RECONNAISSANCE ON THE PACIFIC COAST FROM YAKUTAT TO ALSEK RIVER.

By ELIOT BLACKWELDER.[a]

GEOGRAPHY.

The region explored in the reconnaissance which forms the subject of this paper lies in the northwestern part of the coastal strip of southeastern Alaska. Roughly the area is about 70 miles long parallel to the coast and extends from 5 to 20 miles back from it.

The most prominent feature of this coast is the steep-fronted range of mountains which extends in a nearly unbroken line from Yakutat Bay to Alsek River and beyond. This coastal range is comparatively low, averaging from 3,000 to 4,000 feet in elevation; but back of it rise serrate snowy ranges of greater altitude. North of or within the mountain front the valleys are filled with ice, so that the region is essentially an ice plateau, which is relatively level in the interior but descends about its edges in the form of protruding glacial lobes. Buried ranges of mountains projecting above this interior ice plateau form nunataks. The front range is separated from the ocean by a coastal plain, which varies from 6 to 15 miles in width. This foreland is without notable relief, except for a few low hills close to the base of the mountains and here and there sand dunes near the coast.

From Cross Sound to Copper River, a distance of more than 350 miles, only one valley penetrates back into the interior of the country, namely, that of Alsek River. This powerful stream rises in the interior plateau of the Yukon Territory and after traversing the coastal mountain belt in a series of narrow canyons emerges suddenly upon the foreland and flows into the Pacific through the divided channels of its delta.

GEOLOGY.

GENERAL STATEMENT.

The ages of the indurated rocks of this region have not yet been determined, but on account of their resemblance to formations in adjacent regions it is thought that they belong largely to the Paleozoic

[a] My associate, Mr. A. G. Maddren, deserves commendation here for his excellent service to the expedition, especially in his capacity as topographer.—E. B.

and perhaps in part to the early Mesozoic era. Two distinct series have been differentiated, and the existence of a third is suspected on the evidence of material brought out from behind the range by glaciers. The two oldest of these series are considerably metamorphosed. The youngest is but little altered. All of them have been intensely and complexly folded and have been broken by overthrusts and tension faults to such a degree that the structural features are most intricate.

FORMATIONS.

METAMORPHIC COMPLEX.

The material brought out from the area of the interior ice fields by the Yakutat and Alsek glaciers comprises a large variety of such metamorphic and igneous rocks as hornblende schist, greenstone, gneiss, marble, granite, diorite, and porphyries. No similar rocks were observed in place at any point in the Coast Range by the writer, and, as they are distinctly more altered than the two other series observed, it is believed that they belong to a still older group of formations.[a]

SCHISTOSE SEDIMENTARIES.

The lowest canyon of Alsek River exhibits a fine section of metamorphosed sedimentary rocks lying in vertical isoclinal folds. The section is incomplete at both ends and the relations of the rocks are as yet unknown. The portion of the series there exhibited consists largely of quartzose schists and phyllites—the metamorphic derivatives of alternating graywackes, quartzites, and slates. On account of the rapid alternations in the composition of the original deposits, the initial bedding of the rocks is still fairly distinct, and it happens that the schistosity is in most places parallel to this bedding. Throughout the exposure numerous small quartz veins and stringers traverse the schists. None of these, however, was found to contain valuable minerals.

YAKUTAT SERIES.[b]

The Yakutat series has been described in detail by several geologists[c] who have studied the rocks about Yakutat Bay. Subsequent exploration shows that the greater part of the Coast Range to the east, at least as far as the east side of the Yakutat Glacier, consists of

[a] From observations on the shores of Russell Fiord, Tarr infers that the green schists and gneisses are stratigraphically continuous with schistose graywackes and slates similar to the second series of the present paper (unpublished evidence, 1905).

[b] The use of the word series is not in accordance with the Survey rules of nomenclature, but is a temporary expedient only, to be abandoned as soon as sufficient detailed work is done to permit the subdivision of the rocks to which it is now applied.

[c] Russell, I. C., Nat. Geog. Mag., vol. 3, 1891, pp. 167–170. Emerson, B. K., Harriman Alaska Expedition, vol. 4, 1904, pp. 49–50, 125–146. Tarr, R. S., and Martin, Lawrence, Bull. Geol. Soc. America, vol. 17, 1906, p. 33.

the same rocks. The contact between this series and the older systems has not yet been discovered, but may be looked for near the head of Ustay River. East of that general vicinity the mountains are composed chiefly of the preceding series. The Yakutat rocks are distinguished from those previously described mainly by a general absence of the effects of metamorphism. The predominant rocks are graywackes and black clay rocks which are slates or shales according to locality. Many of the graywackes are conglomeratic, the conglomerates being internal rather than basal. The pebbles consist of black slate, dark graywackes, limestone, granite, schists, etc.

The stratigraphic succession within the Yakutat series was not definitely ascertained, for the structure of the beds is so complex as to defy analysis without detailed mapping. The writer's present interpretation of the structure suggests that the section is roughly as follows:

2. Slates or graywackes of black and gray color, with local beds of coarse and fine conglomerate. Some of the graywacke members are 200 to 500 feet thick.
1. Bowldery slates—black stratified rocks containing pebbles and bowlders of all sizes and various compositions.

