ART. L.—*Note on the Geology of the Peace River Region;* by GEORGE MERCER DAWSON, Assistant Director Geological Survey of Canada.

THE first definite knowledge of the geological features of the Peace River basin was obtained in 1875. In that year Mr. Selwyn, Director of the Geological Survey of Canada, setting out from McLeod's Lake, in British Columbia, descended the Parsnip and Peace Rivers to the confluence of the Smoky with the latter, returning by the same route. The geographical and geological notes published in the report of the expedition have constituted the basis of subsequent work. In 1879 the Canadian government decided to ascertain more completely than had previously been possible, the character of the Peace and Pine Passes through the Rocky Mountains as prospective railway routes, and the economic value, agriculturally and geologically, of the Peace River basin. The writer represented the geological survey on the expedition of that year, and the information now obtained, with that previously alluded to, enables a clear general idea of the geological features of the district to be formed. The geology of this region is of interest as representing the farthest northern portion of the Mesozoic interior continental basin yet known with any precision, the country examined lying chiefly between the 54th and 57th parallels of north latitude. The general geological result of the exploration is the preliminary examination of a section extending from the Pacific Coast to Edmonton, on the Saskatchewan, including the entire Cordillera belt, between the parallels above mentioned, with a length in all of about 700 miles. The remarks here following refer to the eastern portion of this section only.

The Rocky Mountain Range about the sources of the Peace is narrow and comparatively low, the higher peaks seldom exceeding 6,000 feet. It is chiefly composed of limestones in massive beds, which are underlain by saccharoidal quartzites, and overlain on the west by micaceous and plumbaginous schists. In some of the limestone beds, fossils of Devonian age have been found, the most abundant form being *Atrypa reticularis*, a shell widely distributed over the Mackenzie River district farther to the north. The beds of the mountains have general westerly dips, and overturned folds probably occur. On the east side of the range, on both Peace and Pine Rivers, hard dark calcareous beds are found holding *Monotis subcircularis*, a form characteristic of the "Alpine Trias" of Nevada and California, and found also in several places on the British Columbian Coast.

To the east of these beds of the mountains, and resting quite unconformably on them, are the Cretaceous rocks, which, between the mountains and the eastern outcrop of the Devonian rocks on the Lower Peace, occupy a basin with a width of nearly 350 miles, implying a Cretaceous sea of that width.

The Rocky Mountains have here formed a shore-line in Cretaceous times,—though probably not a continuous one—and the Cretaceous rocks along their eastern base are almost entirely sandstones and conglomerates, the constituent fragments of which can be traced to the cherts and quartzites accompanying the limestones of the mountains. The mountains are bordered to the east by foot-hills, in which, on the upper part of Pine River, for a distance of about fifteen miles from the older rocks, the Cretaceous sandstones are folded and disturbed. The disturbance, however, gradually diminishes on receding from the mountains, and the beds at length become flat, or are affected by very slight and broad undulations only. Slaty materials increase in importance eastward, and the Cretaceous series eventually resolves itself into the following subdivisions—clearly shown on Smoky River—which in the annexed table are placed opposite their supposed equivalents in Meek and Hayden's and the Southern Rocky Mountain sections.

Upper, or Wapiti River Sandstones,	Fox Hill (and Laramie?)	
Upper, or Smoky River Shales,	Pierre.	Colorado Group.
Lower, or Dunvegan Sandstones,	Niobrara.	
Lower, or Ft. St. John Shales,	Benton.	
	Dakota.	

The correlation, as above shown, is based partly on paleontological evidence, and partly on lithological resemblance. That the upper Shales represent the Pierre group is quite clear, as a large number of characteristic fossils of this stage have been obtained on Smoky River. No fossils have been found in the overlying sub-division. The fossils of the lower Sandstones are peculiar, consisting chiefly of fresh-water and estuarine mollusks and land plants. In the lower Shales the most characteristic form is a large Ammonite resembling *Ammonites* (*Prionocyclus*) *Woolgari*, but, according to Mr. Whiteaves, specifically distinct. The Peace River country being so remote from the typical region of the Cretaceous sub-divisions, it is not intended to insist on their precise synchronism with the groups here mentioned, but merely to point out a probable general equivalency. No beds so low as the Dakota group

have yet been found in this region, though it is probable that they occur on the Peace below the confluence of the Smoky.

The lithological resemblance of the shales of the Upper and Lower sub-divisions to those of the Pierre and Benton sub-divisions is exceedingly close. It is probable that these mark periods of general submergence, when sediment-bearing currents passed freely through the interior continental valley. Elevation is known to have been in progress during the Niobrara period in the Rocky Mountain region to the south, and in the Dunvegan Sandstones, we may see an indication of the elevation of land surfaces to the north and west, which interrupted these currents and allowed the undisturbed deposition of the calcareous Niobrara beds of the south and east of the interior continental region.

The fossils of the Lower or Dunvegan sandstones are of especial interest, giving us a number of fresh-water mollusks and land-plants of a stage of the Cretaceous, previously almost unrepresented in these respects. The fresh-water mollusks closely resemble those of the Laramie group, and the plants, while showing a close analogy with those of the Dakota group, help to fill a gap in time between these and those of the Vancouver (Chico) Cretaceous, and the Laramie and Fort Union. They include species of *Cycadites*, *Magnolia*, *Protophyllum*, *Sequoia*, *Glyptostrobus gracillimus*, etc., which will be described in the forthcoming Report of Progress of the Geological Survey.

In 1872, Professor Meek described a series of beds at Coalville, Utah, which appear to have been formed at the edge of the Cretaceous sea, at the mouth of a small river, and hold fresh-water mollusks. The fossils from these beds represent a stage somewhat higher in the Cretaceous than those of the Dunvegan rocks, but closely resemble them and those of the overlying Laramie series. *Brachydontes multilinigera* of the Coalville section, is found in several places in the Dunvegan beds. After remarking on the peculiar character of this fauna, Meek writes:* "Here we have, from beds certainly overlaid by one thousand feet of strata containing Cretaceous types of fossils, a little group of forms, presenting such modern affinities that, if placed before any paleontologist unacquainted with the facts, they would be at once referred to the Tertiary."

In the Peace River district we find, instead of a merely local intercalation of this kind, a widely-extended series of beds of Cretaceous age, persistently holding fresh-water and estuarine types of mollusks and land plants.

The chief evidence going to prove the Tertiary age of the Laramie and Fort Union beds, after that afforded by the plants,

* U. S. Geol. Survey of Territories, 1872, p. 435.

has been found in the Tertiary aspect of the mollusks, most of which are fresh or brackish-water forms. Hitherto little has been known of the fresh-water fauna of the undoubted Cretaceous, but if this should prove to have, as now appears probable, a "Tertiary" aspect throughout, it will tend to break down the molluscan evidence of the Tertiary age of the Laramie, and unite this formation still more closely with the underlying beds.

Montreal, March 1, 1881.