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Henry P. Hansen
Oregon State College, Corvallis

Ten peat sections from as many muskegs were taken along the highway between Athabaska, Alberta and the British Columbia-Alberta border, a distance of about 350 miles (Fig. 1). An eleventh section was obtained about 12 miles south of Smith. Principal towns on this highway are High Prairie, about 30 miles to the west of Lesser Slave Lake, and Grande Prairie which is about 60 miles east of the British Columbia-Alberta border, and 370 miles from Edmonton by highway. Athabaska is about 100 miles north of Edmonton (Fig. 1).

Most of the sites of accumulations are of the muskeg type which apparently developed on more or less flat terrain without an initial aquatic stage. This is evidenced by the absence of limnic peat underlying the fibrous Sphagnum peat as well as the dearth of pollen grains of hydrophytic plants in either the clay-silt or in the lowest organic sediments. In a previous paper the author distinguished between the typical bog and the muskeg, largely upon the basis of these criteria (Hansen 1949a). Although the mature stages of bog and muskeg are similar with respect to both species and many physical characteristics, the term muskeg has been applied largely to sites of organic sedimentation in the arctic and subarctic. In this region the muskegs are comparatively shallow and cover vast expanses, many square miles in some cases, and lie on flat terrain or in broad shallow basins. It is possible that the development of muskegs on flat terrain in a region of comparatively low precipitation as in Central Alaska, Yukon Territory, and the area of this study was favored by the presence of permafrost. Permafrost prevents subsurface drainage and causes the water table during the summer to rise to the surface. The abundance of moisture at or on the ground surface promoted the growth of tundra and muskeg plants, which in turn, pro-

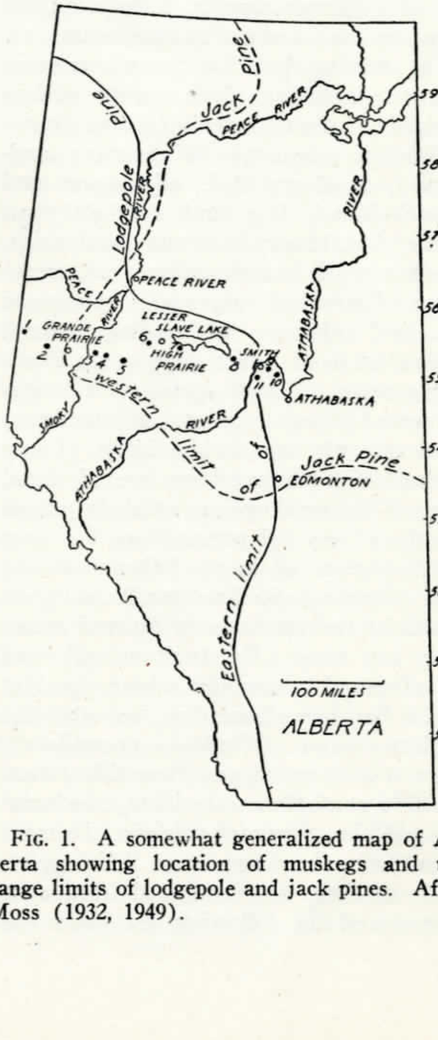

Fig. 1. A somewhat generalized map of Alberta showing location of muskegs and the range limits of lodgepole and jack pines. After Moss (1932, 1949).

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vided insulation for the permafrost and raised the water table. Once started, Sphagnum moss and sedges served to hold the moisture still higher and favored continued growth of muskeg plants and peat accumulation. Sampling of the muskegs of this study revealed no permafrost either in the peat or the underlying inorganic clays and silts. The author believes, however, that permafrost may have existed in this area at the time of muskeg inception, and, in fact, was responsible for the conditions necessary for their development. The occurrence of muskegs as far south as Edmonton, Alberta, suggests that permafrost may have extended as far south as this latitude, and has since retreated northward with the advent of a warmer climate, perhaps during the postglacial warm, dry maximum.