Only the lower member of this section requires further mention. This bowlder deposit consists of black shale or slate in which stratification is usually distinct. Pebbles and bowlders are scattered through it without orderly arrangement. In size they vary from fine gravel to bowlders at least 100 feet in diameter; in composition they include varieties so widely different as granite, white limestone, greenstone, graywacke, and quartzite. Although irregular in form, the bowlders are generally roundish or subangular. They have not the well-rounded contours characteristic of waterworn stones. The general character of the deposit suggests that it may be an offshore formation over which floating icebergs strewed their débris at random.

Fossils are rare in the Yakutat series and are of unsatisfactory nature. Those found consist chiefly of jointed stemlike casts,[a] which may represent plants or possibly worm trails. None are of much value for purposes of correlation with the terranes of other regions.

GLACIAL DEPOSITS.

In view of the great development of glaciers, both now and in the last geologic epoch, it is, on first thought, rather surprising that more extensive deposits of drift are not found in the Yakutat region. The moraines along the east side of Yakutat Bay, stretching out to Ocean Cape, have been described by Tarr and Martin.[b] There appears to be another loop of drift concentric with the south end of

[a] For similar varieties see Ulrich, E. O., Harriman Alaska Expedition, vol. 4, 1904, pp. 125–146.
[b] Tarr, R. S., and Martin, Lawrence, Bull. Am. Geog. Soc., vol. 38, 1906, pp. 155–160.

Russell Fiord and extending eastward along the base of the range nearly as far as Anklin River. This moraine, with its hillocks and lakes, is believed to have been made by a glacier which formerly occupied Russell Fiord. The glaciers in the front range have left only small and relatively fresh moraines. At the foot of the Yakutat Glacier, the largest lobe of ice between Yakutat Bay and Alsek River, a broad, flat terminal moraine hems in a crescent-shaped lake, which in turn borders the present end of the glacier. This moraine has every appearance of being a comparatively recent deposit.

Aside from the deposits of till there is a vast amount of stratified glacial drift mingled with the strictly fluviatile sands and gravels of the coastal plain.

This alluvium of double origin forms much the largest part of the foreland.

RECENT ALLUVIUM.

The streams coming down from the front range, including the Alsek itself, are engaged in building a plain of sand, gravel, and silt out into the Pacific. The formation of salient deltas is prevented by the strong littoral currents, which sweep the finer detritus along the coast and out of it build bars and spits in favorable situations. To some extent the wind has formed low sand dunes along the coast, but the effectiveness of this process is reduced to a minimum by the dampness and the rapid growth of vegetation.

STRUCTURE.

The structure of the most ancient metamorphic series is not definitely known, but is confidently believed to be highly complex.

Both of the younger bed-rock series are intensely and intricately folded. The folds are as a rule isoclinal and in many places overturned toward the west. The strike of the folds is not everywhere parallel to the axis of the range, as it might be expected to be. Near the Yakutat Glacier it trends north-northwest, making an angle of 40° to 50° with the general axis of the mountains. On this account the individual folds come out successively into the plain and disappear; but as the crumpling is repeated over and over again in about the same plane, no older or younger formations are exposed. The details of structure exhibited by the slaty rocks are in many places extremely complex, but the massive layers of graywacke are more regularly flexed. The structural relation between the Yakutat series and the schistose strata on the Alsek was not determined. The marked difference in metamorphism between the two series is thought to imply that they are separated by an unconformity; if not, then the schists of the Alsek may be merely a more altered eastward extension of the Yakutat slates and graywackes.

PHYSIOGRAPHY.

The front range is a maturely dissected ridge, modified and sharpened in its details by recent glaciation. The valleys on the coastal side present distinct evidence of two cycles of valley development. The older cycle is indicated by shoulders on the spurs at an elevation of 1,200 to 1,500 feet; these are interpreted as representing the bottoms of broad valleys. Above the shoulders the average slope is not steep and the ample tributary gulches have occupied the entire field. Beneath the shoulders the more recent canyons belonging to the second cycle are intrenched. Along the front of the range a series of rocky terraces corresponds to and merges into the high shoulders just mentioned. Another and less continuous line of terraces and flat-topped hills of rock stands at an elevation of about 100 feet along the border of the mountain front. Both sets of benches are attributed to erosion by the waves of the Pacific when it stood farther inland than now.

