## A REPPORT <br> ON THE EgTABLTSHRANTT

OF PRECISE ASYRONOXTCAL STATE ONS
ALONG

# THE BRITTSH COLUMBTA - YORTHWES\% TTERRITORIRS BOUNDAFY <br> FAST OF THR LTARD RIVKR <br> SBASON OF 1950 

C. H. NEX<br>DOMTMIOA LAND SURVEYOR<br>GRODETIC SURVEX OF GAMADA

A report on the establishment of precise astronomical stations along the British Columbia-Northwest Territories boundary east of the Liard River

> C.H. Ney, D.L.S. Geodetic Survey of Canada

In ompliance with instructions received from the British Columbia-Yukon-Northwest Territories Boundary Commission,* the organization of an astronomical observation party to establish preoise latitude stations at intervals along the 60th parallel of latitude east of the Liard River was undertaken in May, 1950.

From the meagre available information pertaining to the area adjacent to the theoretical boundary, it was apparent that the transportation problem would be difficult to solve. Whether or not the Petitot River, which crossed the boundary a number of times, was navigable for canoes or flat-bottomed boats was most uncertain. However, the existance of a canyon and many rapids on the most northerly $40-\mathrm{mile}$ stretch of the river was definitely established.

Questionnaires regarding the feasibility of landing on the Petitot River in summer with pontoon-equipped planes were sent out. Mr. R.M. Crowther, the former owner and operator of the Musqua Air Service at Fort Nelson, who had been operating in the Fort Nelson area for three years, reported that he had flown over the Petitot River a number of times. From his observations of the local conditions, he considered that sumer aeroplane landings would be very hazardous or impossible.

The use of packhorses for transportation was given scant consideration due to the remoteness of the theatre of
*Composed of Mr. B.W. Waugh, Surveyor-General of Dominion Lands, Chairman, and Mr. N.C. Stewart, Director of Surveys and Mapping of the British Columbia Department of Lands and Forests.
operations from Fort Nelson, the nearest possible base, and the prevalence of soft muskeg in the area along possible routes leading to the observation station sites.

In reply to an air mail letter sent out early in March, a radio telegram from Mr. R. Cunningham, Manager of the Hudson's Bay Company at Fort Liard, was received on April 6th. From this communication, it was learned that the Petitot River was navigable for shallow-draught, flat-bottomed boats or canoes for three or four weeks following the spring break-up, provided that sufficient mechanical power was available for propulsion. With this definite and reliable information, it was decided to attempt water transportation for the first $60-\mathrm{mile}$ stretch of boundary lying to the east of the Liard River, by descending the Fort Nelson and Liard Rivers by boat, and then ascending the tributary Petitot River from its mouth at Fort Liard, for about 90 miles to its most easterly crossing with the 60th parallel of latitude. For the remainder of the boundary line lying to the east of the last mentioned point, it was planned to use aerial transportation, provided that lakes suitable for plane landings could be found on or adjacent to the boundary.

On May 14th, I left Ottawa for Edmonton which was reached on the morning of May 17 th . On the evening of the same day, I continued the journey to Dawson Creek which was reached on the evening of May 18th. The next day, a number of purchases were made locally and truck transportation arranged for the shipment of canoes, instruments and camp equipment, from Dawson Creek to Fort Nelson. For safe-keeping, the shipment was consigned to the Hudson's Bay Company, which has a storage warehouse on the west side of the Fort Nelson River, accessible by truck from the Alaska Highway.

At Fort Nelson, considerable diffiaulty was
small boats and canoes in fast water. Most of the local trappers had already returned to the settlement from their trap lines, but the majority of them were, for the time being, so well sapplied with money from their recent fur sales, thet they were not disposed to accept employment on a survey party. Several suitable men refused offers of eight dollars per day.

After some delay, Chas. $\mathbb{E}$. Jensen was engaged as river pilot and cook, and R.M. Crowther as labourer. With John G. Moffatt of Victoria, who had already been engaged as recorder, this completed the recruiting of help. It was decided that any additional men required might be secured at Fort Liard.

For transportation of personnel and equipment, a 35-foot, flat-bottomed river boat powered with a 25 H.P. marine engine was hired at Fort Nelson. Two l8-foot canvascovered, freight-model canoes brought from Ottawa were taken along to supplement the boat transportation. While the Fort Nelson River is relatively safe for cances, the Liard River is very fast at high water. During the early summer, it may rise 5 or 6 feet in as many days. At such times, currentvelocities of 9 or 10 miles per hour may be encountered in certain stretches of the river. This makes the use of canoes very hazardous, especially in going up stream.

As an alternative to canoes, there has been developed on some of the northern rivers, a flat-bottomed type of boat about 5 feet in width, 35 to 45 feet in length, and 3 to 4 feet in height. These boats, drawing one to one and a half feet of water, are usually powered with inboard marine engines of from 25 to 50 H.P. capacity. This year's experience goes to show that a 25 H.P. unit is inadequate to cope with the highvelooity currents sometimes encountered on some of the northern
pivers.
Supplies for the $600-1 \mathrm{ile}$ boat trip, estimated to take 6 weeks, were purchased locally Irom the Hudson's Bay Company. Although prioes are high at Fort Nelson, it would not be expedient for a surveyor to purchase supplies in Famonton and pay train and truck transportation charges to Fort Nelson, unless the party was large and warehouse storage facilities available at Fort Nelson at low cost. By notifying the Hudson's Bay Company a couple of months in advance, a complete line of food supplies suitable for work in northern areas, could be secured without delay. On Monday morning, May 29th, the party loaded the canoes and boat, and set our for Port Liard, 180 miles dowstream. All the astronomical instruments and most of the camp equipment were stowed in the boat. The two canoes were lightly loaded and towed behind the larger craft.

The trip down the Fort Nelson River to Nelson Forks, and thence down the Liard River passed without incident. The waters of the Liard were not yet swollen by excessive run-off in the mountainous region to the southvest. As a result the current-velocities encountered on the Liard seldom exceeded 7 miles per hour. However, particular care had to be exercised to avoid fouling the flotilla on "sweepers" or "dead-heads" - trees detached from the bank which had become grounded on the river bottom with one end projecting above the surface of the water.

Towards evening of the second day, we neared the Vicinity of latitude $59^{\circ} 58^{\prime} 42^{\prime \prime}$, where the Dominion Observatory had established an astronomical station on the river bank in 1922. After considerable search, the old conorete pier (with bronze tablet) was located, and camp made near-by for the night. Commencing at the pier, a chain-and-compass traverse was
projected along the shore to the estimated position of the 60th parallel of latitude. At that place, a marker, visible from the river, was attached to a tree to indicate the approximate site of the astronomical station to be established on our return trip.

