class these rocks with the Devonian system, or the Permian rocks of Russia." Some years later Dr. Gesner more distinctly avowed this opinion in reference to the corresponding sandstones of Nova Scotia.

There was, however, a modicum of truth in Dr. Gesner's earlier view of the age of the red sandstones, because there are certain small areas among the rocks referred by him to the New Red Sandstone that actually are of Triassic age. These are small isolated patches along the shore of the Bay of Fundy, and perhaps some larger ones on the eastern coast of New Brunswick.

But while we thus gladly give Dr. Gesner the credit of having discovered certain small areas in southern New Brunswick that are truly referable to the New Red Sandstone, there are other larger areas of his map thus colored, that must be removed from this category. Such is the considerable district on the Kennebecasis river and extending thence through Westmorland county. Such, also, is the eastern end of this county; and such, also, two oval areas on Grand Lake in Queen's county. These latter, by the Dominion Geological Survey, are relegated to the Coal Measures, and the two former to the Lower Carboniferous series.

When reduced by the abstraction of these areas, the remaining tracts of New Red Sandstone are quite insignificant, and are strictly confined to the southern coast.

Lias Limestone.

Having found salt springs and gypsum in the red sandstone district of Sussex and elsewhere in Kings county, Dr. Gesner, as we have observed, saw reason to refer the rocks to the New Red, or Triassic Sandstone. Hence he naturally supposed that the limestones which are found in these districts toward the centres of the "New Red" basins were of the age of the Lias of Great

Britain, seeing that they abounded in shells and some of them were of dark color and bituminous. The error was a natural one, though a better knowledge of the bearing and significance of the fossils which he found in these rocks would have corrected it. The genus *Productus* is so common in these limestones that the modern geologist wonders how the limestone could be mistaken for Lias. Dr. Gesner originated this error in the Carboniferous limestones of Nova Scotia, seen near Windsor, etc. But there there are two sets of limestones quite different in aspect and in the species of the fossils they contain. Of these the lower contains well marked fossils of the Lower Carboniferous, but the upper has many which are very like those of the Permian, the very latest of the Palaeozoic rocks. There would be less surprise if these were mistaken for Mesozoic limestones, but there is no such reason applicable to Gesner's Liassic limestone in New Brunswick. We suppose, therefore, that having classed the upper limestones at Windsor as Lias because they overlaid the Red Saliferous Sandstones of Nova Scotia, he applied the same rule to New Brunswick.

In 1843 Dr. Gesner's survey was brought to a sudden and unexpected close, and he never completed the geological map of New Brunswick which he had commenced. This appears from a paragraph in his last report, where he says: "An incomplete geological map of the province is also submitted for your Excellency's consideration. By this it will be observed that the labor of another season will be required to bring the geological survey to a conclusion: and it is very desirable that the undertaking should be finished in the same spirit in which it was commenced." This however was never done.