The muskeg flora has many species in common, including black spruce (*Picea mariana*), Labrador tea (*Ledum groenlandicum*), cranberry (*Vaccinium oxycoccus*), blueberry (*V. uliginosum* and *V. vitis-idaea*), bog birch (*Betula glandulosa*), bunchberry (*Cornus canadensis*), cloudberry (*Rubus chamaemorus*), crowberry (*Empetrum nigrum*), *Sphagnum* spp., and others. All muskegs except the one south of Smith support an abundant growth of black spruce, but lodgepole pine (*Pinus contorta latifolia*) was noted on only two, while larch (*Larix laricina*) was observed on five of them. Some of the muskegs are miles in extent and these two arborescent species may well be present on more of them. White birch (*Betula papyrifera* var.) occurs on several of the muskegs in burned areas. Hairy cap moss (*Polytrichum* sp.) was also observed commonly where the bog surface had been burned as was also the reindeer moss (*Cladonia rangifera*). Other species noted are *Potentilla palustris, Chamaedaphne calyculata, Andromeda polifolia, Kalmia polifolia, Drosera rotundifolia, Carex* spp., and *Salix* spp.

The muskegs are numbered from west to east, and the following list gives the location in relation to some landmark or town:

Section	Location
1.	3 miles east of the British Columbia-Alberta border.
2.	16 miles west of Grande Prairie, near Saskatchewan Lake.
3.	5 miles east of Smoky River, 25 miles east of Grande Prairie.
4.	20 miles east of Smoky River.
5.	near west end of Sturgeon Lake, about 45 miles east of Grande Prairie.
6.	6 miles west of Triangle, 15 miles west of High Prairie.
7.	30 miles east of High Prairie.
8.	6 miles east of Slave Lake village.
9.	10 miles east of Smith.
10.	20 miles east of Smith.
11.	12 miles south of Smith.

The thickness of the sections varies from 1 to 2.5 meters, with an average of about 1.95 m. This includes in some cases a half meter of clay-silt upon which the fibrous Sphagnum peat immediately lies. The almost complete absence of pollen grains in this inorganic material indicates that it constitutes the original pre-muskeg surface, which has since undergone gleization as a result of the waterlogged conditions caused by the overlying organic mantle. Volcanic ash fragments occur in most sections near the surface, while they are also present in several of the sections at a lower horizon. The glass in the upper levels may be from the eruption of Mt. Katmai on Kodiak Island which occurred in 1912, while the lower ash apparently came from an earlier eruption of unknown location. A second lower layer of ash occurs in two bogs west of Edmonton, and muskegs along the Alaska Highway in the Yukon Territory also contain volcanic glass at two different stratigraphic levels (Hansen 1949b). The source of the former has been suggested as Glacier Peak in north-central Washington, but the distance of the Yukon muskegs from this site hardly favors this source. It should be said, however, that the postglacial eruption of Glacier Peak was of considerable magnitude and its ash dispersed extensively to the east and north. A peat section at Newman Lake, 20 miles northeast of

Spokane, shows a layer of pure volcanic glass almost a foot thick (Hansen 1939). The Grande Prairie-Lesser Slave Lake region lies about 550 miles north of Glacier Peak. Pumice noted in peat sections from bogs in south-central British Columbia indicates that postglacial volcanic activity occurred in this region.

In preparation of the peat for pollen analysis the potassium hydrate method was used (Hansen 1947). From 100 to 200 pollen grains of indicator species were identified from each level except from the underlying clays and silts. In the few inorganic horizons included in the profiles, not less than 50 pollen grains of significant species were identified. It seems possible to separate white spruce (*Picea glauca*) from black spruce, and lodgepole from jack pine (*Pinus banksiana*) with some degree of accuracy by means of the size range method (Hansen 1947). This was done for some sections, but pollen profiles of the individual species are very irregular with uninterpreted fluctuations from level to level. A pine pollen, more minute than that of either lodgepole or jack pine, was noted sporadically in most of the sections, but most abundantly in the more easterly located muskegs. As most of the sites of this study lie within the area of overlapping ranges of lodgepole and jack pine, it is possible that this small pollen grain represents the hybrid between the two species which occurs in the region (Moss 1949). The occurrence of ericad pollen in the lowest levels lying directly upon the inorganic clay and silts, and the abundance of conifer pollen also, indicate the forests already existed in the area when the peat accumulation began. Other pollens in the lowest horizons include those of alder, willow, sedge, and birch.

