GEOLOGICAL RECONNAISSANCES IN SOUTHEASTERN
ALASKA*

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INTRODUCTION

During the summer of 1901 the writer, assisted by Mr Corey C. Brayton, spent about two months in making a preliminary reconnaissance of the Ketchikan mining district, and later about one month in a more general reconnaissance of other parts of southeastern Alaska. The results of this work are to be published by the U. S. Geological Survey in a report entitled "Preliminary Report on the Ketchikan Mining District of Southeastern Alaska." In view of the little that is known of this region, it has seemed worth while to abstract the more important conclusions bearing on the general geology of the region.

A few small areas in this region have been studied in some detail and many facts have been gathered, but almost no attempt has been made to correlate them. The work of the Canadian geologists, however, near the boundary and in British Columbia has added to the knowledge of the stratigraphic succession and of some of the larger structural features. Every worker in the field must acknowledge his indebtedness to Dr George M. Dawson,† who has contributed so much to our knowledge of the geology and resources of the northwestern part of our continent.

*Published by permission of the Director of the United States Geological Survey.

†Geo. M. Dawson: Report on an exploration in the Yukon district, N. W. T., and adjacent portions of British Columbia. Ann. Rept. Geol. and Nat. Hist. Survey, Canada, 1887, part B.

Portions of the region have also been the subject of investigations by Blake,* Hayes,† Dall,‡ Becker,§ Russell,|| Spurr,¶ Reid,** Cushing,†† and the writer.‡‡ There are a number of others who have contributed to our knowledge of the glaciers of the region.

GEOGRAPHY

The panhandle of the territory, extending southeastward from mount Saint Elias, is usually called southeastern Alaska. This coastal belt and its contiguous islands have an area of nearly 40,000 square miles. It is included between 54 degrees 30 minutes and 60 degrees 30 minutes parallels of latitude and the 130th and 141st meridians of longitude. That portion which is more especially the subject of this sketch lies to the southeast of Cross sound and Glacier bay, and includes an area of about 20,000 square miles.

Alaska is divisible into four geographic provinces, corresponding to and, broadly speaking, coextensive with those of western Canada and the United States. The westernmost of these includes a mountainous belt, which, in conformity to Major Powell's §§ nomenclature, may be called the Pacific Mountain system. East of this is the Plateau region, bounded to the east and north by the third province, which is formed by the northern and western extension of the Rocky Mountain system, and to the east and north of the Rocky mountains is the fourth province, comprising the Plains region. Southeastern Alaska lies entirely

* William P. Blake: Topographical and geological features of the northwest coast of America. *Am. Jour. Sci.*, 2d series, vol. xlv, 1868, pp. 242-247.

Alaska Territory, Geology of. U. S. Coast Survey, Report for 1867, pp. 281-290.

† C. Willard Hayes: An expedition through the Yukon district. *Nat. Geog. Mag.*, vol. iv, pp. 99-162.

The writer is under obligations to Doctor Hayes for the use of unpublished notes.

‡ William H. Dall: Coal and lignites of Alaska. Seventeenth Ann. Rept. U. S. Geol. Survey, part i, pp. 763-908.

§ George F. Becker: Gold fields of Southern Alaska. Eighteenth Ann. Rept. U. S. Geol. Survey, part iii, pp. 1-86.

|| I. C. Russell: Expedition to Mount Saint Elias. *Nat. Geog. Mag.*, vol. iii, 1891-'92.

Second expedition to Saint Elias. Thirteenth Ann. Rept. U. S. Geol. Survey, part iii, pp. 1-91.

¶ J. E. Spurr: Geology of the Yukon gold district. Eighteenth Ann. Rept. U. S. Geol. Survey, part iii, pp. 87-392.

** H. F. Reid: Studies of the Muir glacier. *Nat. Geog. Mag.*, vol. iv, 1892-'93.

†† H. P. Cushing: Notes on the geology in the vicinity of the Muir glacier. *Nat. Geog. Mag.*, vol. iv, 1892-'93; *Am. Geol.*, vol. viii, pp. 207-230.