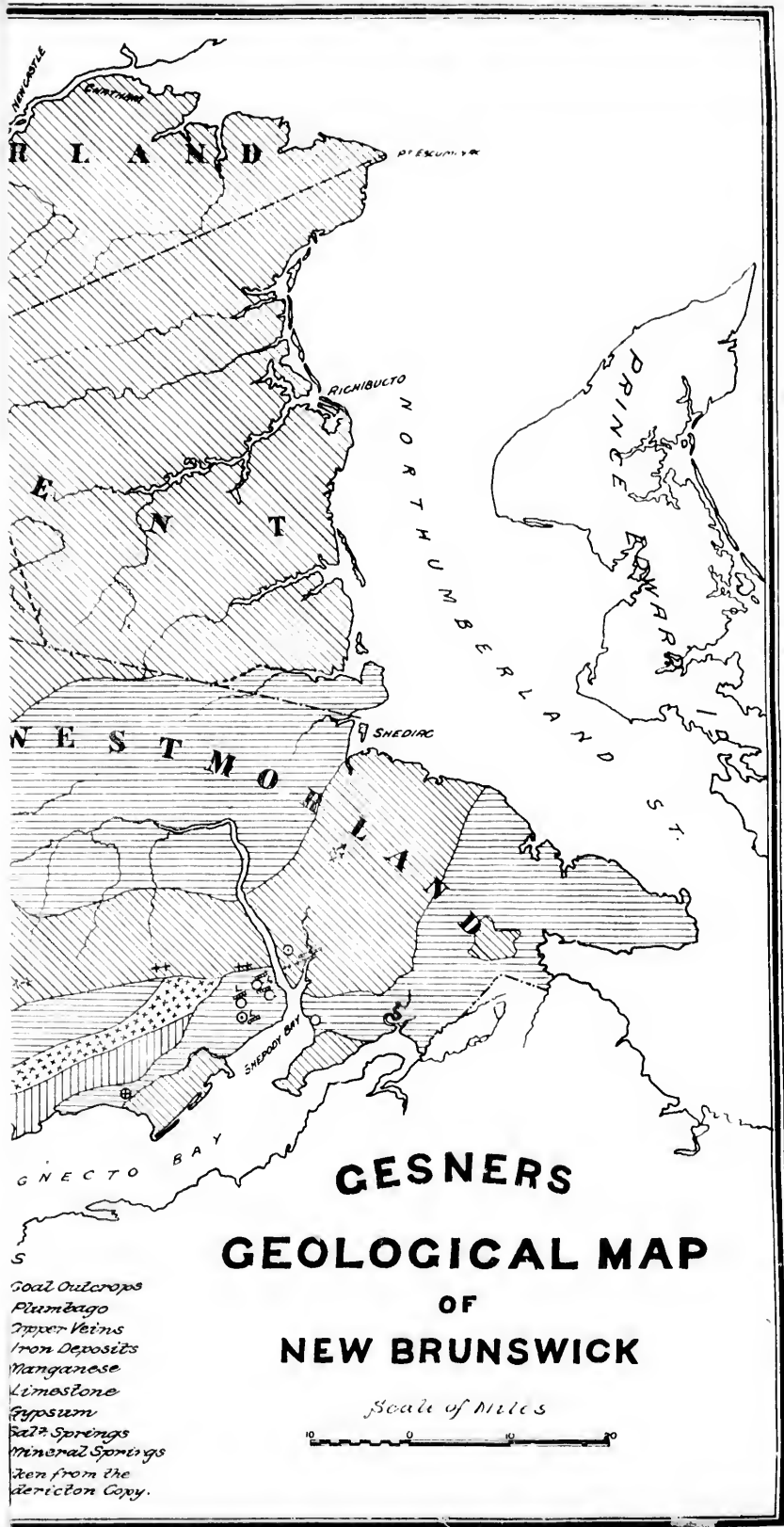
Dr. Gesner tells us that at the close of his last season's work there still remained to be examined the chief part of the counties of Northumberland, Gloucester and Restigouche.