Forests of the Region

The Grande Prairie-Lesser Slave Lake region encompasses the meeting place of three climaxes. These are the boreal forest, the subalpine or Cordilleran forest, and the grassland. The transect of muskegs from which the peat sections were obtained actually traverses the zone of overlapping ranges of species of the boreal and subalpine forests. The boreal forest extends across the continent from Labrador into Alaska. It is bordered on the north by the tundra and on the south by the lake forest and grassland, and contacts the main body of the subalpine forest near the eastern front of the Rocky Mountains in Alberta, British Columbia, and the Yukon. In Alberta, the climax or primary arborescent species of the boreal forests are white spruce and balsam fir (*Abies balsamea*). Jack pine, a subclimax species in the boreal forest, which finds its westernmost range in Alberta, thrives after burning or on sandy soil. In the latter habitat it simulates a climax species, probably because of lack of competition. It is particularly abundant on the sandy outwash in the vicinity of Smith and Athabaska, and ranges almost as far west as Grande Prairie (Fig. 1). Aspen (*Populus tremuloides*) is one of the most abundant trees in the region and it has been favored by recurring fire and clearing. It is abundant in the Grande Prairie region, and in the absence of continued cultivation rapidly takes over. Larch (*Larix laricina*) and black spruce are confined largely to muskegs, with the latter being by far the more abundant. White birch is not abundant in the region and thrives as a result of fire, either on the muskeg or upland. It was noted in abundance on several of the muskegs in burned areas. Balsam poplar (*Populus balsamifera*) is locally abundant on floodplains and was noted especially in abundance along the floodplains of the Smoky and Little Smoky Rivers, and the Athabaska River farther east.

Two arborescent subalpine or Cordilleran species occur in the region. Alpine fir (*Abies lasiocarpa*) is a climax dominant which ranges eastward to central Alberta but is not common (Halliday 1943). Although the ranges of alpine fir and balsam fir almost meet in north-central Alberta, as yet they have not been found to overlap. More abundant is lodgepole pine which extends eastward in Alberta to Smith and almost to Edmonton. It also occurs as an outlier in the Caribou Mountains south of Great Slave Lake (Raup 1935). Lodgepole is subclimax throughout its vast range and owes its persistence to burning and clearing or edaphic disturbance. It forms vast pure stands along the Alaska Highway in British Columbia and the Yukon, but becomes less abundant eastward in the Grande Prairie-Lesser Slave Lake region. The ranges of lodgepole and jack pine overlap in this region with the greatest concentration of jack pine in the eastern part and lodgepole pine in the western portion. Lodgepole occurs on the lighter soils and on muskegs with black spruce and larch. As mentioned earlier the pine pollen of this study is obviously a mixture of the two species. Moss (1949) has noted the occurrence of hybrids between lodgepole and jack pine and has mapped their overlapping ranges. It is probable that the pollen of the hybrid also occurs in the sections, as most of them lie within the range of the hybrids. It is interesting to note that Moss observed more hybrids farther east of the range of overlap than to the west, suggesting the influence of prevailing westerly winds during anthesis. Moss (1932) extends the Cordilleran forest eastward to Athabaska, probably due to the ranges of lodgepole pine and alpine fir this far east.