‡‡ Reconnaissance in Tanana and White River Basins, Alaska, in 1898. Twentieth Ann. Rept. U. S. Geol. Survey, part vii, pp. 425-494.

Reconnaissance from Pyramid Harbor to Eagle City, Alaska. Twenty-first Ann. Rept. U. S. Geol. Survey, part ii, pp. 331-391.

§§ Major Powell included under "Pacific Mountains" ranges lying west of the Basin ranges in the United States. The term "Pacific Mountain system" is intended to include all of the mountains of North America which lie contiguous to the Pacific ocean. *Comp. Monograph Nat. Geog. Soc.*

within the first of these provinces. The Pacific Mountain system includes four important ranges, whose axes are parallel to each other and to the coast line, with numerous inferior transverse lines of height. Of these the Coast range, the Saint Elias range, and the Aleutian range lie adjacent to the coast, while the Alaskan range is inland and forms the northern boundary of the system. The two latter lie without the region under discussion, and will not be further considered.

The so-called Coast range extends from near the boundary of Washington northward through British Columbia into southeastern Alaska. In British Columbia it has a width of about 100 miles, which decreases to the northward. Its peaks vary in altitude from 7,000 to 8,000 feet. Following the coastline for nearly 900 miles, it passes behind the Saint Elias range near the head of Lynn canal, beyond which it can be traced northward, but with decreasing altitudes, and gradually loses its distinctiveness, finally merging with the interior plateau. The Coast range has no distinct crest line, but is, as Doctors Dawson and Hayes have shown, an irregular aggregate of mountains, whose summits mark an elevated plateau and whose limits are often ill defined. Inland it locally merges with the interior plateau, and on the coast side it is not always well differentiated from the mountains of the Alexander archipelago.

Westward from Cross sound the Saint Elias range forms the coastal feature of Alaska, and is extended to the southeast mountainous Alexander archipelago. Near mount Saint Elias the range has a width of about 100 miles, but it narrows down in both directions. Near Cross sound the Fairweather group of mountains in the Saint Elias range reach altitudes of over 15,000 feet. Toward the west it increases in height and complexity, culminating in mounts Saint Elias and Logan, 18,060 and 19,500 feet in height. The mountains of the Alexander archipelago cannot be said to form any well defined range. On Baranof island are mountains reaching altitudes of 3,000 to 4,000 feet. On Prince of Wales island there are also many peaks which rise to these altitudes, but they are irregularly distributed. In general, the trend of these mountain groups is in a northwest-southeast direction, parallel to the coast line and to the Coast range. There is but little topographic data available in this region except the contour of the actual shoreline.

The coastline of this part of Alaska is very irregular, the shore being marked by many deep embayments and islands. The shores are usually very abrupt, and the deep water lies close to the land.

Southeast of Glacier bay over half of the land area is included in the islands of the Alexander archipelago. The longer axes of the larger islands have a rough parallelism to each and to the general trend of the

mainland coast. The otherwise smooth coastlines of the island are broken by numerous fiords similar to those which penetrate deeply into the adjacent Coast range. The islands are separated from each other and the mainland by deep and often very narrow waterways. Some of these, like Lynn canal, penetrate far inland. An examination of a map will show that these features have a more or less parallel arrangement, and attention will be drawn to the fact elsewhere that the direction of these channels is consequent on structural lines in the bed rock.

In southeastern Alaska four rivers of considerable size—the Alsek, Chilkat, Taku, and Stikine—have their sources in the Interior Plateau region, and reach the sea after traversing the coastal ranges. The Chilkat flows through the depression which separates the northern extension of the Coast range and the Saint Elias mountains. There are many minor streams on the mainland of southeastern Alaska which have their sources within the Coast range. The drainage of the islands of the Alexander archipelago is usually carried to the sea by small streams. The lack of topographic maps makes it impossible to describe them in any detail.

GEOLOGY

STRATIGRAPHY

While but few of the details of the geology of southeastern Alaska are known, and even the general succession of beds is very much in doubt, yet the distribution of certain lithologic types is fairly well established. The general trend of the rocks is in a northwest and southeast direction parallel to the coastline. There are certain lithologic types occurring as belts running parallel to this strike, which seem to persist with rather remarkable uniformity from Dixons entrance to Lynn canal and Icy straits.