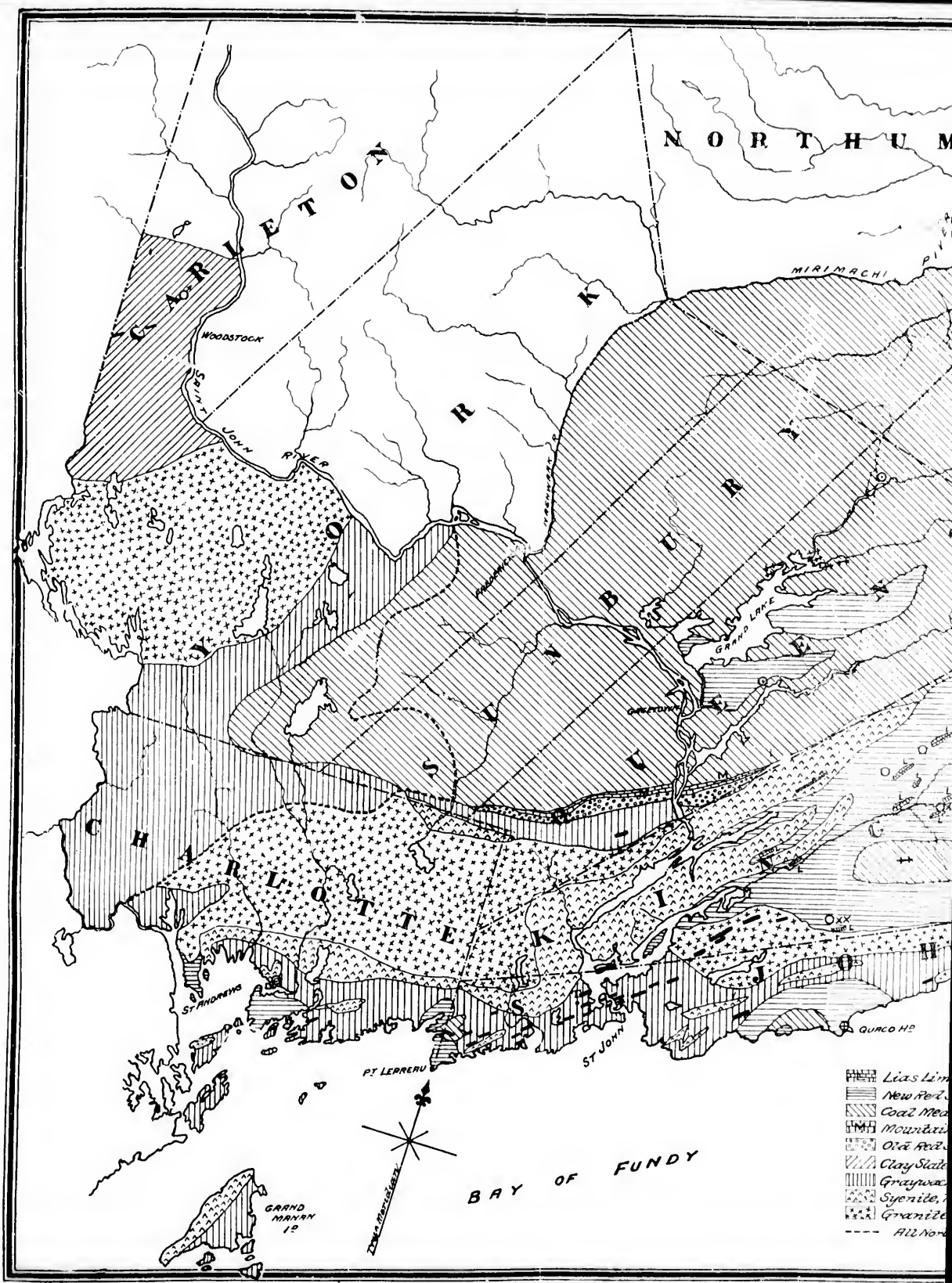
Dr. Gesner enlivened his geological reports in a way that is not usual now, though common enough in earlier narratives, by introducing descriptions of scenery and incidents of his journeys.

