APPENDIX A

BOTANICAL AND GEOLOGICAL SURVEY

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I can make, in the short time available, only a brief report of our findings on the botany and glacial geology along the Alaska Highway. The material presented was gathered between June 8th and Sept. 5th of the past summer, while our party travelled the road from Dawson Creek to Whitehorse and return. I can do no more than mention our deep appreciation of the generous support that made our work possible, and of the excellent cooperation we received from the Northwest Service Command. Although presented by myself alone, this report must in reality be considered a joint paper prepared in collaboration with Dr. Charles S. Denny. 2/

It is necessary, at the outset, to state the premises from which we have reasoned in the following discussion. Knowledge of climates and soils, with which it might be possible to make a rational program of biological exploitation along the Highway, has been almost entirely lacking. It would be a happy coincidence if we could examine the native vegetation and interpret local climates and soil potentialities from it; but our present knowledge of the relation between subarctic vegetation and these external factors is so tenuous that the desired interpretation is extremely hazardous. We seem to be reduced, therefore, to what we hope is an intelligent use of simple trial and error. If we can find sites near the road that closely simulate other, more distant ones for which much of the "error" has already been eliminated, we can expect to eliminate a goodly portion of our own error before ever the experiment is started.

Serious, long-term gardening trials in our region are necessarily few and scattered. North of Fort St. John, only those at old Fort Nelson and Lower Post are of any consequence. Though successful, and very significant in the present problem, they are of small local area, and the extent to which they can be expanded, in time and space, is yet to be defined.

The native vegetation along the road, except in parts of the Peace River agricultural district, is almost entirely of forests. If the native flora, therefore, is to give us clues on potential utilization, the clues should be looked for in types of forest and their distribution, particularly in their relation to soil and topography.

Although the forests are of vast extent and apparent complexity, only 8 species of trees are significant in their composition. These are: white spruce, black spruce, subalpine fir, lodgepole pine, tamarac, paper birch, trembling aspen, and balsam poplar. Along the road these trees occur in nearly every conceivable mixture, and seem to defy any arrangement by which

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combinations among them can be made to characterize different parts of the region. With the detailed examination of many stands, however, a number of facts stand out and tend to simplify the problem. Two of the species noted, lodgepole pine and aspen, both of which are enormously abundant, appear to owe their prevalence to the wide occurrence of fires in the distant or recent past. Except on some of the lightest, driest soils, these two trees do not reproduce themselves after a single generation following fire. Throughout most of the area, therefore, they are of only temporary significance in the forest, and can be eliminated in our search for types that reflect local environmental differences. Tamarac is nowhere very abundant and is confined to muskegs. Paper birch is usually a scattered constituent of other forest types, rarely abundant enough to form stands of its own or seriously to modify others. Balsam poplar, except in the Peace River district, is nearly always confined to the newest of river flood plains and terraces. If the nearly ubiquitous and opportunist pines and aspens can be eliminated, therefore, we are left with only 4 species whose behavior can be of use in defining basic upland forest types: the two spruces, the subalpine fir, and the balsam poplar. The first three of these are able to perpetuate themselves, one generation following another, on the same site. The white spruce is almost universally distributed on the upland, better-drained soils, and on river flood plains. Subalpine fir is characteristic of rather high slopes in the foothills of the mountains. Compared to the spruces it is of small extent along the route of the highway. The black spruce is, throughout most of its range across the northern part of the continent, a tree of muskegs and bogs. However, in the foothills and mountains of the northern cordilleran region, it extends its habitat to certain types of upland topography and soils. In the more rugged mountainous districts it reaches high up on the steep rocky slopes, associated with white spruce and lodgepole pine. At lower elevations, in country of subdued relief, it appears with the pine and white spruce on some areas of heavy clay soils. I have already noted that balsam poplar is mostly confined to river flood plains, but in the Peace River agricultural region it is not so limited, and, like the black spruce farther north, extends its habitat to the uplands.

With these facts in mind, then, the principal criteria for the definition of natural regions in terms of forest types become the presence or absence of quantities of black spruce, subalpine fir, and balsam poplar in the upland forests.

There is not sufficient time on this occasion to give even brief consecutive descriptions of forest types along the road. I can only point out where the principal variations occur.

The most abundant and widespread type is of white spruce, lodgepole pine and aspen. It is best developed on the better-drained soils at low and middle altitudes, at or below 2500 feet. It produces its heaviest, and commercially most promising, timber on the flood plains and lower river terraces along the Prophet, Musqua, Nelson and Liard Rivers. It is also well-developed on the divide between the Halfway and Blueberry Rivers northwest of Fort St. John.