The granite which forms the Coast range is the best defined of the lithologic belts, and has been traced, practically without interruption, from Portland canal to the head of Lynn canal. East of the granite belt are a series of quartz-schists and limestones, which seem to be fairly persistent from Bennett lake southward. These are in turn succeeded to the eastward and unconformably overlain by younger sediments. To the west of the granite is a belt of black phyllites and arenaceous schists, which are locally much metamorphosed and include many greenstone schists. These are fairly persistent throughout southeastern Alaska. To the west of the phyllite belt bluish limestones have been observed at a number of localities. This belt has not been so well traced. Still farther west is a belt of white and blue crystalline limestone associated with phyllites. These rocks are very persistent, and

FIGURE 1.—Geological Map of Southeastern Alaska.

occupy large areas in Prince of Wales, Baranof, Chichagof, and Admiralty islands.

These four formations, (1) the white limestone and phyllite, (2) the blue limestones, (3) the black phyllite and arenaceous schists, and (4) the Coast Range granite, form the country rock of the larger part of southeastern Alaska. There are also younger sediments, volcanic rocks, and various types of intrusives in this field.

The oldest beds of the region in which fossils have been found are the limestone outcropping on the shores of Glacier bay.* Professor Cushing found a few fossils in this limestone, which were determined as Paleozoic by Professor H. S. Williams. Later, on the evidence presented by these fossils and on that of coral collected from the Dirt glacier by Professor J. J. Stevenson, these limestones were assigned to the Carboniferous.† It will be shown below that the latter fossil is from an entirely different horizon. Through the kindness of Professor Williams the Drake Island material was submitted to Mr Charles Schuchert, to whom the writer is indebted for the following report on three fossils:

"I have examined the Drake Island material and find a large *Leperditia* of the *L. baltica* group.

"*Megalomus* sp. undet.; sections of a very large species very similar to *M. canadensis*.

"*Hormotoma* sections, like several found in the Guelph of Ontario.

"The species on which one can depend for age determination is the *Leperditia*. These large species of *Leperditia* cease with the basal beds of the American Devonian (Lower Pentamerus = Coeymans), but their greatest abundance is in the Wenlock and Dudley horizons of Europe. The Glacier Bay species is unmistakably related to the *L. baltica* of the Upper Silurian. Further, it is not related to the large Lower Silurian forms of the *L. flabulites* group, and this is again shown by the presence of very large bivalve shells, which I take to be of the genus *Megalomus*, a fossil so characteristic of the late Upper Silurian. Even if the large shells are not *Megalomus* these *Leperditias* alone prove that the limestone can not be younger than the late Upper Silurian. It is true that the genus *Leperditia* is stated to occur as late as Lower Carboniferous time (*L. carbonaria* Hall, *L. nicklesi* Ulrich), but all the Devonian and Carboniferous species are minute forms, and if they do not belong to other genera, which seems probable, they certainly can not be included in the *L. baltica* group of *Leperditia*.

"The coral identified as *Lonsdaleia* comes from another locality (Dirt glacier) more than fifteen miles away, and can not be included in the Drake Island fauna. To this locality one should for the present restrict the type section for the 'Glacier Bay limestone,' for the reasons above given, and for the further one that the coral was not found in situ."

Reid and Cushing found argillites underlying the limestones conformably and both forming a closely folded series. This series has been

* Nat. Geog. Mag., vol. iv, p. 59; 16th Ann. Rept., part i, p. 433.

† Sixteenth Ann. Rept., part i, p. 434.

identified by the writer at a number of localities to the south, and forms the westernmost of the lithologic belts which have been referred to.

Reference has already been made to a coral which was found on the moraine of Dirt glacier by Professor Stevenson. The following is quoted from Professor Stevenson's description : *

"The Dirt glacier or first western tributary of the Muir must head up against an outcrop of this limestone, for one of the passengers on our vessel picked up a form like *Acervularia*, which, taken in connection with some *Leperditia* obtained by Mr Cushing in 1890 (Drake island), tends to show that the limestone (Glacier Bay limestone) is not younger than Middle Devonian."