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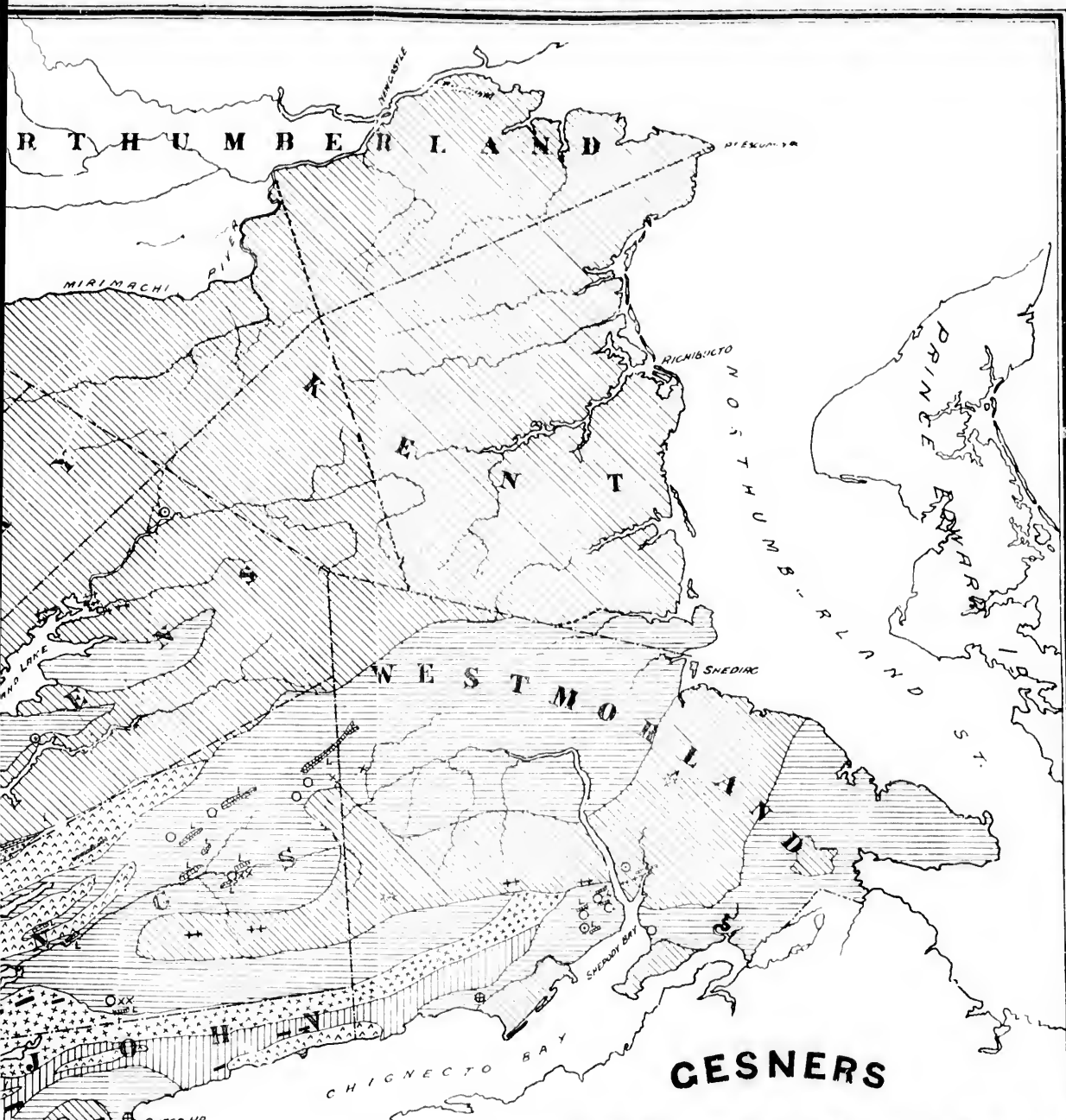
ST. JOHN

GURCOHE

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BAY OF FUNDY

-  Lias Limestone
-  New Red Sandstone
-  Coal Measures
-  Mountain
-  Old Red Sandstone
-  Clay Slate
-  Graywacke
-  Syenite
-  Granite
-  All North



GESNERS
GEOLOGICAL MAP
OF
NEW BRUNSWICK

REFERENCES

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|--|-------------------------|--|-----------------|
| | Lias Limestone | | Soil Outcrops |
| | New Red Sandstone | | Plumbago |
| | Coal Measures | | Copper Veins |
| | Mountain Limestone | | Iron Deposits |
| | Old Red Sandstone | | Manganese |
| | Clay Slate or Argillite | | Limestone |
| | Graywacke System | | Gypsum |
| | Syenite, Trap &c. | | Salt Springs |
| | Granite | | Mineral Springs |
- All North of this Line is taken from the Fredericton Copy.

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The following may be taken as an instance :

"It is impossible to conceive a more interesting sight than is presented in the Bay [of Fundy] during the summer season. Boats and vessels becalmed and carried away by the tide are at one instant hidden by the blackened rock, or the green foliage of some little island. At another they glide from behind the curtain, and appear, struggling with the overwhelming current. Often several hundreds of boats, huddled together and practising a deadly deception on the haddock and cod, from a signal given by the tide, draw up their anchors and hasten to the shore. The silence of evening is broken by the sound of the Indian's gun, levelled with deadly aim as the rising porpoise. The hollow sound of the "loon's" note is discordant with the scream of the gull. Here the glassy surface of the water is broken by a shoal of herring : yonder the spouting grampus is blowing up the spray in preparation for another dive. * * * The sea is alive with fish, its surface with human beings, and the air with feathered tribes."