Northward along the road from Dawson Creek to about 25 miles above Ft. St. John the upland forest is a mixture of white spruce, aspen and balsam

poplar. This whole region is distinguished by the abundance of aspen on burned-over land, and, as noted previously, by the presence of balsam poplar on the prevailing upland clay and clay till soils.

A mixture of black spruce, white spruce and pine, sometimes with aspen, is of wide occurrence along the highway. It has its most extensive development in two areas, the first of which appears about 50 miles north of Ft. St. John. From here it extends over a high plateau area northward for about 150 miles. The road attains an altitude of about 4100 feet on this plateau. The soils are derived from heavy clay tills or post-glacial lake clays. The other large area of black spruce is in the rugged mountainous country between Summit Pass and the lower crossing of the Liard River. Here it is mixed with white spruce and lodgepole pine on high, steep mountain slopes, especially those of northern exposure. The soils are mostly of sand and gravel. In both of these large areas the black spruce type is mostly at moderate elevations. In the Liard valley, however, it extends down to about 1600 feet, occurring at irregular intervals on the upland between the Coal and Hyland Rivers. The soils of this upland are developed on outwash sand and gravel interspersed with patches of clay till. Wherever these heavy clay soils occur the black spruce becomes abundant in the forest mixture. Farther west, near the lower crossing of the Rancheria River, it appears again on similar soils.

In the region of the continental divide, from the lower crossing of the Rancheria westward to Swift River, the country is somewhat rough and mountainous, though not so rugged as that between the Summit and the Liard. The soils are mostly developed on sand and gravel, with only occasional areas of boulder till. Altitudes are not great, and the divide is only about 3100 feet high. The forests are of white spruce, pine and aspen, and site qualities are poor except on some of the narrow flood plains and terraces along the Rancheria River. Westward from Swift River, boulder and clay tills become more common, and the black spruce type appears at various places between Swift River and Teslin. Between Teslin and Whitehorse, however, it does not reappear in sufficient amount to be recognizable.

The black spruce type seems to have certain altitudinal limits that appear along the road. North of Ft. St. John its lower limit first appears at about 2800 feet, and its upper limit is somewhere above the 4100 feet reached by the highest plateaus. West of Nelson its lower limit is down to 1700 or 1800 feet, but in the mountains of the Summit area it seems to have an upper limit at about 3500 feet. Farther north, in the Liard valley it descends to about 1600 feet. Judging by these few figures the altitudinal limits of the type slope downward to the north, touching the lower levels of the road only along the Liard River.

Nowhere does the black spruce type produce forests of much value. Most of its trees are of small stature and are often widely spaced.

The third notable variation in forest types is in mixtures involving subalpine fir. This tree appears in quantity in only two places along the road. The first is in the Steamboat Mountain area about 50 miles west of Nelson, and the other is on a divide, about 3300 feet high, between the

Swift and Morley Rivers east of Teslin. These are the heaviest upland forests seen along the road. They occupy rather steep foothill slopes at moderate elevations--1800 - 3500 feet, and are composed of fir, white and black spruce, lodgepole pine and paper birch. Some sawmills have already been established in the districts mentioned, but the actual areal extent of the type, away from the road, is not known.

In seeking immediately practical applications for these facts of forest type and distribution, it is worth while to look at the whole region in perspective. It is possible to define three geographic phases in the flora and vegetation of the whole region. The coniferous forests of the northwestern interior of the continent can be divided usefully into boreal and cordilleran types. The boreal forest extends across the continent from the Gulf of St. Lawrence to Alaska. It is dominated, on the better-drained soils, by white spruce, with the black spruce and tamarac occupying muskegs. The cordilleran forest of the central Canadian Rockies is dominated by Engelmann spruce, white-barked pine, and subalpine fir, and in the foothills and on high northerly slopes the black spruce extends up from the muskegs to occupy some upland sites. The region of the Alaska Highway is beyond the northern limit of the white-barked pine, and the Engelmann spruce is apparently rare--replaced by the white spruce of the boreal forest; but the subalpine fir and the upland habitat for the black spruce persist. It is obvious that the boundary between cordilleran and boreal influences is not straight, but is rather an interdigitation, and that the new highway passes through the area of intermingling. To a considerable extent there is an altitudinal separation of the two influences, as well as an areal one, but we have shown that the cordilleran upland black spruce also occurs at low elevations along the Liard.

The third geographic phase of the northwestern forests is that of the poplar parkland of the upper Peace River country. This appears to be a part of the broad prairie-forest transition of central Alberta and central Saskatchewan.