On May 3lst, we reached Fort Liard where final preparations were made for the ascent of the tributary Petitot River. From local inhabitants we learned that only one of the Indians in this district attempted boat travel on the first 40 miles of the Petitot River. The one exception was Joe Donta, the Indian assistant to Clarence Shattuck, the Federal Government fire warden stationed at Fort Liard. As Mr. Shattuck was interested in inspecting this part of his domain, it was agreed that he and Donta should come along with us in his power boat. This boat, of shallow-draught design, was powered with two outboard engines - a 35 and a 15 H.P. Johnson. With both engines operating simultaneously, it could develop speeds up to 20 miles per hour. At the time When arrangements for the trip were being made, we didn't realize how lucky we were in securing such helpful travelling companions. Without their aid, we probably would never have been able to reach our objectives on the Petitot River. On the morning of June lst, we set out on the $90-\mathrm{mile}$ trip. Donta and Shattuck led off in the fast power boat which soon outdistanced our slower crait. To speed up the latter, we put a light load in one of the towed canoes and ran it as a separate unit. The 5 H.P. Johnson engine on the canoe proved inadequate to cope with the fast current encountered later in the day. The other canoe, we loaded upside down on Donta's boat. In spite of this attempt at equalization, our boat lagged behind the other. However, by running at partial throttle, Donta managed to keep the lead boat within our visual range, thus permitting us to follow
it through the winding channels of the river.
About three miles from Fort Liard, we encountered the first rapids, which we were able to ascend with throttle wide open. In the next $10-m i l e$ stretch, we passed through 7 rapids of a similar type, and about 15 miles upstream from the mouth, we entered the Petitot River canyon. This gorge, about 500 feet wide at the water surface, has precipitous walls estimated to be 500 to 800 feet in height eut through soft sedimentary rocks. The water, which varies from 2 to 10 feet in depth, attains velocities up to 12 miles per hour, with an average value of about 8 miles. In two or three placed, the water surface is a seething mass of whitecrested waves 2 to 21 feet high. These patches of rough water constitute real hazards to navigation for heavilyladen canoes. For the flat-bottomed, shallow-draught type river boat, with 3 -foot sides, such as we were using, the waves are not particularly dangerous, provided that the engine is sufficiently powerful to cope with the current. Shortly before entering the 6-mile-long canyon, I had farther lightened the Jensen boat by accepting a place with Shattuck and Donta in the leading craft. About three-quarters of the way through the chasm, we encountered a partioularly fast stretch of white water crested with turbulent waves. Donta's boat propelled by its two outboard motors had no trouble forging ahead. From it, we watched Jensen's boat strive futilely to breast the current. Realizing that it could advance no farther under its own power, we stopped at a narrow ledge of rock attached to the base of the canyon wall. To return and track them up the fast water was impossible, due to the height of the sheer, rocky eliffs on either side of the river. Finally, it was decided to try towing the boat up the rapids.

Leaving me seated on the ledge, with the empty canoe held alongside, Donta and Shattuok turned the nose of their boat dowstream, and a few moments later disappeared from view behind the nearest bend in the canyon wall. After a 20-minute wait, the two boats reappeared as if by magic through a hole in the rocky cliff. The towing effort was a huge success - so great, in fact, that before another 15 minutes had elapsed, the two boats had reached the upper end of the fast, turbulent water. As I watched anxiously from my narrow ledge, I saw the leading boat cast off the tow line. Flung high in the air, the coiled rope missed the deck and dived like an angry snake into the boiling water in front of Jensen's boat. The bowman of the boat, inexperienced in river transport, and quite unaware of the potential danger, failed to retrieve the tow Iine promptly. Then things began to happen. The rope, Whipped astern by the current, was caught by the revolving blades of the propeller. In a few seconds, it was wound round and round the shaft in a tightly-dram, tangled mesh which so restricted the rotation of the propeller that the engine sputtered and stopped. The boat, swept backwards through the foaming water, narrowly missed a huge boulder, and disappeared around the canyon wall. Then the tow boat turned and followed it domstream, and out of sight.

Seated on the rocky Iedge of the canyon wall, I had plenty of time to ponder over the fate of the boat and its crew. Fifteen minutes passed - then a half an hour, and finally an hour with neither sight nor sound of my companions. The approach of night spurred me to action. Although the prospect of descending the white-water rapids alone in a canoe was anything but pleasant, I started the outboard motor and set out downstream. The navigation of the swift water and
the dodging of boulders and rocks was not too difficult. But when I reached the white-crested waves already described, the successive upward impacts lifted the unballasted bow high in the air and threatened to capsize the canoe. At last, I passed through the rough water, rounded the bend and came upon the remainder of the party with the two boats tied up at the foot of the cliff, while the crew was busily engaged cutting free the snarled rope from the propeller. The story of their unpremediated descent of the rapids without oars or power was luridly described by Jensen in the expressive vernacular of the Northland. In one thing we all conourred that the safe passage of the boat was a near-miracle for which sincere thanks were due to that partioular guardian angel charged with the safe-keeping of Govermment survey parties. Soon, we were ready again and with Donta towing, the flotilla progressed steadiy upstream till late in the ovening, when we emerged from the canyon and made camp for the night.

From the southeast end of the canyon to three miles beyond latitude $60^{\circ}$, there is a 12-mile stretch of river broken at fairly regular intervals by rapids. Some of these are nothing more than ripples; others are white water rapids that can only be ascended by shallow-draught oraft equipped with powerful motors. On most of the rapids, the navigable channels are so far out from shore that tracking mould not be feasible.

On the second day of our trip, Donta and Shattuck towed us up most of the rapids as far as the creek which has its origin near Maxhamish Lake and empties into the Petitot River about $2 \frac{1}{2}$ 哣les southeast of astronomical station $\mathbb{N} 8$. Knowing that we could navigate under our own steam from this point onward, our two friends bid us good-bye and set out on the return trip to Fort Liard.

On June 3rd, we voyaged along a delightful section
of the Petitot River. Only a few small rapids occur on this 50 -mile stretch. In most places the river is about 600 feet wide with 10 to 50 foot banks. However, fairly recent bush fires have destroyed much of the forest cover in this part of the country. From time to time throughout the day, we encountered small flocks of Canada geese which were nesting along the river bank. Ducks, muskrat and beaver were also observed along the route.

From the 8 -mile National Topographic Series map of the area, we chose a suitable camp site estimated to be close to the most easterly orossing of the Petitot River with the 60th parallel of latitude. A preliminary observation for latitude on the night of June 3rd showed that we were about 650 feet south of the desired position. The next morning station N 9 was established, the observatory tent and the precise astronomical equipment set up, and preparations for observational work completed. On the nights of June 6th, 7th, 9th and loth, star observations were carried on as long as weather conditions permitted.

On Sundey, June llth, we rase early, packed up all our equipment and made the return trip to the vicinity of the most westerly erossing of the Petitot River. A preliminary star observation that same night indicated that our latitude was $59^{\circ} 59^{\prime} 17^{\prime \prime}$. The next morning we ran a rough traverse down the river and selected an observation site for station N 8. In the afternoon, the astronomical equipment was set up and adjusted. At night, light clouds prevented us doing much work. However, we got one pair of latitude and a longitude determination.