Speaking of the shore between Beaver Harbor and Red Head, on the coast of the Bay of Fundy, he says :

"This part of the coast has a very gloomy and forbidden appearance : lofty precipices — shelving and overhanging cliffs — rise abruptly from the sea, and being inaccessible at almost every point, offer no way of escape for the unfortunate traveller who might be landed beneath them. There are also deep caves and wide chasms, where but a few rays of light ever enter, and no sound can be heard but the murmurings of the sea, ever washing their deepest vaults. That these openings were formed by earthquakes there can be no doubt, as the walls on either side clearly show that they were once united. The examination of such places is not free from danger on account of the violence of the waves, and the detached pieces of rocks, constantly falling from the cliffs above."

From Dr. Gesner's narrative we may judge that he met with many obstacles to his progress, due to the wild and unsettled condition of large tracts of the country, and to the imperfect means of communication. Of his journey on the St. Croix and Eel rivers, along the western boundary of the province (see sketch-plan of his journeys facing the title-page), he says :

"Having procured three expert Indians with canoes, and being accompanied by my son and Mr. Charles Ketchum, a volunteer — with a sufficient quantity of provisions and the requi-

sites for encampment, a portage of twelve miles was made from St. Stephen to the Upper Schoodie or Grand Falls. * * * About six miles above the Little Cheputnecticook Falls the river expands into a lake surrounded by a tract of low ground called Porter's Meadows.

"Above this, four miles (out of eight) are occupied by rapids, the most dangerous of which are the Elbow Rips at the foot of the Lower Lake. Our canoes were pushed up over an evenly inclined plain two miles long, where all our strength and skill were required to overcome the swiftness of the current. After much labor and difficulty the light barks were urged upward over the last rapid, and we paddled along the surface of the lake where the water is quiet and its gloomy stillness is strongly contrasted with the roaring of the river below. * * *

"We next encamped at the east side of the North Lake, where there is a portage to Eel River Lakes. The difficulty of discovering an old Indian path through the woods is always great to the unpracticed; and as the portage trail had become obscured by the growth of grass during the summer, and none of our Indians had ever passed this route, it was feared that the advantage of the path for carrying the canoes and baggage would be lost, and we should be obliged to steer through the thick forest by compass. From this embarrassment I was relieved by the discovery of some Indian hieroglyphics upon a tree, which expressed clearly the necessary information. On the clear wood of a large cedar there was clearly marked in a peculiar black and durable ink an Indian carrying a canoe; and the direction of the figures was exactly that of the portage; so that the old winter paths of the lumbermen were readily avoided. Two deer, with an Indian presenting his gun at them, were also exhibited, indicating to the traveller to look out for these animals: the information was important and found to be strictly correct.

"The trail is a deep and narrow path, worn out by human feet, and at some places the solid rocks were found to be furrowed by the mooccasins of our native tribes. After carrying our canoes across this portage, we again embarked for the exploration of the rocks of the Eel river and its lakes."

Another instance in which Dr. Gesner found the benefit of Indian pictorial representation was when his party was about to descent a dangerous rapid and fall on Eel river. Here they saw a large drawing of two Indians with their heels uppermost and their canoe capsized, executed in black ink on a broad piece of cedar fixed to a post on the bank of the river.

Difficulties with his Indian guides prevented Dr. Gesner from carrying his exploration of the Tobique to a completion.* He had at this time reached the forks of the Tobique where it parts into four branches; at this point one of his Indians had deserted and the rest refused to proceed further into the wilderness, with a short stock of provisions and with shattered canoes. He was therefore reluctantly compelled to return. Generally, however, he found the Indians willing and intelligent guides.

Dr. Gesner's scientific activity did not cease with his work on the Geology of New Brunswick, for about this time he must have written a memoir on the geology of Nova Scotia, accompanied by a geological map of that province, showing an advance on his earlier work there by the delineation of the crystalline axis of the Cobequid hills. That he was still thoroughly imbued with the belief that the gypsiferous sandstones of these provinces were not Carboniferous is shown by this map, in which they are represented as Devonian, or Old Red Sandstone.