South of the boreal forest and east of the subalpine forest in Alberta, in order are the Poplar area, the Parkland, and the Prairie (Moss 1932, 1944; Moss and Campbell 1947). It is possible that these vegetation provinces lay farther north during the postglacial warm dry maximum, and have since moved southward as the climate became moister and cooler. This is suggested by the fact that the southern fringe of the boreal forest occupies black soils that have become partially podsolized into transition or gray soils (Odynsky 1945). In the Grande Prairie and Peace River region there are extensive grassland areas that may have persisted from greater expanses during the xerothermic interval.

The heterogeneity of the forests in the region of this study is well suggested by the term "Mixedwood" section applied by Halliday (1937). Outliers of Halliday's Aspen Grove section which lies adjacent to the praire of southern Alberta occur in the vicinity of Grande Prairie, Peace River, and west of Lesser Slave Lake. The dark soils of this section suggest former grassland which was replaced by aspen in more recent time. The Aspen Grove section has been largely cleared and today is utilized for growing grain, chiefly wheat. The Mixedwood section is further fragmented by extensions of the Foothills section eastward from the foothills of the Rocky Mountains, forming an ecotone which in effect constitutes the merging of the boreal and subalpine forests. The muskegs of this study lie largely within this ecotone. There seems to be every conceivable combination of the species mentioned above, with patchwise mixtures of aspen, white spruce, birch, balsam poplar, the firs, and even grassland. These species also occur in pure stands. This mixture has been fostered by fire and clearing in conjunction with soil and exposure. It seems probable that over the region white spruce would become the predominant tree and occur largely in pure stands if there were no disturbance for a few hundred years. In the sandy areas jack pine would probably persist even in the absence of fire, while on the south slopes aspen would also thrive without the benefit of continued disturbance. The three climax types or geographic elements, the boreal and subalpine forests and grassland, were probably separated by the Late Wisconsin glacier, and have since migrated into the region from their proglacial refugia. The dynamics of adjustment are still progressing and with the constant changes in environment caused by fire and clearing no ultimate phytogeographic pattern can be foreseen. With hybridization occurring, natural selection of biotypes taking place, and continuing migration of some of the species, new combinations of the floristic elements may gradually develop.

Glacial relationships in the Grande Prairie-Lesser Slave Lake region are unknown and uncertain. It seems improbable that the Late Wisconsin Cordilleran ice was sufficiently nourished on the east flanks of the Rocky Mountains at this latitude to extend this far east (Flint 1947). It is also problematical whether the Keewatin ice sheet, moving south and west from centers in the Hudson Bay region, reached the area of this study during the last glacial stage. Cameron (1922) has shown that glacial lobes extended south and west up the Peace and Athabaska river valleys in his study of postglacial lakes in the MacKenzie River basin. He does not show them reaching as far south as the region of this study, although it is doubtful if he considered these lobes as the maximum extension of the Late Wisconsin ice. Bretz (1943) located the Altamont (Late Wisconsin) moraine about 75 miles east of Edmonton, and traced its eastern border northwestward in Alberta north to latitude 54°. Extension of the Altamont moraine border in the same general direction to meet with the Athabaska and Peace river lobes would indicate that the Grande Prairie-Lesser Slave Lake region was not covered by Late Wisconsin ice, and that there was an ice-free corridor a hundred or more miles in width in western Alberta and northeastern British Columbia. The level terrain, extensive lacustrine deposits, and the persistence of broad shallow lakes in the Grande Prairie region today denote the existence of vast proglacial lakes ponded against the glacier to the northeast during the maximum extension of the Late Wisconsin glacier.