The best agricultural areas touched by the road are obviously at Dawson Creek and Ft. St. John. Is it possible that they could be pushed northward, or that others like them could be found farther north? The one good forest indicator we have for them is the presence of balsam poplar in the upland timber on clay soils, together with a high development of aspen on burned-over land. We saw this combination only for about 25 miles after leaving Fort St. John. The only other place in which we found a suggestion of it was on the clay tills just west of Ft. Nelson at an altitude of about 1600 feet. Aspen is extremely abundant there, and occasional balsam poplars occur with it. The type is completely absent along the Liard River and westward.

A successful, though limited agriculture can be practiced throughout most parts of the boreal spruce forest region wherever suitable soils occur. This is amply demonstrated in the Clay Belt of northern Ontario, throughout the Mackenzie basin northward beyond the Arctic Circle, and in the central Yukon valley. I believe it is not true of the northern cordilleran forest region. The successful gardens of the lower Peace and Athabaska valleys, and of the Slave and Mackenzie River areas, are at low elevations, on the

alluvial soil of the more recently formed river flood plains. Whether they could be extended to the uplands bordering the rivers is yet unknown, but there is ample space for expansion on many of these lowlands without using higher levels. The only gardens of proved success along the Alaska Highway north of Ft. St. John are in areas dominated by the boreal forest. They are in the Liard drainage, at Nelson and Lower Post, and both are at low elevations. The areas available for expansion in these valleys are of necessity much smaller than in the Mackenzie country, due not only to the narrowness of the valleys but also to the greater likelihood of floods on what alluvial soils there are.

It becomes of first importance, therefore, to determine the feasibility of using the higher river terraces and the till-covered uplands bordering the Musqua, Nelson and Liard Rivers. I have already noted that there is little evidence from forest indicators that the more extensive agriculture of the Peace River area could be so extended. It is altogether possible, however, that the limited gardening of the Mackenzie country could be practiced on the higher ground. So far as frost and the length of the growing season are concerned, the uplands should be better than the lowlands where the gardens are now. Water supply might turn out to be the critical problem, for this is all a country of low summer rainfall. If this should be the case, the selection of soil and exposure would have to be made wisely. The gardens that were located during the past summer in sandy river valleys such as at the Sikanni River, or on sand and gravel outwash plains such as that at Watson Lake, failed to produce much in spite of the fact that this was a wet year. These results suggest that the lighter soils should be avoided. The heaviest clay soils at moderate elevations, on the other hand, especially along the Liard, should probably also be avoided as being too "cold" and too poorly drained. These are the soils, along the Liard, that reflect a cordilleran forest influence, in the form of the black spruce mixture. This influence does not descend to the uplands around Nelson, although the heavy soils are there.

With regard to existing timber values and site qualities, the most promising outside the comparatively narrow flood plains of the large streams are on the foothill slopes at altitudes below 3500 feet, and on the tills and outwash plains along the Liard River. These are the areas in which the Cordilleran elements in the forest find their more complete expression. It is difficult to visualize what the forests would be like after a long-term, all-but-inconceivable absence of fire. Judging by what we know of the habits of the trees, the lodgepole pine would largely disappear except on very light sandy and gravelly soils such as occur around Watson Lake. On the better sites the spruces could be expected to grow to large size and good timber quality. Whether the subalpine fir would spread more widely under such millennial conditions is problematical.

By way of summary, it may be said that some evidence for the feasibility of a limited agriculture along the Alaska Highway may be gained from the native vegetation in its relation to topography and soils. The prevalence

along the Nelson, Musqua and Liard Rivers, at altitudes below 1600 feet, of a boreal forest, similar to that of the Slave and Mackenzie River valleys, suggests that agricultural practices which have proved successful in these valleys can be extended westward provided suitable sites can be found. The presence of cordilleran elements in the forests along the Liard at these low elevations suggests that this more northern area is not so promising as that in the vicinity of Fort Nelson. Gardens in the Mackenzie country and in the upper Liard basin have thus far been tried chiefly on recently deposited alluvial soils; and since the extent of such soils, free of floods, is not great in the vicinity of Nelson or on the upper Liard, any large extension of gardening in these areas depends upon the feasibility of raising it to the higher river terraces and adjacent till plains. Evidence that this can be done is scanty. Upland forest types in the immediate vicinity of Nelson show a slight similarity to those of the Fort St. John region, and may indicate that such an extension is reasonable in this district. If so, the best soils for the experiment are probably those derived from clay tills.

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