This memoir (or an abstract of it) was published in the Proceedings of the Geological Society of London (Vol. IV, Pt. I, No. 95, 1843), and curiously enough the same number of this journal contains an article from the pen of Sir Charles Lyell,

"On the Coal Formation of Nova Scotia, and on the Age and Relative Position of the Gypsum and accompanying Marine Limestones." Both from paleontological and stratigraphical considerations Sir Charles adduces convincing reasons for placing these gypsiferous sandstones in the Carboniferous system beneath the coal measures.

Sir Charles also describes a newer red sandstone without fossils on the Salmon river, near Truro, resting unconformably upon the edges of the Carboniferous strata; this we now know to be of the age of the Red Sandstones of the Annapolis valley, which are universally recognized as Mesozoic.

Except for the error in regard to the age of the red sandstones, this later geological map of Nova Scotia of Dr. Gesner is much in advance of his earlier one.

* Fifth Report, p. 32.

"NEW BRUNSWICK."

In the course of Dr. Gesner's geological survey of New Brunswick, he picked up a great deal of information on its natural history and resources. This information he embodied in a work published in London a few years after the close of his survey, bearing the above title.*

The first three chapters are given to the history of the province, first as a part of ancient Acadia, and then as a part of the Province of Nova Scotia, and finally as a province by itself. Another chapter is given to the boundary disputes and a general description of the country, and a fifth chapter to the native Indians or aborigenes of the province.

This chapter describes the character, customs, dress, dwellings, etc., of the two tribes which have inhabited the province since it became known to Europeans.

A long chapter is devoted to a description of the topography of the province, that of each county being given separately, with valuable information relative to the settlements, lumbering, soil, minerals and fisheries. Agriculture forms the subject of another chapter, in which the climate is favorably spoken of, the forest trees described, and directions are given for applying manure and clearing up the wild land.

The author devotes considerable space to an historical account of the colonial fishing rights and of the aggressions of the American fishermen. The timber trade, the manufacture of lumber and the export trade in this commodity, also receives much attention from Dr. Gesner in this book.

The next chapter treats of the population of New Brunswick, and of its religious, social and political status. An examination of this chapter will show the great increase in the material prosperity of the province since this book was written. The imports and exports have greatly increased, and there has been a like increase in the material comfort and prosperity of the

*New Brunswick, with Notes for Emigrants, by Abraham Gesner, Surgeon, F. G. S., etc., London, 1847.

people. There has been some change in the denominational status of the population. The number of clergy of the Church of England has more than doubled. The relative change in numbers of the Roman Catholic population, then imminent, has come about, and they are now the most numerous of all the Christian bodies. The Baptists and Methodists have greatly increased. King's College, established in 1828, had been thrown open to all denominations, but there still remained a course in divinity in connection with the Church of England. The social conditions of the population in New Brunswick half a century ago, as described in this book, contrast greatly with the existing state of society. The isolation of the people in the winter time no longer exists; and social pleasures are not now, as then, so much limited to the coldest season of the year. Nevertheless, according to this author, the City of St. John at that day had grown from its foundation by the Loyalists sixty years before to a population of 26,000 souls. The revenues of the city were only £5,000 per annum; a contrast to the large amount collected for civic purposes at the present day.

In speaking of "society" in St. John and Fredericton in those old colonial times, Dr. Gesner says:

"There is a constant struggle between the aristocratic principle and the spirit of freedom and equality characteristic of the American. Persons who have risen from the lower ranks, and have arrived at affluence, are apt to overrate their importance; and such as have the advantage of birth and education are frequently supercilious. It is to be regretted that from these causes endless jealousies arise, and society is divided into small circles and parties."

The author of "New Brunswick" devotes a short chapter to the geology and mineralogy of the province, and another to its natural history; and the work closes with "Notes to Emigrants."

"INDUSTRIAL RESOURCES OF NOVA SCOTIA."

The next important work published by Dr. Gesner was a volume of 375 pages on the "Industrial Resources of Nova Scotia."