On the morning of June 14th, the men commenced the construction of the survey monument, while I set out to connect the local river traverse with the newly established
astronomic station N 8 . With 4 or 5 traverse pickets and an axe, I was working my way along the boulder-strewn edge of the river. In turning around after planting a picket, I caught my foot in a moss-covered hole and was thrown violently backward over a large boulder. In the fall, my full weight came down on my left hand which struck a second boulder. In this accident, the outer bone in the finger was fractured and the knuokle joint completely dislocated.

To descend the river at once for medical attention meant that it would be impossible to return to the station till next year. Accordingly, it was decided to get as many latitude observations as possible that night and leave for Fort Liard the following morning. Fortunately the sky was clear so that another longitude set and 21 pairs of latitude stars were observed. This work, however, was accomplished under very trying conditions due to the pain and swelling of the left hand. After a sleepless night, the loeal surrey Work was completed and the instruments and equipment pecked up.

About noon June 15th, we commenced the trip downstream but soon ran into trouble. In the interval since coming up the river, the general water level had dropped 15 or 18 inches, greatly increasing the difficulty of negotiating the rapids. Where formerly there was 3 feet of water, there was then only a foot and a half. No clear channel could be found down many of the rapids. In running the first three or four, we struck rock áfter rock but managed to serape over them. On the fifth rapids, the one inch planking on the bottom of Jensen's boat was broken in three places. This meant a serious delay as most of the load had to be taken ashore in the canoes, so that extensive repairs could be made to the boat's bottom. For the remeinder of the day, the men
waded through the rapids holding on to the boat which had to be pulled, shoved, and pried over the shallow places. At times, one or two men went ahead With pike poles to clear away boulders from the Ifver botton, so that a passage could be made for the boat. More than a half a day was required to advence 5 miles under these conditions.

On June l6th, we made better progress. Some of the rapids were descended under power with the engine at quarter throttle; other rapids were so dangerous that the crew was obliged to go overboard and manhendle the boat through the most likely-looking channels. The passage through the canyon was without incicent. Although the current was fast, there was a greater depth of water in most places than in the section of river we had just passed over.

At this stage, we commenced to congratulate ourselves on the success of our voyage. The morst rapids of the river lay behind us. Fort Liard lay only a fev wiles ahead and only two rapids intervened. We started dom the inst one. The rays of the setting sun were in the pilot's eyes and he didn't see his nemesis ahead. Suddenly, we landed squarely on a large submerged boulder and the boat turned sideways in the current. One of the canoes we were towing was swept against us - swamped and capsized. To avoid further trouble we out it loose. Leaving Jensen, the only experienced river man in the crew, in charge of the stranded boat, I set out alone down the rapids in the second canoe to chase the upturned craft. Three-quarters of a mile downstream, I was able to tow it ashore and salvage much of its light load of tents and camp equipment. The list of material lost in the accident included:-

1 pađđle
1 tool kit for Johnston engine
1 funnel
1 pair pliers

2 rock drills
1 screwdriver
1 shovel
2 carborundum stones
2 fly sprayers
Assorted food supply, probably worth $\$ 70.00$
Realizing that the three men left in the stranded boat would not be able to get it off the rocks, I paddled on to Fort Liard and engaged a power boat and two men for salvage operations. Returning at once to the soene of the accident, we unloaded all the astronomioal instruments and other assorted gear from Jensen's boat. Aftar being lightened in this manner, it was possible to pry it off the rocks with no further casualties. The party finally reached Fort Liard about 10 p.m. tired and wet.

The next morning I sent a radio message for a plane to come from Fort Nelson to take me to the hospital operated by the Royal Canadian Air Force at that point. On arriving at Fort Nelson, it was found that the resident doctor had left for "outside" two days previously. However, the nurse superintendent of the hospital took an $X-r a y$ of the injured hand, which showed a fracture and complete dislocation of the finger joint. As a general anaesthetic would be required before reduoing the dislocation, the nurse refused to attempt the operation. Aocordingly, it was necessary to seek the services of the nearest doctor at Fort St. John, where the dislocation was reduced and the hand and lower arm put in a plaster cast.

Returning by air to Fort Liard as soon as possible, my party made ready for the trip upstream to latitude $60^{\circ}$, Where we were to establish station N 7, - the third of the season's series.

On June 24th, we reached the desired latitude and set up our camp and observatory tent close to the marker located on our trip downstream, over three weeks previously. By July lst, the station was completed together with a local triangulation joining our N 7 station with the Dominion Observatory astronomical pier established one and a half miles distant in 1922.

Four deys were required to ascend the Liard and Fort Nelson Rivers. On our arrival at Fort Nelson, the river pilot was paid off. The other two members of the party were retained for work on the eastern section of the boundary, using aeroplane transportation.

Associated Airways Limited of Edmonton had, at that time, a Bellenco Skyrocket pontoon-equipped plane stationed at Fort Nelson for the use of small geological survey parties engaged on oil exploration in the area. On July 7th, this plane was chartered for a reconnaissance trip of the western section of the boundary line. After flying a straight course to our station $N 7$ at the intersection of the Liard River with the 60th parallel, we took some pictures of the station site from the air. The white cotton ground strip, $6^{\circ} \times 9^{\prime}$, which we had placed in position before leaving the station, showed up plainly from the plane which circled around at 2500 feet. After completing the photography, we flew westward along the line for about 15 miles to get an idea of the nature of the country. In general, the area west of the Liard River is heavily-timbered, rolling terrain which rises in elevation as one proceeds westward. No open soft muskegs were observed along this section of the boundary line. Information received from trappers who are familiar with the region, indicates that there are no extensive muskegs and that horse feed should be found without too much difficulty. Twenty-four miles west of the Liard River is the valley of the Beaver River which
cuts through mountainous country. According to one trapper, the valley is deep and precipitous in most places. To take packhorses across the river, it would be necessary to detour several miles to the north of the boundary Ine.

Before reaching the Beaver River, we turned around and flew back eastward - recrossed the Liard River and continued along the 60th parallel past station $N 8$, and on to station N 9. East of the Liard River Iies an area of vast muskegs, through which there flows numerous streams. Adjacent to the Liard and the tributary Petitot River, there is a strip of timbered terrain probably two to five miles wide. Elsewhere, it is mostly open muskeg, some of which appeared to be very wet. While we were camped at station N 7 on the Liard River, one of the crew was sent on a ground reconnaissance to the eastward. On his return, he reported that the 4 -mile strip of terrain adjacont to the river mas composed of heavily wooded muskeg that was reasonably firm. 'Although feed mould not be arailable early in the season, till new grass and vegetation had sprung up, packhorses would find the footing reasonably good. From the air, however, it was seen that the timbered strip did not extend far to the east of the Liard. Instead, vast stretches of open muskeg dotted here and there by ponds and small lakes were to be seen. North of Maxhamish Lake, a particularly wet-looking area was observed. As we flew along towards the east, the sun's rays were reflected from the stagnant water lying below us in the many slimy, green pools which merged into an uninviting looking emsemble. How soft this muskeg is, we do not know. From our superficial inspection from the air, it was concluded that it would not support the meight of packhorses. However, by detouring several miles to the north, horses might be taken through to the Petitot River.