Through the courtesy of Professor Williams, Mr Schuchert was enabled to examine, too, the coral secured by Professor Stevenson, and he reports as follows :

"Later this coral was sent to Professor Williams, and Cushing reports that he identified it as a *Lonsdaleia*, 'and regards it as demonstrative of the Carboniferous age of the horizon whence it came.'

"I agree with Stevenson that the coral in question is an *Acervularia*, since it has no *columella*, as is demanded for species of *Lonsdaleia*. It is a species near *A. davidsoni*, a coral so characteristic of the Middle Devonian of the Mississippi valley. It may prove to be a new species when sections are made. The genus *Acervularia*, however, is unknown above the Devonian. Another *Acervularia* is known from the Mackenzie River country (*Cyathophyllum arcticum* Meek), so that the genus may be expected to turn up elsewhere in the far north.

"Since *Acervularia* of the type *A. davidsoni* is so characteristic of the Middle Devonian, it seems safe to assume that beds of this age occur in the Glacier Bay region, and that it is the same general horizon discovered the past summer by Mr Brooks at Long Island, Kasaan bay, Prince of Wales island."

According to Mr Schuchert, then, this coral is from a bed which is an entirely different horizon from the limestones at Drake island, which he determined as Silurian. This evidence points to the conclusion that there is a younger limestone in the Glacier Bay region which is of Devonian age. This limestone, however, has not been identified at any other locality in the northern part of the region under discussion.

In the southern islands of the Alexander archipelago Devonian beds have been found at several localities. Mr Schuchert identified as Devonian † some fossils contained in a white crystalline limestone collected at Saginaw bay, Kuiu island, by Mr Brightman. It is interesting to note that some fragments of sandstone from this same locality contain Upper Carboniferous fossils. This is the only locality in southeastern Alaska where this horizon has been identified.

* The Scottish Geog. Mag., vol. ix, 1893, p. 70.

† Charles Schuchert : "Report on Paleozoic Fossils from Alaska." Appendix ii, Coals and Lignites of Alaska, Seventeenth Ann. Rept., part i, p. 902.

In the Ketchikan district, Middle Devonian fossils were found at Long island, Kasaan bay, Prince of Wales island, and at Vallenas bay, Gravina island. The presence of Devonian fossils in these widely separated localities goes to show that this period is probably well represented in southeastern Alaska. At the Prince of Wales Island locality the Devonian beds are almost entirely unaltered, and this rather unsafe criterion has been used to differentiate them from the older white crystalline limestone series. When more detailed examinations have been made, it may be found that some of the crystalline limestones are of Devonian age. These rocks of Devonian and Carboniferous age form the second of the lithologic belts.

The third belt in which the rocks have lithologic similarity lies west of and adjacent to the Coast range. It consists of argillites, with some limestones and a large amount of intrusive greenstone. It has been recognized by the writer in the southern province and again in the northern part of the province. Its age has not been determined, but it probably includes both Carboniferous and Triassic rocks. Near the contact with the granite, which latter is intrusive, it is often considerably altered.

The granite belt which forms the Coast range has already been referred to. It is a batholitic intrusion of great extent which has been traced for 800 or 900 miles. This intrusion probably took place in Triassic times. While most of the granite is massive, it in places includes some schistose and gneissoid phases. There are also outlying masses of granite both east and west of the Coast range.

The older sediments west of the Coast range have been differentiated into three groups, of which two are Paleozoic and one is probably in part Paleozoic and in part Mesozoic. The corresponding series east of the Coast range are all grouped together as Paleozoic. The writer has only studied them along one section, and found it impossible to differentiate them.

In the southern part of the Alexander archipelago a heavy conglomerate was found overlying Upper Paleozoic rocks unconformably. These are believed to be Mesozoic and probably Cretaceous, though no fossils were found in them. East of the Coast range and in the Queen Charlotte islands to the south Dawson and others have found beds of similar character, which are of Lower Cretaceous age.