This work opens with an historical sketch of the province, beginning with the early French settlement of the country and extending down to the time in which Gesner lived. This is followed by a geographical outline, giving an account of the harbors, lakes, marshes, etc. In another chapter the vegetable products of the province are described, and then in succession the fisheries, agricultural capabilities, manufactures, geology, mines and minerals. Chapter X gives an account of the climate, history and resources of Cape Breton; and there is a final chapter devoted to prospective railways and to emigration.

This book is imbued with the local politics of the time at which it was written. It advocates the protection of the sea-fisheries from foreign aggression, complains of the monopoly of the mining rights, and calls for the construction of a railway from Halifax along the Gulf shore of New Brunswick to the Metapedia river and Quebec. This railroad has since been built almost exactly on the line advocated by Gesner.

One remarkable feature of the book is the strong advocacy of a protective policy in relation to the commerce and manufactures of Nova Scotia. It outlines the "national policy" adopted by the Canadian confederation soon after the consolidation of the provinces. The policy of protecting domestic manufactures was adopted in New Brunswick about this time, but soon after abandoned for a tariff purely for revenue.

The geological chapter may be considered to contain Dr. Gesner's matured views on the geology of his native province. Thirteen years had elapsed since the issue of his work on the Geology and Mineralogy of Nova Scotia, and several able geologists had in the meantime given their attention to the geology of Nova Scotia.

The views expressed in this work differ in some points from those of the earlier one. His first division consists of granitic

or hypogene rocks, and he speaks of the associates of the granite he also would include the gneisses and mica schists. He now describes the clay slates and quartzites of the primary district and those of part of his former "clay slate district" as *Cambrian*—a natural out-growth of the improvement of geological nomenclature, and parallel to his recent work in New Brunswick. Under the head of *Silurian Group* he includes the remainder of the "clay slate group" of his first book on Nova Scotia. His fourth group is the "Old Red Sandstone," or Devonian group, for the red rocks that were found below the coal measures, etc. This is merged in the Lower Carboniferous by later writers. The fifth division is the "Carboniferous rocks or coal formation." The sixth is the "New Red Sandstone." This division, extensive in the former work, is now limited to certain strata near Truro. The seventh group is the "Intrusive and Igneous rocks" of the North Mountains. The eighth is the Boulder or drift formation. This group was not recognized in the earlier work, for in that the surface deposits are mentioned casually in connection with the coherent rocks of the older formations. Dr. Gesner attributes both the unstratified and stratified drift to the action of water, manifested through ocean currents, floe ice, etc.

Over thirty pages of this work are devoted to a description of the economical minerals of Nova Scotia, with statistics of the exportation of coal.

Dr. Gesner lived in a period when the science of geology was in its infancy. Hence we see proof, as we peruse his works, of the gradual acquisition of new ideas upon the theoretical part of the science. Now a geological surveyor enters upon his work after a long course of preliminary training; then he had to make himself acquainted year by year with the rapid development and new phases of thought in his favorite science. Now he enters the field provided with the stores of knowledge accumulated in the last one hundred years; then he was slowly gathering those facts and observing those phenomena which lie at the base of geological theory.

We cannot judge Dr. Gesner by modern standards, but by the criteria of the times in which he lived; nor should we omit from consideration the slowness and difficulty of communication in those times. Knowledge of the kind required by the geologist was not disseminated in those days by the magazine and scientific journal; there were no great schools for investigation and for teaching the science to the same extent as now; and for those who lived far from the active centres of thought the attainment of exact knowledge in natural science, and especially of its new discoveries, was slow and difficult. Hence we should give Dr. Gesner full credit for the good he accomplished and excuse the mistakes and deficiencies incident to his times and position. That his later life was to some extent clouded cannot but be a matter of regret to those who witnessed his zeal in pursuing the chief object to which he devoted himself, viz.: the development of the natural resources of his native country. That he struck out the main geological features of the maritime provinces of Canada correctly there can be no question, that he committed errors of detail is also undeniable, but this is what every geological surveyor who works in a difficult and complicated region is liable to do.

He recognized what would now be termed the Pre-carboniferous "massif" or "complex" of these provinces in the complicated rocks of the several bands of crumpled and more or less metamorphic rocks which traverse them. These he included under the name of Graywacke system, referred by him at one time to the Silurian, but finally to the Cambrian age; and as regards the northern metamorphic belt in New Brunswick in part to the Silurian. This massif or complex is now known to contain rocks ranging from the Laurentian to the Devonian.