Postglacial Forest Succession

Interpretation of the pollen profiles into terms of forest succession and paleic composition is qualified by the same conditions as those along the Alaska Highway in British Columbia as well as those in other regions (Hansen 1950). Perhaps the most significant is the almost complete absence of *Populus* pollen which is not well preserved in peat. While aspen and balsam poplar are the only species of this genus in the region, the former undoubtedly has been an important and abundant component of the prehistoric forests. The influence of fire as reflected by the successional relationships of aspen to pine, spruce, and grassland would undoubtedly be manifested many times in the sedimentary columns if aspen pollen were representatively preserved. Although birch pollen is fairly abundant, no attempt has been made to separate bog birch from white birch. Both are present on the muskegs but the latter is also present on the uplands. In view of its present sparseness in the forest complex, however, it may be that white birch was never abundant in the past. Its fluctuations, like those of aspen, would probably express a pyric influence. The occurrence of black spruce on muskegs and white spruce on adjacent uplands denotes their differences in environmental requirements. Consideration of all spruce pollen in a single profile may present a false picture of forest succession inasmuch as only white spruce pollen is an indicator of adjacent upland forest succession. Individual profiles of the two spruces based upon their pollen separation by the size range method, however, presents noncoordinated and uninterpreted profiles (Hansen 1950). A consolidated profile produces less erratic fluctuation and the indicated successional trends seem to be more logical. Peculiar to this study is the fact that both lodgepole and jack pine, and possibly their hybrid, are represented by their pollen, at least in the more eastern sections. A study of the pollen size ranges of the two pines denotes that lodgepole pollen runs slightly larger than that of jack pine. Individual profiles of these two species would add little or no value to this study as far as succession is concerned, although accurate separation of

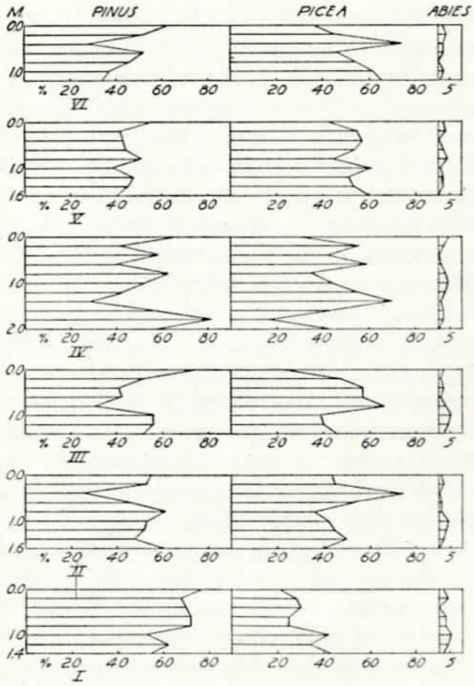

FIG. 2. Pollen diagrams of six muskegs beginning at the west end of the transect.

their pollen would perhaps reveal their postglacial migrations in this region. Perhaps of greater significance is the fact that the pines produce more pollen than the other species and at a much earlier age. It can be assumed with little doubt that the pines are somewhat overrepresented in this study. Although fir is scarce in the region, the occurrence of both alpine and balsam fir pollen indicates the muskegs are within range of pollen dispersal of one or both of these species. Fir pollen in the more westerly muskegs has been identified as that of alpine fir, while pollen of both species was noted in the more eastern bogs. This suggests that the prevailing westerly winds during anthesis carried alpine fir pollen eastward, while preventing balsam fir pollen from drifting westward.

The paucity of pollen from other species causes the profiles of spruce and pine to fluctuate conversely to each other throughout the region. Their total proportions at each level equal almost one hundred per cent because that of fir is negligible. While the picture of their relative abundance in adjacent areas denoted at any one horizon is probably accurate wthin the limits of pollen analysis, their fluctuations from level to level may be often merely relative. A decimation of one species may be reflected by the recorded increase of the other although there was no actual increase in the abundance of the latter. This is also true when several species are involved, but it is accentuated with fewer species represented. It is true that pine produces more pollen than spruce, but this is at least partially offset by the prevalence of black spruce on the muskeg.