Large areas of extrusive rocks, probably of Mesozoic age (Cretaceous?), were observed by the writer on Prince of Wales island. These are chiefly of andesitic character, and are closely associated with intrusive rocks, from which they can not always be easily differentiated.

Tertiary sediments have been noted at a number of localities. They

consist of conglomerates, sandstones, and shales, usually slightly indurated and only gently folded. They have been studied in some detail by Dall,* who determined them as belonging to the Kenai division of the Oligocene. At Lituya bay the Kenai beds are overlain by Astoria beds (Miocene).

At Sitka some highly feldspathic sandstones were observed, whose stratigraphic position was not determined. These were described by Becker† as pyroclastic diorites. In thin-section they show many minerals derived from crystalline rocks. In the field they are sometimes massive, but more often plainly bedded. Their stratigraphic position has not been determined, but they may provisionally be assigned to the Tertiary.

In the northern part of the Alexander archipelago there are some lavas, probably of Pleistocene age, but which may be in part Tertiary.

Greenstones are the most widely distributed of the igneous rocks in the province. This term is made to include various igneous rocks of a rather basic character and of varied composition. The oldest intrusion seems to have taken place in early Paleozoic times, and was of a diabasic nature. These older greenstones are usually schistose. Diorites and quartz-diorites occur both massive and schistose. Among the less common types are gabbros, pyroxenites, and amphibolites. The older greenstones are usually much altered and made up chiefly of secondary minerals. In the Ketchikan district the diabases form the latest intrusives. Syenites have been found at a number of localities, notably at the Treadwell mine near Juneau.

SUMMARY

In the province under discussion Paleozoic terranes, ranging from Silurian or older to the Carboniferous, have an extensive development. Large masses of greenstones are intruded in the lowest members of the Paleozoic succession. In part of the region, at least, a stratigraphic break is known to occur somewhere in the Devonian. A series of argillites occur which seem to belong to the Upper Paleozoic horizons and Lower Mesozoic, but whose stratigraphic position was not determined. Mesozoic time is represented in one part of the region by sedimentary strata, whose basal member is a conglomerate, overlying the Paleozoic rocks unconformably, and in another part by large extrusions of volcanic rocks. Very large injections of granite took place along the Coast Range axis, probably during middle or latter Mesozoic times, and in smaller masses elsewhere in the region. The Tertiary is represented

* Coals and lignites of Alaska. 18th Ann. Rept. U. S. Geol. Survey.

† George F. Becker: Gold fields of southern Alaska. 18th Ann. Rept., part iii, p. 43.

by lignite-bearing sediments of Oligocene age, which are only slightly disturbed or indurated. Some volcanic rocks have been extruded in post-Tertiary times. Besides these, dikes of various rock types are present in all the pre-Tertiary beds.

The earliest epoch of intense disturbance was in pre-Devonian times, and was accompanied by large intrusions of basic igneous rocks. The next period of metamorphism was in middle Mesozoic times, when the intrusion of the granite of the Coast range took place. The alteration of the sediments adjacent to the mass of granular igneous rock is assigned jointly to contact metamorphism and the mechanical effect of injections. The granite itself shows the effect of deformation by which it has been locally changed to gneiss and mica-schist. No evidence of any post-Tertiary disturbances has been found.

The history of the deformation of the rocks of the region is a complex one, and has not yet been deciphered. In the western belt of Lower Paleozoic beds the strata are intensely metamorphosed and deformed. To the east in the Upper Paleozoic beds dynamic action has been less, while still farther to the east in the belt of argillites, the metamorphic action has again been intense. To the east of the Coast range the Paleozoic rocks have all suffered about the same degree of alteration, with the exception of those which lie immediately adjacent to the intrusive granites. It is evident that the observed metamorphism has been of two kinds, assignable to different causes—the regional metamorphism, which is due to deformation; and the contact metamorphism, which has been brought about by the intrusion of igneous rocks.