He recognized as overlaying these a mass of secondary strata consisting of softer and unaltered rocks as covering extensive tracts in these provinces. These he referred to three geological systems—the Old Red Sandstone, the Coal Formation, and the New Red Sandstone. His Old Red Sandstone is now regarded as Lower Carboniferous, and while we retain his "New Red" Sandstone, we eliminate from it large areas which he supposed were of this age, and refer them to the Carboniferous system.

Gesner thought he found Tertiary deposits in certain places along the coast, but as these contain marine shells, all of living species, it is evident they are of later date than he supposed, and should be referred to the Quarternary age.

Though Gesner outlined correctly in a general way the geology of the Maritime Provinces, his work cannot be accepted in all its details, as his methods were not sufficiently exact for modern requirements, and notably, in the department of Paleontology. We should, however, in estimating its value, bear in mind the difficulties he had to encounter, and the short time at his disposal for the exploration of a province mostly covered with forest, with few exposures, except on rapid streams, and along the coast, and with means of transportation imperfect and tediously slow. We should rather wonder that under these circumstances he was able to accomplish so much, and to inspire an enthusiasm for geology which has borne fruit until the present day.

SUPPLEMENTARY.

The Gesner Museum. A Corresponding Member of the Natural History Society, Henry F. Perley, C. E., writes to me to say that he remembers well the formation of the Gesner Museum, and how it expanded until it out-grew the house,* and quarters had to be taken for it in the upper story of a building on Prince William Street, near where McMillan's bookstore now is. Mr. Perley remembers, as a very little boy, attending a course of lectures given by Dr. Gesner in 1841, in a building just south of the corner of Germain and King Street ("Foster's Corner").

Dr. Gesner involved himself in considerable expense in collecting and arranging his museum, and it was sold to a company of gentlemen in St. John, who deposited it in the Mechanics' Institute (then a new building) on certain conditions and with reservation of rights to have it open to the public. Many of the owners gave in their shares to the Institute, and this institution came in time to be considered the owners. When this body was dissolved, the Gesner Museum with the collections which the Institute had added to it, was purchased by the Natural History Society of New Brunswick, and added to their museum.

* Where Dr. Gesner lived, near the corner of Coburg and Hazen Street.

The most valuable parts of the Gesner and Institute Museum are the ethnological collections now in the lecture hall of the Natural History Society, and the collection of minerals from the Jurassic Trap of Nova Scotia, made by Dr. Gesner. The collection of birds and mammals has been superseded in importance by that of the Natural History Society. The minerals are kept in a room called the "Gesner Museum."

The Albert Mine Case. Early in the "forties" a peculiar mineral was discovered near Hillsboro in Albert County, N. B., which was claimed to be coal, and a license was obtained to mine it. Gesner contended that it was not coal, but asphaltum, and obtained a license to mine this mineral. The contending parties laid their claims before the court at Halifax and a long trial was the result: both sides brought expert testimony: Dr. C. T. Jackson and Dr. A. A. Hayes of Boston, and J. G. Percival of New Haven, were brought to show that the mineral was coal. R. C. Taylor and Prof. Jas. Robb were the experts called by Gesner and his associates to prove that the mineral of the Albert mine was asphaltum. After long argument on both sides, when the question was passed to the jury, the judge drew attention to the fact that the license to mine coal included "and other mines and minerals," and stated that the substance was a mineral. On this point the question was decided in favor of the defendants, and Gesner lost his case: though there is no doubt his contention was right, for the mineral is not a coal, but a variety of asphaltum (melan asphalt).

Dr. Gesner was appointed Commissioner to the Indians in Nova Scotia, and in 1847 made a report on their condition to the provincial government.

Other Publications. To the list of publications referred to in this article, or mentioned in that published in Bulletin No. XIV., the following may be added — Geology of New Brunswick, Nova Scotia and Prince Edward Island, Fisheries of the Provinces; Practical Treatise on Coal, Petroleum and other Distilled Oils.

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