From station N 8 to station N 9 in longitudes $122^{\circ} 58^{\prime}$ and $122^{\circ} 11^{\prime}$ respectively, the area adjacent to the boundary is well drained by the Petitot River. Either packhorses or canoes could be used along this section of line. In two places marked "X" and "Y", there are possible landing places for pontoon-equipped planes. At these places, the river is sufficiently straight and deep to afford reasonable landing facilities for 5-passenger aircraft. In June 1950, landing stretoh "X" had from 3 to 4 feet of water, while "Y" was found to have between 3 and 5 feet. By making use of these landing places, the demarcation party could be supplied by aerial transportation. Medium-sized canoes might also be flow in and made available for the line-cutting party. Later in the season, however, if the general water level of the river dropped appreciably, the two landing stretches would become too hazardous for anything but very light two-passenger aircraft.

Next, it was planned to fly along the boundary and land at one, or both, of the small lakes $A$ and $B$ show astride the boundary in longitudes $121^{\circ} 17^{\circ}$ and $120^{\circ} 58^{\prime}$ respectively on the 8 -mile Topographic map. With light instrumental equipment and sufficient food supply for about a week, we took off on July 9th and flew directly to station N 9. At this point, we turned and flew eastward along the boundary to locate the above-mentioned lakes. Several miles east of N 9 , we crossed the bull-dozed winter tractor road that was opened up by the U.S. Army Engineers in 1942-43. From information received at Fort Nelson, this road was used only once in 1945 by the Department of National Defence on Operation Muskox. It crosses areas of soft muskeg unsuitable for the use of packhorses in the summer time and is known to be obstructed by windfall in certain sections.

Along the boundary east of the tractor road, lies an extensive stretch of soft muskeg. This vast swamp is approximately 100 miles from west to east and probably as great a distance from north to south. Around some of the larger lakes in the area, there are marginal strips of terrain that appear to be composed of fairly dry muskeg. The smaller lakes and rivers appear to have no solid ground adjecent to their shores or banks. Shellow, mudy, slimecovered ponds and small lakes are numerous. In places, where no ponds, streams or lakes exist, the presence of stagnant surface water was indicated by the reflection of the sun's rays from the ground below.

Lakes A and B proved to be too shallow and small for safe lendings with pontoon-equipped planes. From the air, mud bars relatively close to the surface could be plainly seen. In all probability, the water is no more than two feet deep in both of these bodies of water.

We then flew north 5 miles to the nearest lake where a landing was made near the centre of the southern bay (marked $C$ on the map). Soundings at various points showed only 4 feet of water. The plane was taxied successively towards the shore in four different places and, in each case, wes grounded $200-300$ yards from the maskeg banks. Finally we waded ashore carrying the light astronomical equipment on our backs.

Although no real solid terrain could be found along the shore, we set up the instrument in preparation for the observation of the meridian transit of the sun at noon. The instrumental set-up was not all that could be desired, but an observation of reasonable accuracy was secured. The ensuing computation showed that the cocupied point (on the easterly side, and about one mile from the southern tip of the lake)
is in latitude $60^{\circ} 06^{\circ} \pm 30^{\prime \prime}$. From this observation, it is apparent that the lakes shown on the map of the local area are depioted about 2 miles too far south.

The relatively well-drained muskeg, close to the shore of the lake, was much too soft to provide a stable support for a pier for precise astronomical observations. In fact, no terrain suitable for a camp site could be found. In the much wetter, bady-drained area near the boundary line, 6 miles to the south, the taking of precise astronomical observations would be out of the question, unless the ground was frozen to a depth of several feet. Accordingly, plans for establishing one or more points in this vicinity were temporarily abandoned.

Due to previous commitments with other organizations, Associated Airways could not prolong the trip on July 9th, so we returned to Fort Nelson immediately after making the latitude determination on the sun.

On the afternoon of July loth, we set out on the final flight to investigate the terrain from lake $B$ eastward along the boundary to the northeast corner of the province of British Columbia. This $40-\mathrm{mile}$ streteh of territory also was found to be composed of very wet, open muskeg. No "1slands" of solid terrain were observed anywhere close to the line. The 60th parallel of latitude will most certainly intersect the 120th meridian of longitude in a particularly wet area. The nearest lake (marked D), which is 6 miles to the northeast of the intersection, appeared to be only a foot or two in depth and scarcely a mile in length. No landing should be attempted there, except with skiis in the winter time. As we circled around over the locale of the intersection, we could see for 30 or 40 miles. To the limit of visibility, the same flat
monotonous, greenish-Jellow muskeg, dotted here and there with ponds and small lakes, extended in all directions.

On the return that evening to Fort Nelson, a telegram was sent to the Chairman of the Boundary Comission, advising him of the impossibility of establishing preeise astronomical stations on the boundary line east of the Petitot River during the summer months. A reply received the next day approved the disbanding of the party, preparatory to my return to ottawa. Accordingly, the instruments and equipment were shipped on July 12th to Dawson Creek, where they were re-consigned to ottawa.

On July l4th, Moffatt and I left Fort Nelson by bus for Dawson Creek. At 6.10 a.m. July 19th, I arrived back in Ottana.

The establishment of a pracise astronomical station at the northeast corner of British Columbia, and another on the boundary near longitude $121^{\circ} 17^{\prime}$, must of necessity be undertaken when the muskegs and lakes are frozen. Two methods or carrying on the project are suggested.

The easlest way of doing the job would involve the use of a tractor trailer combination. By leaving the Mackenzie Highway, which extends from Grimshan to Hay RIver, at latitude $60^{\circ}$, and following the tractor road bull-dozed through the bush in connection with the Topographical Survey project of 1949-50, the northeast corner of the Province of British Columbia could be readily reached. From the northeast corner of the province to longitude $121^{\circ} 17^{\prime}$, the muskeg is so open, that little or no bull-dozing would be necessary to open a road. In alternative route would be possible from Fort Nelson northwerd along the old tractor road to Fort Simpson. On reaching latitude $60^{\circ}$, a road could be bulldozed eastwara along the boundary with very little effort.

The second method would involve some hardship for the personnel of the observation party. The plan of operation, very similar to the 1947-48 demarcation of the Ontario-Manitoba boundary, terminating on the Hudson Bay coast, would involve aeroplane transportation supplemented by dog team.