The phenomena of contact metamorphism are commonly regarded as confined to chemical effects produced by the heat and accompanying gases of igneous intrusions, but many cases are on record where the mechanical effect caused by the pressure of the invading rock has been of great importance. Such is the case in the vicinity of the granite masses of the Coast range, where the mechanical alteration of the rocks is quite comparable to the regional metamorphism noted in neighboring localities; and, since the intrusion occurred after the greatest regional disturbance, the effects of the latter have been to a certain extent obscured by the former.

There are three zones in the province which are marked by more or less intense metamorphism. The one includes the rocks of the Lower Paleozoic beds, extending through the western group of the Alexander archipelago, while the other two lie on either side and adjacent to the granite of the Coast range. The two westernmost of these zones, in the southern part of the region at least, are separated by a belt of Upper Paleozoic beds, which are folded, but only slightly indurated, while the Coast Range granite separates the two eastern zones.

In the western belt the sediments are intensely folded and plicated, and are generally metamorphosed to such an extent that the limestones appear in the form of marble and the argillaceous strata as phyllites. The broad structural lines are in general parallel to the northwest and southeast, but the axes of minor folds are extremely variable in direction.

The period of mountain-building during which these effects were produced is the earliest of which we have any record in southeastern Alaska, and it was during this epoch that the injection of igneous rocks included under the designation "greenstone" commenced. Other intrusions of similar basic rocks are known to have occurred also at later dates, as shown by their relatively massive character when compared with certain highly sheared phases of the greenstones.

In the southern part of the province the Paleozoic sedimentation was interrupted by mountain-building, and also a period of erosion ensued, probably in early Devonian times. The Devonian beds are much less altered than those of the Lower Paleozoic, and the folding which they exhibit is of a broad, open type. Tracing these Devonian beds eastward, they are found to become metamorphosed as the zone of the Coast Range intrusives is approached.

The two eastern zones of metamorphic strata which lie adjacent to the intrusive granite belt of the Coast range may be assigned, in part at least, to contact metamorphism. Most of the rocks on the west side of the range are argillites, which are much altered. To the east of the range there is a succession of sediments whose basal members are also considerably altered. This metamorphism is in part plainly due to igneous contact, but must in part be assigned to the mechanical stress brought about by the intrusion of the granite. The intrusion of the granite has been shown to be Mesozoic and probably post-Triassic. The evidences of contact metamorphism are the minerals, such as garnet and micas, which are developed in a limited contact zone. Mechanical metamorphism evinces itself in the development of shear zones and of foliation as the granite mass is approached.

During the Mesozoic times and after the injection of the granite large extrusions of volcanic rocks took place. These, as well as the granite, were subsequently somewhat deformed. This deformation was more intense along the axis of the Coast range, where the granites were in part changed to gneisses and mica-schists. Subsequently another intrusion of igneous rocks took place, which, though widely distributed, was not great in bulk. This epoch of injection is represented by the large number of dikes, usually quite massive, which are found in different parts of the region. Deformational movements since Kenai times have been

only of minor importance, as is shown by the very gentle folding found in the Tertiary beds. So far as known, there is absolutely no evidence of a southern extension of the post-Tertiary disturbance which Russell* noted in Saint Elias regions. The most recent evidences of dynamic activity are the volcanic rocks of mount Edgcombe and some basalt flows which have been found in various parts of the province.

One of the effects of the crustal movements is to produce lines of weakness in the rocks which have been sought out by the erosive agencies. These structural lines, which are shear zones and lines of foliation, have affected not only the bedded but also the massive rocks, and consist of two systems, the one having nearly a north and south trend, the other running northwest and southeast. The position of the channels and inlets of this coastal belt is largely determined by these structural lines (compare map, page 257).

CORRELATION

The stratigraphy of the regions lying adjacent to the province under discussion is too imperfectly known to enable correlations to be made. It will be of interest, however, to draw attention to certain analogies of stratigraphic succession and lithologic character in adjacent regions. This is especially true of the field to the south, where the Canadians have done some more or less detailed mapping.