In general, pine has been progressively less abundant eastward during the time represented by the sedimentary columns. The major deviation from this recorded pattern is in section 11, south of Smith (Fig. 3). This muskeg lies on sandy outwash and jack pine has been predominant in the absence of spruce competition. With the exception of this section, the average of pine proportions is highest in the westernmost muskeg, which shows 66 per cent. It then declines eastward to as low as 36 per cent in section 8 about six miles east of Slave Lake (Figs. 2, 3). The average of pine and spruce proportions for each profile is shown in Table I. Although the pollen records of lodgepole and jack pine are not treated separately, pollen size frequencies indicate that lodgepole pollen is far more abundant than that of

TABLE I. *Pine and spruce pollen averages for each section*

Section	1	2	3	4	5	6	7	8	9	10	11
Pine	66.1	47.1	50.5	53.2	45.2	44.0	36.3	36.0	42.2	38.7	69.4
Spruce	31.0	48.8	47.0	44.7	53.0	54.3	63.0	62.3	57.0	61.0	26.6

jack pine in all sections except 9, 10, and 11. It seems probable and reasonable that lodgepole survived in ice-free areas in western Alberta and possibly in more localized areas in northeastern British Columbia during the Late Wisconsin glaciation and then migrated eastward as the Keewatin ice retreated. Jack pine must have moved into this region from the south and east from its proglacial persistence south of the ice in the Lake states. Both species may be extending their ranges at present and their overlapping ranges today probably have developed in comparatively recent time, perhaps within the past few centuries. In only one section is either spruce or pine predominant throughout, and that is pine in the westernmost muskeg (Fig. 2). Extensive stands of lodgepole south and west of Grande Prairie may be responsible for this, as well as its occurrence on the muskeg.

Although only pine and spruce are represented by the bulk of the pollen, there seem to be several consistent trends and patterns, both regional and chronological. Spruce is predominant in the lowest pollen-bearing level in seven sections (Figs. 2, 3). This is consistent with its recorded trend along the Alaska Highway in British Columbia, where it is represented as predominant in 14 of 17 sections for a distance of over 500 miles (Hansen 1950). Pine preponderates spruce at the bottom in the four westernmost sections where it is recorded to over 50 per cent in each. In none, however, does pine supersede spruce by more than 20 per cent. Farther south in Alberta in the vicinity of Edmonton near the southern border of the boreal forest, however, pine is predominant in 6 of 7 sections at the bottom, while west of Edmonton, 3 or 4 sections reveal pine as most abundant (Hansen 1949a, 1949b). The minimum and maximum proportions of pine at the bottom are 26 and 60 per cent respectively with an average of 44 per cent. For spruce the minimum and maximum are 40 and 70 per cent re-

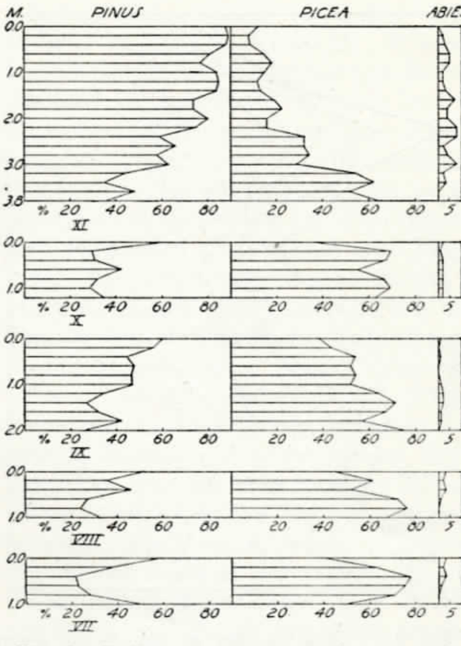

FIG. 3. Pollen diagrams of five muskegs. No. 11 is located 12 miles south of Smith on sandy outwash.

spectively, with an average of 56 per cent. Considering the more prolific pollen production of pine, it seems probable that over the region as a whole, spruce was somewhat more abundant than pine when the lowest pollen-bearing sediments were deposited. In all but two sections pine declines to its minimum between and top, which occurs at various stratigraphic positions in the profiles. The lowest proportion for pine is 22 per cent in section 7 (Fig. 3).