According to information acquired at Fort Nelson, aeroplane landings may be made on the ice surface of local lakes and rivers up till the middle of April. From the second week of March onward, the temperature may be expected to remain above zero. In the three-meek-and-a-half period from March 2lst to April 15th, two or three precise astronomic stations could be established without too much personal discomfort to the observers.

Judging from the latitude observation taken at lake $C$, it is probable that the boundary will be found to pass about 2 miles south of lake $B$. Using plane transportation out of Fort Nelson, a camp could be established on lake B. A dog team could then be flown to the lake to transport the instruments and equipment 2 miles south to the locale of the precise station. No trail cutting would be required through the open muskeg. The northeast corner of the Province of British Columbia could be established in a.similar manner using lake $D, 6$ miles to the northeast, as a landing field.

West of the Liard River, two astronomic stations are required. One of these could be reached with comparative ease by ascending the Beaver River soon after spring breakup. By leaving Fort Nelson shortly before June Ist with a suitable Ilat-bottomed boat equipped with a $40 \mathrm{H} . \mathrm{P}$. motor, no speaial diffieulty should be encountered. Arrangements for boat transportation could probably be made through the

Hudson's Bay Compeny, or directly with Ed. Cooper, or C.E. Jensen of Fort Nelson. An astronomic station, established at the intersection of the 60th parallel with the Beaver River, would give suitable spacing with $N 7, N 8$, and $N 9$ established in 1950.

To establish the second station about longitude $125^{\circ} 28^{\prime}$, midway between station $N 6$, north of Smith airport, and the Beaver River, it mould be necessary to resort to packhorses. A suitable packhorse train could be rented at Fort Nelson from Collison Brothers, who are equipped with facilities to transport them by truok to Smith airport. From the airport, there is a tractor road leading northward to Tobally Lake. This road was used in 1944 for tractor transportation to the site of station $\mathbb{N} 6$.

Mr. L. Larsen, with headquarters at Fort Nelson, has had years of trapping experience in the area east of Smith River Airport and Tobally Lake. Larsen Lake, elose to the headwaters of the Beaver River, bears his name. During a conversation at Fort Nelson this year, Larsen stated that there is a packorse trail joining Tobally and Larsen Lakes. However, the trail is poorly defined, requiring a guide with looal experience to follow it from point to point.

According to Larsen's report, the terrain adjacent to the boundary east of Smith River is rolling country which becomes more hilly in the neighbourhood of the Beaver River. The forest cover in this area is not extremely dense, so that the eutting of horse trails would not be very difficult. Ferly in the season, before the new plant growth has developed, horse feed would be hard to find. Supplementary feeding of oats would be required at this season of the Jear. Taking into consideration the various factors involved, it is considered that it would be more advantageous to cut a new horse trail eastward along the boundary from station $N 6$, than to use the old trapper's trail 10 miles to the north.

In general, survey operations between the Smith and Liard Rivers should involve no great difficulty. Supplementary air transport could be made available by making aeroplane landings on Larsen Lake eight miles north of the boundary line. From the lake, an old horse trail is known to lead southward along the Crow River. Horses and horse wranglers may be hired during the summer months at Fort Nelson, Lower Post, and at other points on the canadaAlaska Highway.

$12739-1$

Sodimentary rook olifs on tho Fort Helson RIver


Rook ellfts along the Fort Noison River


Poh-pull mothod of ascending the Petitot River Raplas


12ク3 A-

Supper time on the banks of the Petitot River. The entrance to the canyon is seen in the background.


[^0]Cliffs along the Petitot River


127．3 ターシ

Tiew along the Petitot River


View along the Petitot River


1273••••9

Flotilla moored on the banke of the Petitot River


Plotilla moored on the Potitot River


1273 A-11

Seene along Patitot River

$1273 \pi-13$

Rock cliffs on Petitot River


1273日-13

Fintrance to canyon, Petitot River


1273F-14

Canyon, Petitot River


1273 A-15

Cliffs along Petitot RIver


1273A-16

View near end of Petitot River Canyon


12738－17

Taking soundings in the Petitot River


12きる有～！

Remains of forest cover，destroyed several years previously by $11 r e$ ， Petitot River


1273A-19

Observatory tent and oamp set up at station $\begin{gathered}\text { an }\end{gathered}$ on the Liard River.


1273A-20

Conorete pler for astronomical inatrument at station 117 on the Liard River.


1273A－21

Diesel－powered river boat pushing a flat－ bottomed seow up the Liard River．Taken Irom station N 7，at latitude $60^{\circ}$ ．


12ファคージ

Diesel－powered river boat pushing a ilat－ bottomed soow up the Liard River．Taken from station $\mathbb{N} 7$ ，at latitude $60^{\circ}$ ．


View from station N 7, looking westward across Liard River. Distant hills in background.



1273A-25

Camp site at station N 9, on the upper reaches of the Petitot River.


Observatory tent at station N 9 on the upper reaches of the Petitot River.


White ground strip set out at station N 9 for the identifioation of the site in the aerial photographs.


## APPENDIX

Station N 7
Description of Station.
Tabulation of observations.
Blue print showing local topography.
R.C.A.F. aerial photograph of adjacent area.

Aerial photograph taken with small camera showing white ground marker.

## Station N 8

Description of Station.
Tabulation of observations.
Blue print showing local topography.
R.C.A.F. aerial photograph of adjacent area.

Aerial photograph taken with small camera showing white ground marker.

Station N 9
Description of Station.
Tabulation of observations.
Blue print showing local topography.
R.G.A.F. aerial photograph of adjacent area.

Aerial photograph taken with small camera showing white ground marker.

## Daily Diary

## Doserpition, Aatrononte 日tation MF

The station monumeat is an 1 ron poet marisod 17. mound, and 4 pits altuated in the hoavy timber 180 foet oast of the high water mark on the east bank of the Liard hiver.

Thelve feet frow the river bank, there is a eonerete pier with a brome tablet marked "Ooodetic Survoy - Triangulation Statioa". The pior marke the alte of the tomporary obaortutery. The iron peat is 38.2 feet north and 206.4 reet east of the bronze tablet in the conerete pler.

The station site whioh is 15 feet above the hich water mark is elmest tireetly ecrese smem the mouth of a marrow chanol loading to the wentward of an slelad near the weat side of the siver.