In a previous report † the writer grouped the Carboniferous and Devonian beds of the upper White and Tanana rivers together under the name Nutzotin series. This Nutzotin series would in a measure correspond to the subdivision called Upper Paleozoic on the accompanying map, but will probably also embrace a part, at least, of the argillites which lie adjacent to the Coast range. In the report cited the limestones of Glacier bay were all put in the Nutzotin series, as they were then believed to be Carboniferous. In the same report the pre-Devonian sediments are grouped together as the Kotlo series, which would include the rocks of the Lower Paleozoic, as defined in this report. As in southeastern Alaska, the two series are separated by an unconformity, and there are, broadly speaking, certain lithologic similarities.

In the Copper River district Schrader ‡ and Spencer have described two formations which probably fall in the Upper Paleozoic. These are the Chitistone limestones, believed to be Carboniferous, and the underlying Nicolai greenstone. This limestone can be provisionally correlated

* Nat. Geog. Mag., vol. iii, 1891-'92, p. 167.

† A reconnaissance from Pyramid Harbor to Eagle City. Twenty-first Ann. Rept. U. S. Geol. Survey, part II, p. 359.

‡ Geology and mineral resources of the Copper River district. U. S. Geol. Survey, 1901.

with the Upper Paleozoic beds of southeastern Alaska. The subdivision made by Schrader and Spencer of the beds below this limestone finds but little analogy in the older sediments of the region under discussion.

The comparison of the Mesozoic beds of the two regions does not suggest correlations. In the southern region the Mesozoic is represented, as far as known, more especially by conglomerates and coarse fragmental beds, while in the Copper River basin the rocks of this age are chiefly limestones and black slates. The Kennicott series, however, in the Copper river of Jura-Cretaceous age is made up of fragmental rocks similar in character to the Mesozoic of southeastern Alaska. The Tertiary sediments of southeastern Alaska are chiefly Kenai, and this horizon has been identified in many parts of Alaska.

Dawson's last investigation* on the geology of this northern region is a report on the Kamalooop district in southern British Columbia.

This work was done in much more detail than any which preceded, and the stratigraphic succession was definitely determined.† The Kamalooop region is too distant from the province under discussion to make correlations possible. It is interesting to note that the Cambrian period is represented by beds aggregating a thickness of 40,000 feet. It seems probable that some of the Lower Paleozoic beds of southeastern Alaska may eventually be found to be of Cambrian age. The absence of Silurian and Devonian in the Kamalooop region is noteworthy in comparison with the southeastern Alaskan section. Dawson finds definite evidence of the existence of pre-Cambrian rocks in this southern district.

In Queen Charlotte islands‡ Dawson grouped the Triassic and Carboniferous beds together, and states that these are unconformably overlaid by Cretaceous rocks. After the deposition of Triassic, folding took place, and it was probably during this period that the granites were intruded. From the descriptions of Dawson these Triassic and Carboniferous rocks show a striking analogy to the metamorphic argillites which lie adjacent to the Coast Range granites in southeastern Alaska. Dawson finds a large amount of volcanic material in the southern part of Vancouver island, which he believes to be Carboniferous. These volcanic effusives seem to have the same stratigraphic position as some found in southeastern Alaska which have been provisionally assigned to the Mesozoic.

* George M. Dawson: Report on the Area of the Kamalooops, map sheet, British Columbia. Geol. Survey of Canada, Ann. Rept., new series, vol. vii, 1894.

† Dawson summarized the results of his twenty-five years of investigation of northwestern America in a presidential address to the Geological Society of America. "Geological record of the Rocky Mountain region in Canada." Bull. Geol. Soc. Am., vol. xii, 1900, pp. 57-92.

‡ George M. Dawson: Report on the Queen Charlotte islands. Geol. Survey of Canada, 1880, p. 45 B.

The Mesozoic beds in the province under discussion would seem to correspond to the Cretaceous of the Queen Charlotte islands, both in stratigraphical position and lithologic character. Dawson notes a period of folding which succeeded to the deposition of the Cretaceous. The Tertiary rocks described by him are chiefly volcanic, and are provisionally assigned to the Miocene.

On the lower Skeena river and in the vicinity of Port Simpson, Dawson found a metamorphic series, made up of mica-schists and some limestones, closely associated with gneisses. These would seem to be the southern extension of the Ketchikan series, part of the belt of argillites which lie adjacent to the granite of the Coast range.