Most profiles show pine as initially increasing upward from the bottom, then diminishing, again increasing, then declining, and finally expanding in the upper levels to attain its maximum in all but one section. In all sections pine reaches higher proportions at the top than does spruce. The minimum and maximum proportions of pine at the surface are 50 and 88 per cent respectively with an average of about 65 per cent. Spruce shows a minimum and maximum at the top of 12 and 47 per cent respectively with an average of about 34 per cent. Al-

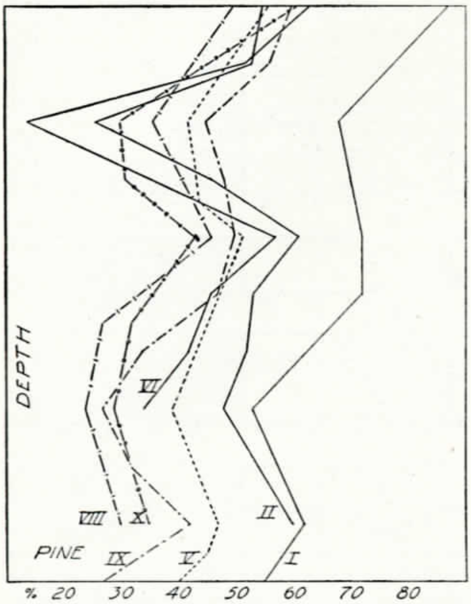

Fig. 4. Pollen profiles of pine from seven muskegs, showing possible correlation of the major trends.

though in some cases the difference between pine and spruce at the top is nonsignificant, it is probable that pine has been generally more abundant than spruce during the last century or so.

Conversely to pine, spruce attains its maximum between the bottom and top in most sections, indicating that conditions became more favorable for its expansion as postglacial time passed. The early postglacial preponderance of spruce in this region suggests the influence of a moist and cool climate in the wake of the retreating glacier. Expansion in some areas and maintenance of this initial abundance in others indicate continued favorable conditions for spruce which may have been sufficient moisture and absence of fire for a long time. Sharp and broad fluctuations in some of the profiles may express the occurrence of fire in local areas that favored pine, followed by fire-free periods which permitted spruce resurgence. That some regional influence was at play, however, is suggested by the similarity of pattern in these fluctuations in several of the profiles (Fig. 4). In spite of the alternating fluctuations, the over-all trend of pine expansion in the upper levels suggests an ever increasing pyric influence probably augmented by a drying climate. The general postglacial expansion of lodgepole pine also along the Alaska Highway in British Columbia and westcentral Alberta denotes that this entire vast region was subjected to environmental adjustments that were more favorable for pine than for spruce.

Fir (*Abies*) pollen is too scanty to be of any interpretative significance, except that it has never been abundant in the region. In the three westernmost sections fir is best represented near the bottom, but in the other sections it portrays no particular trend. Two sections reveal the fir maximum in the upper half, while section 11 shows the highest proportions of fir throughout, but with no fluctuations relative to those of spruce or pine (Fig. 2, 3).

Other species of tree pollens noted are *Betula, Alnus,* and *Populus*. Of these, birch is the most abundant and consists of both bog and white birch pollens. Aspen pollen is too scarce and sporadic to be of any significance, although 10 aspen pollen grains were counted in the uppermost level of section 11. Grass representation is also scanty, and its pollen most abundantly noted in the same section. This may be accounted for by the fact that the muskeg supports a luxuriant growth of *Muhlenbergia glomerata* var. *cinnoides*.[2] The small quantities of grass pollen noted in the other sections occur in the upper horizons, denoting perhaps the effects of clearing, cultivation, and fire in more recent times. There is no evidence of a grass expansion during the postglacial warm, dry maximum such as is suggested in the pollen profiles from muskegs in the vicinity of Edmonton. Here a pronounced influx of grasses, chenopods, and composites in the middle third of most sections has been interpreted

[2] Identified by E. H. Moss, University of Alberta.

as an expression of the xerothermic interval (Hansen 1949a, 1949b). The occurrence of Douglas fir (*Pseudotsuga taxifolia*) pollen grains in the upper levels of section 11 denotes that pollen of this species can be airborne great distances, as the nearest known Douglas fir is near Jasper, more than 200 miles to the southwest.