Two bearing speen wore ettabliched as sollowa Dosignatioa Magnetic Boaring Distance


## Timal Valmoen

Letituat
$50^{\circ} \mathrm{ge}{ }^{\prime} 80^{\prime \prime} .4 \mathrm{t}+0.22$
Longltude 1854730.38


## PABULATION OF OBSERVATIONS AT STATION N 7 (Continued)

| Latitude |  |  |  |
| :---: | :---: | :---: | :---: |
| DateJune 30, 1950 (continued) | Latitude | V | $v^{2}$ |
|  | $59^{\circ} 59^{\text { }} 57.50$ | $.56$ | . 31 |
|  | 57.20 | . 86 | . 74 |
|  | 56.90 | 1.16 | 1.35 |
|  | 59.61 | 1.55 | 2.40 |
|  | 59.40 | 1.34 | 1.80 |
|  | 58.28 | . 23 | . 05 |
|  | 60.03 | 1.97 | 3.88 |
|  | 59.57 | 1.51 | 2. 28 |
|  | 59.33 | 1.27 | 1.61 |
|  | 56.12 | 1.94 | 3.76 |
|  | 57.71 | . 35 | . 12 |
|  | 58.75 | . 69 | . 48 |
|  | 58.62 | . 56 | . 31 |
|  | 58.51 | . 45 | . 20 |
|  | 58.59 | .53 | . 28 |
| Mean of 44 pairs | $59^{\circ} 59{ }^{\prime} 58.06$ | $\mathcal{L} \mathrm{V}^{2}$ | 7 *.85 |
| Reduction to site of monument | $+0.38$ |  |  |
| Reduction to sea level | -0.02 |  |  |
| Latitude of Post $\frac{\text { N } 7}{1950}$ | $59^{\circ} 59{ }^{\prime} 58.42$ | . 11 |  |

## TABULATION OF OBSERVATIONS AT STATION N 7

## Longitude

## Date

| June 27, 1950 | $123^{\circ} 47^{\prime} 33^{\prime \prime} .40$ |
| :--- | ---: |
| June 28, 1950 | 32.41 |
| June 30, 1950 | 32.01 |
| Mean value | $123^{\circ} 47^{\prime} 32^{\prime \prime} .61$ |
| Reduction to site of monument | -2.09 |
| Longitude of Post $\frac{N 7}{1950}$ | $123^{\circ} 47^{\circ} 30^{\prime \prime} .52$ |



N7 Astronomical Station
Scale: I in $=3160 \mathrm{ft}$.

| $N$ |
| :---: |

$\frac{60 \text { th Parallel } \text { of Latitude. }}{\text { O }}$

ASTRONOMIC PR. N 7
B.C. - M. W. T. Boundary

North


ASTROHOHIC PT. $\mathrm{N}_{7}$
B.C. $-\mathrm{N} . \mathrm{W} . \mathrm{T}$. Boundary

North


North


## Daseryption Aatrononio station 18

The station monumont is an iron poet maxked H8, mound, and 4 pits altuated on a lovel atretoh of land in a burnt-over area 195 foet from the south ohore of the Petitot River and Alreothy opposite a out bank 800 feet hich. Botween the station monumont and the river, eleme the mptalen line, there ie a 280-foot atrotoh of heavy spruee. About 800 reet to the east of the station, the fotstot River tumas charply tewarde the seuth.

A piece of board marked N 8 was malled to a blased apruce tree on the river bank to mank the alto. A goed samp sto may be round in the apruce area.

Two bearlas trees wore eateblimed as followat-

| Deatgation | Hegmetio Boarims frem Iron poty | Dtetanee in feet |
| :---: | :---: | :---: |
| T. 1-10" Spruce | $30{ }^{\circ}$ | 88.0 |
| T. $2-20^{\prime \prime}$ spruce | $0^{\circ}$ | 49.8 |

Pral Tolues

Longttude 1823005.06

## Latitude



## TABULATION OF OBSERVATIONS AT STATION N 8

## Longitude

| July 12th, 1950 | $122^{\circ} 59{ }^{\prime} 08.08$ | weight $1^{*}$ |
| :---: | :---: | :---: |
| 14th | 1225904.05 | 3 |
| Weighted mean | 1225905.06 |  |
| Reduction to site of monument | 0.00 |  |
| Longitude of Post $\frac{\text { N } 8}{50}$ | $122^{\circ} 59^{\circ} 05^{\prime \prime} 06$ |  |

[^1]


ASTRONOMC 2ONNT N 8
B.C.-N. W. T. Boundary

North


## 

The atation monwiont is an iron post marked $\frac{10}{10.50}$ morma, and 4 pita altuated on a bench 40 foet in olevation and 60 foet oast of the hich-mator mark on the oast bank of the Potitot River.

A ploee of beard mariced N 9 was nalled to a $16^{\circ}$ peple sree on the bank of the fiver wheh riems almont morthwoat from the marker. A samp alte may be sound 600 reat to the south, on the same side of the siver.

Three bearing treea were entablished as
sollowes-

Bealgnation
B.T. 1 - $10^{\prime \prime}$ Poplax
B.T. 2 - $6^{\prime \prime}$ Baln of 02lead
B.T. 3 - $8^{\prime \prime}$ Poples

Magnotis Boarims frem Iron Post $282^{\circ}$ $809^{\circ}$ $84^{\circ}$

Distance in reat 48.6 88.7 89. 6

## Timl Values

Latstuct $\quad 89^{\circ} 89^{\prime} 89^{\prime \prime} 80 \pm 0.09$
Longtude 1821859.91

## Latitude

| Deste | Latitula | Y | $y^{2}$ |
| :---: | :---: | :---: | :---: |
| June 6th, 1950 | $59^{\circ} \mathrm{59}{ }^{\prime} 60^{\prime \prime} .38$ | 2.45 | 2.10 |
|  | 59.07 | .14 | . 08 |
| June 7th, 1950 | 59.68 | .78 | . 52 |
|  | 58.61 | . 32 | . 10 |
|  | 59.25 | . 28 | . 05 |
|  | 58.26 | . 67 | -45 |
|  | 52.25 | 1.08 | 1.04 |
|  | 58.98 | . 03 | . 00 |
|  | 57.04 | 1.89 | 3.57 |
|  | 58.57 | . 36 | . 13 |
|  | 59.28 | . 29 | . 08 |
|  | 58.58 | . 35 | . 12 |
|  | 58.71 | -22 | . 05 |
|  | 61.10 | 2.37 | 4.71 |
| June 9th, 1950 | 87.56 | 1.57 | 2.88 |
|  | 58.72 | . 21 | . 04 |
|  | 57.37 | 2.83 | 2.43 |
|  | 89.94 | 1.01 | 1.08 |
|  | 59.35 | . 40 | . 16 |
|  | 58.33 | . 60 | . 88 |
|  | 58.69 | . 24 | . 06 |
|  | 57.84 | 1.09 | 1.19 |
|  | 50.04 | . 89 | . 79 |
|  | 58.71 | . 22 | . 05 |
|  | 59.65 | .72 | . 52 |
|  | 58.87 | . 06 | . 00 |
|  | 58.45 | . 50 | . 85 |
|  | 81.42 | 2.49 | 6.20 |
|  | 60.42 | 1.49 | 2. 28 |
|  | 39.07 | . 14 | .02 |