The following summary of the physiographic history of the region conveys the writer's interpretation of the observed facts. It is presented as a suggestion for more detailed and critical work by future students of the region:

1. *Early erosion cycle.*—Mature dissection of a broad west-northwest uplift.[a] Formation of open main valleys with divides 1,000 to 2,000 feet high, and the production of broad marine shelves by waves cutting on the seaward front of the mountains.
2. *Canyon erosion cycle.*—Rejuvenation of drainage by an uplift amounting to about 1,200 feet. As a result the development of V-shaped canyons within the older valleys. In most places the rejuvenation has not yet reached the heads of the older gulches. Formation of high sea cliffs and low cut terraces on the outer spurs of the mountains.
3. *Glacial erosion cycle.*—Maximum extension of glaciers; excavation of cirques in the heads of the gulches. Ice mounted 1,200 to 1,500 feet higher on the slopes of the valleys than now, and was proportionately more extensive. Most of the large glaciers discharged into the ocean, which skirted the mountain front.
4. *Glacial retreat.*—Uplift of about 100 feet, resulting in the partial uncovering of the coastal plain. Yakutat Bay and Russell Fiord glaciers formed moraines upon the flat before retreating. Other glaciers probably receded before the ocean was excluded from their valleys, and consequently formed no moraines. Plain gradually extended by the deposits of shifting streams. The glaciers decreased to nearly their present size and many of them entirely disappeared.

PROSPECTING.

The district described has been explored to some extent by prospectors since the early nineties, but as yet no deposits of proved value have been discovered. The beach placers about Yakutat Bay have been described by previous observers.[b] Deposits of black sand on Black Sand Island contain small amounts of gold and have been

[a] From results of studies by Russell and by Tarr and Martin it seems probable that this is a rising fault block.

[b] Tarr, R. S., Bull. U. S. Geol. Survey No. 284, 1906, p. 64.

worked in a desultory way by several parties, but without material success. Prospectors who have explored the valley of the Alsek report finding "colors" at several points in the canyons. Aside from these somewhat unpromising occurrences there is no evidence of the existence of gold deposits in the district.

It is stated that there are green stains indicative of copper in the canyon of the Alsek just above the main forks; but nothing is known of the value of the deposit. The slates of the Yakutat series along the front range also contain abundant small nodules and stringers of iron sulphides which probably contain a small percentage of copper. A large vein of this mineral is reported to have been found last summer on the shore of Russell Fiord and a claim has been staked for the purpose of developing the property. Specimens of the ore appear to be chalcopyrite, and as the deposit is located at tide water it may become valuable if sufficiently extensive.

A large portion of the coastal plain east of Yakutat was staked out in oil claims some years ago, evidently on the supposition that it is similar geologically to the plain near Controller Bay. There is not, however, the slightest indication of the presence of oil-bearing rocks in the district, and the claims are now abandoned.

POSSIBLE ROUTES TO THE ALSEK VALLEY.

At present there seems to be no easy way of reaching and exploring the valley of Alsek River. Nevertheless, there are several routes which are feasible, although some of them are more or less dependent on the season of the year and the condition of the glaciers.

From Dry Bay.—Alsek River can be ascended in small boats from its mouth only in time of low water. In the months of June, July, and parts of May and August the lower canyon, 20 miles from its mouth, is usually impassable. At these times the river fills this canyon in the Coast Range from the front of the Alsek Glacier, which forms one wall of the canyon, to the precipitous cliffs of rock on the opposite bank. Although difficult, it is possible even under these conditions to drag boats up along the west bank; but the almost incessant falling of rocks from the cliffs renders such an undertaking eminently perilous. It is said that when the river subsides in the autumn a gravel bar is uncovered and boats may be hauled along this without special danger. Once above this canyon, the navigation of the river appears to involve no great difficulties—at least as far as the abandoned settlement of New Hamburg.

Across the glacier from Yakutat.—In 1898 parties of prospectors reached the Alsek by crossing the ice fields from Russell Fiord. They landed from boats in Northeast Arm and carried their outfits up the moraine of the south branch of the Nunatak Glacier. After reaching the bare ice they were able to sled their baggage about 40 miles, over to

the head of American River, a tributary of the Alsek. Some years later another party attempted to cross by this same route, but were unsuccessful on account of the badly crevassed condition of the glacier. Evidently the feasibility of this route depends on the state of the ice at the time the attempt is made.

It may also be possible to use the Yakutat Glacier in the same way and thus to shorten the distance of ice travel by at least one-half. From Yakutat a party can take boats to Dangerous River and ascend it to the east side of the lake at the foot of the glacier. The Indians say that from this point the interior ice field can be reached by traveling along the edge of the glacier. So far as the writer knows, the route has not yet been actually traversed by either natives or white man.

From Chilkat River.—Another route, which has the advantage of being well known, extends from Chilkat River over Dalton's trail as far as the head of the east branch of the Alsek. This stream is said to be navigable for river skiffs, although somewhat turbulent for ordinary canoes. The first explorers [a] of the Alsek descended this branch to the forks and then reached the coast by way of the main river.

By way of Whitehorse and Dezadeash River.—It is possible to go from Whitehorse to Dezadeash River over a wagon road recently built into the Kluane Lake mining field. Having reached the Dezadeash a party can easily descend by boat into the upper canyon of the main Alsek as far as the first glacier which comes into the river. It is said that this glacier forms a series of rapids which is entirely impassable, but that by making a portage of several miles across the end of the glacier it is possible to reach the river again below. From that point navigation can be resumed and continued to the Pacific.

[a] Glave, E. J., Frank Leslie's Illustrated Newspaper (weekly), vols. 70-71, June 28, 1890, to January 10, 1891.