The chronology of the recorded forest history of this study is indefinite. Although it is not certain that the region was entirely covered by the Late Wisconsin ice, the occurrence of many large lakes in the region ponded against the northeastward retreating Keewatin ice may have prevented migration of forests into the region until the lakes were drained or the ice had receded or both. As mentioned above, the region is the meeting place of the boreal and subalpine (Cordilleran) forests with the grasslands not far to the south. It seems probable that jack pine and balsam fir migrated into the region from the south and east. The writer believes that the Cordilleran species, lodgepole pine and alpine fir, migrated from the west where they persisted in an ice-free corridor in western Alberta and smaller refugia in the northern Cordillera, northeastern British Columbia, and in west central Yukon during the Late Wisconsin glaciation (Hansen 1949a, 1949b, 1950). The occurrence of lodgepole pine on the apparently unglaciated higher portions of the Caribou Mountains in northern Alberta may represent another refugium (Raup 1946). The increase of high proportions of lodgepole pollen in the lower levels of muskegs in this study, in west central Alberta, and along the Alaska Highway in British Columbia, denotes the existence of a nearby source for early postglacial migration of this species. If it did not persist in the refugia mentioned above it would seem hardly possible that it would be so abundantly represented at the bottom of muskegs at this latitude and farther north.[3] If the entire region of Alberta and British Columbia were covered by ice simultaneously, it would be more logical to find spruce and fir represented by practically 100 per cent at the bottom of the muskegs. The present range of spruce far north of pine indicates that it would have been better able to persist closer to the glacier and thus migrate into deglaciated areas sooner than lodgepole. This interpretation is supported by Hultén's theory with respect to the survival of boreal flora in unglaciated areas in the Upper Yukon River Valley and parts of Alaska (Hultén 1937). Aside from the firs and pines, western and eastern varieties of white spruce, larch, and white birch occur in northern Alberta (Raup 1946). While it is uncertain as to when these species became variegated, it is conceivable that the western varieties *Picea glauca albertiana, Larix laricina alaskensis,* and *Betula papyrifera neoalaskana* postglacially invaded the area from refugia to the northwest while the typical species advanced from the southeast. Black spruce and aspen may have reached the Grande Prairie-Lesser Slave Lake region from either or both the southeast and the west.

[3] Unpublished data from Yukon muskegs, being studied by the author.

Summary

Pollen profiles from eleven peat sections in the Grande Prairie-Lesser Slave Lake region of Alberta reveal that pine (*Pinus*) is more abundantly represented in the western part and becomes less abundant eastward with the exception of the easternmost section which lies on the pine-forested sandy glacial outwash north of Edmonton. The pollen proportion averages of pine decrease eastward while those of spruce (*Picea*) conversely increase. In nine sections pine is recorded to its maximum at the top while spruce attains its maximum at some point between the top and bottom. The expansion of pine in the upper levels may reflect the influence of fire and a drier climate in more recent time. Fir (*Abies*) is only slightly represented and its trends do not seem to be significant. The absence of

aspen (*Populus*) pollen, due to its poor preservation, undoubtedly distorts the pollen profiles and presents an incomplete picture of forest succession.

The chronology of the recorded forest history is not clear because it is not known whether the region was covered by the Late Wisconsin ice, although vast lakes in the region probably prevented extensive forest development until postglacial time. The relative shallowness of the muskegs does not point to great antiquity, and they may have developed since the warm, dry maximum. The region was postglacially invaded by species of the subalpine Cordilleran forest, the boreal forest and the grassland. Species of the Cordilleran and boreal forests may have persisted in refugia in northeastern British Columbia and central Yukon during the last glaciation.

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