## TABMLATIOT OF OBSBRVATIOHS AT BKATLOH H 39 (Continued)

| Date | Lattinae | $\xrightarrow{\mathrm{V}}$ | $\mathrm{v}^{2}$ |
| :---: | :---: | :---: | :---: |
| June 9th, 1980 | $59^{\circ} 58{ }^{\prime} 57^{\prime \prime} 50$ | 2.45 | 2.04 |
|  | 59.38 | .45 | . 20 |
|  | 58.27 | . 86 | . 46 |
| Juac 20th, 1950 | 58.27 | . 04 | . 00 |
|  | 58.35 | . 58 | . 34 |
|  | 59.35 | . 42 | . 18 |
|  | 58.57 | . 36 | .18 |
|  | 52.30 | . 54 | . 29 |
|  | 58.86 | . 07 | . 00 |
|  | 59.02 | . 09 | . 01 |
|  | 58.92 | . 01 | . 00 |
|  | 59.73 | . 80 | . 04 |
|  |  | .05 | . 00 |
| Mean value or 43 pairs | $59^{\circ} 59{ }^{\circ} 58.93$ |  | 34.40 |
| Reduotion to alte of monument | -0.08 |  |  |
| Reduction to sea level | -0.05 |  |  |
| Latitude of rost $\frac{1}{50}$ | $39^{\circ} 59{ }^{\text {\% }} 58.80$ | . 09 |  |

## 

## Loncl tude

nete

| June 6th, 1950 | $122^{\circ} 22^{\prime} 60.50$ |
| :---: | :---: |
| 7th, 1950 | 60.20 |
| 9th, 1950 | 59.56 |
| Mean value | $222^{\circ} 12{ }^{\prime} 60.08$ |
| Reduotion to site of monument | -. $3 x$ |
| Longituce of Fost N 9 | $122^{\circ} 12^{\prime} 59$ "72 |

## PLAN

Showing topography adjacent to
N 9 ASTRONOMIC STATION

British Columbia - North West Territories
Boundary Survey

```
Scale - linch = 400 feet
```

June 10th, 1950

$$
\begin{aligned}
& \text { Plan } 796 \\
& \text { File } 1275
\end{aligned}
$$




Nowth


ASTRONONIC Pt. N 2
B. C. - N.W. T. Boundary


North


## DAILY DIARY

## 1050

May 14 - Left Ottawa at 20.46 Dolmo B.D.T. Sor Dawnon Creek.
26 - Arrived Winnipeg 9.55 a.r. at height of 1050 spring Moed.

17 - Amelved EAmonton about 7.40 a.m. Contaotod J.G. Moffatt, recorder from Vietoria. Left for Dawaion creok by train at B. 50 poll.

18 - Aftor colay en route, arpived at Dawnon Greok about msanicht.

19 - Arranged with the Amorioan Truaking and Diatributiag Company to transport the astronomicea inatrumonts and conp equspmeat to Tort Nelcon. No bus avalleble Tor pescenger sravel 1111 Mey 2me.

30 - Made purchaces leenliy of mocessary oump oquipment, prinolpuly dishoe and oooking outifit.

21 - Sunday.
22 - Latt Dawson Creek 9.45 a.m. on Buttidh Yukon Navigation company bue for Tort Noleon whieh we reachod about 10.20 pom . Kn route, wo paseed throuct mewetort betveen Fort 8t. Yohm and Fort relson.

23 - In the morning, went by taxi 10 miles to the Nelson River. Groased by amall boat to the old eettlomont on the east itce of fiter. Arrenged with Manager of the Fludson's Bay Company for rontal of apace in etorage warohouse for a weok. Moved over to settlemont in ovoaing. Aoocmmodation for the sravolife publio almont impenalble to find at the old settlement. Finelly secured inpmevised eccomodation with Mr. C. Greagan.

24 - Brought eomo of the radlo eguspmant frow the lludaon's Bay Company warohouse on the west alde to our quarters on the east alce in erder to sheok and test receiver and tranmatter.

- Hed broken thwart on sanoo repaired. Arranged with Hix. Davis, osficer-in-oharge Department of Transport radio atation at Fort Roleon Ar port, for dally radio sohedule curing our mork along the 60th parallel. sohodule as followas-

[^2]1950
May 26 - Purchasing supplies for trip. At night made inal test of radio oomunieation with VFDT. Messages were interohanged vithout any trouble.

27 - All equipment packed for trip. Jade out acoounts to date and attended to oorresponderee.

28 - Sundey.
Had Viatt from Socony Vaouum 012 Company, geologiats, who expeoted to $12 y$ into the area adjacent to the upper stretches of the petitot River.

29 - Although it was drignling rain, we lert Mopt Nelson at 10.10 antl. The two lightly-1oaded oanoes were towed behind the larger oraft. Operating at है throttle, we made about 20 mlles per hour. Some large ice cakes were observed along the rivor bamk. In spite of heavy elothing, the cold penetrated quicicly, making the personnel vory uncomfortable. camped for night about 30 miles upstream from Nelson Forks.

30 - Left camp at 8.45 a.m. artor a good sleep. Passed Nelson Forks about noon whore wo 2 unchad on the river bank. On entering the Liard River we found the oursent much faster. However, the pilet managed to avold the numerous and bare. Wlo passed Iranoels Indian village about $4 \mathrm{p} \cdot \mathrm{m}$. At $5 \mathrm{p}, \mathrm{m}$. wo arrived at the looale of the Dominion observatory estronomicel plor antabliahod in 1925, about $1 \frac{1}{\text { B }}$ miles south of the 60th parallel of latitude. After supper, ohaln-and-bompase travores was extended northward from the pier to find the apprextinte loeale of the 60 th parailel.

31 - After a $\mathrm{g}_{\mathrm{g}}$-hour irip, warrived at Fort Liard about 10 a.m. The rest of the day was spent in sorting and rearranging ouz equipment. Arrangements were also made whereby $\mathrm{Kr}_{\mathrm{p}}$ G. Shattuel; Doninion Pire Warden, and an Indian, nawed Joe Donta, should accompany us up the Petisot River in their fat power boat.

June 1 - Left Fort Liard at 9.15 A.ll. to establish two points on the Petitot River at isa most easterly and westerly orossing of the 60th parallel. Had a great ceal of srouble setting up the raples tue to the inadequate pewer plant in Jensen's boat. About 15 miles upstream from the mouth, we entered the 6 mile canyon. About three quarters of the way through, we narrowly avolded an accident due to the fouling of the propeller by a tow rope. quite late in the evening we emerged from the canyon and camped on the river benk for the night.

June 2 - Bhortly arter leaving oamp at 6.45 a. .1. we encountered rapias arter rapids at rairly regular intervals. With the aid of Donta and his boat we were able to meke slow but steady progress against the eurrent. By midafternoon, we were about 2 miles upstream from the

## June 9 - (eontinued)

first arossing of the 60th parallel. As the current veloeities in the Petitot River beyond this place are known to be feirly moderate, Shattuak and Donta said good-bye to us and hoaded baek downstream to Fort Liara. Canp was made that night near longitude $122^{\circ} 45^{\prime}$.

3 - Left earap et 6.30 esm, end efter 6it hours steady progress with three motors operating at rull aapacity, we reached the locale of the most easteriy crossing of the river with the 60th parallel. From the 8 -mile-to-the-inch map, National Topographie series, we identiried a site which appeared to be close to the desired latitude. A camp was made moaziy and, at night, a preliminary observation fos latitude showed the point of observation to be in latitude 59059 ' $53 \%{ }^{\circ} 5$.

4 - Sundsy. Chained 650 feat northward along Piver benk and set up observatory tont and the preeise astronomical equigment. Overeast with rain at night。

5 - Cut the large trees adjacent to the observatory in order to make white ground strip markers Fisible from the air. started construetion of mound and pite. At night, overesst with rain.

6 - Before breakfast, sam 6 Canada geese, one beaver, and a black boar all on the river. Spent some sime tracing an open oirouit in the eleotrieal aystem of the accessory equipment. Located and messured bearings and dietanoes to bearing trees. At night had trouble getting started on the star observations due to the brightness of the night sly. Woriced 11112 a.m. when it mas broad faylight again. Got a longitude determination and 8 pair of latitude starm.

7 - A black bear swam aoross river close to our camp. In afternoon, I measured the angles of the local trianguletion seheme. At night, we got a longitude deternination and 12 pairs of latitude stars. clouds obscured sky at 12.40 a.ra.

B - Bright and olear during day when we aid some computing. at $8 \mathrm{p} . \mathrm{m}$. it clouded over completely sor the night.

9 - Overoant all day. Mosquitoas bad. In the afternoon, inished the looal triangulation soheme with ties to the mouths of tributary ereeks. Clear at night. observed a Longitude set and 21 pair of latitude stars.

10 - Bright and elear at night. Observed 10 more pairs of latitude stars, completing the station with a total of 3 longitude sets and 43 paira of latitude stara. Before going to bed, we packed up most of the astronomieal equipment.


13 - Commenced the construation of the survey monument oomalating of 2 ron post, mound and pits. Readjusted preeise equipment to ensure better operation. At night rain and olouds. No observing. Set up radio transmitter and contacted Hudson Bay Co. atation XKK 30 at Fort Liard.

14 - While the men were digging the pits and building the mound, I set out with a number of plelcote for use in extending the local traverse along the river bank. In turning around after planting the first pieket, I saught my foot in a moss-covered hole and fell baokward over a large boulder. The first finger of my left hand struck another large boulder, and the impact fractured the bone between the knuckle and firat joint and in addition completely Aislooated the firat joint. The finger was also badiy lacerated by the violent conteet with the rough boulder.
As all attempte to pull the finger back into joint proved rutile, it was realized that it was necessary to get medical attention as soon as posaible. It was alto realized that the general water level of the rifver had lowered about 16 inoher ainee our journey upstream two weoke previously. This meant that if we descended the Petitot River to Tort Liard, it would be practioally imponsible to return upstream till the high water period the following spring.
Although the pala and swelling rendered my left hand almost useleas, it wes deelded to try to carry on that night with the observational program and then leave the next day for Fort Iiard. The final objective was Fort Nelson where the RoC.A.F. had a medical orricer and a small hospital. Fortunately the alght was alour so that we were able to obaerye a second longitude set and 22 pairs of latitude stars. Although this number of latitude obsorvations fell far short of the 40 pairs prescribed by the Commiasion, it was realized that the mean value of the latitude so determined would not be expeeted to differ very much (no more than 0 "10) from the mean of 40 pairs. Under the eir-
cumstances, the Boundary Commission might be disposed to accopt the mean value of the 22 pairs without fesp of introducing any serious inacouracy in the demarastion of the boundary inne.

15 - After a sleepless night, we completed the looal aurvey, rinished the monument and established two beawing trees. By this time the left hend was almost purple and the swelling extended up the arm.
At 12.30 p ein. we were packed $u p$ and ready to start the trip to Fort Liard. Three or four rapids were descended at throttle. The descent In eaoh case was most hazardous due to the 10 w water. Rock after rook was hit by Joneon's boat. Yor a while the one-inch planking was able to withstand the battering. On the next rapide, one of the bottom planks was broken in three places. After a long delay to make repalra, we started again. To avoid complete disaster, we "walked" the boat down the rapids. Two men slung to the stern and one to the bow in order to keep it straight in the ourrent and to retard ite velooity. In some places the water wes deep; in others too shallow to permit our passage without lifting, pulling and prying. The two lightlyloaded cances were dragged behind.

16 - Continued man-handling boat down rapids for most of morning. Later in the day, the conditions improved pemitting us to travel under partial engine power. We passed through the eanyon without incident but farther down we got stranded on a submerged boulder whore the adjacent water was fast and quite deep.
One of the towed canoes swemped and cepsized with the loss of some food and tools. By rollowing the upturned canoe down the rapids in the second oanoe, I managed to retrieve several tents. Faddled on to Fort Liard and secured power boet and men to help rerloat the stranded boat. Arrived at the post about $10 \mathrm{p} \cdot \mathrm{m}$.

17 - Set up cook toat and hung out the wet tents and tarpaulins to dry. The instruments and other equipment were stored in the Fire Warden's warehouse for safe-keeping. At 9 A .m. I sent a radio message to Fort Helson for a plane to come and take me to the hospital at that point. Associated $\Delta i$ ways plane arrived at 4 p 0 . and flew me to Fort Helson. On arrivel at the hospitel, I found that the resident doctor was avay on holidegs. as no anaesthetic could be given without a quelified doctor, I was obliged to go to Fort 3t. John. The next southbound plane or bus was due to Leave Fort Welson on June 19th.

| ne 18 | Sunday. <br> The weather very hot and sultary. The air temperature during the middle of the day about $98^{\circ} \%$ 。 |
| :---: | :---: |
| 19 | - Left at 4.55 a . $\mathrm{In}_{\text {. }}$ on C.P. Air2ines plane for Fort 3t. John. about 8 a, wlit. contacted Dr, Leon Komar who took me to loal hospital, administered general anaesthetic and put finger back into shape. Plaster cast was put on almost half way to elbow. |
| 20 | Got reservation on next plane back to Fort Nelson. Very hot weather. |
| 21 | Met an old friend, Mr. MacLeod, Manager of the Hudson's Bey Company local store, Mr, and Mrs. MacLeod had boen at Lower Post during work in that area in 1942. |
| 22 | - Left for Yort Nelson about 3 a.lli. Arrived at 5.30 a .lli. After attending to some business, I <br>  Airways plane and arrived at Fort Liard shortly after noon. |
| 23 | Up early; packed up and left at 9,45 a,the to ascend the Liard River as far as latitude $60^{\circ}$. The river now 5 reet higher than it was a month earlior. The ourrent was so fast that we only made 2 miles per hour upstrean. Arrived at 9 pom . in pain at our objeetive. |
| 24 | cleared site for observatory along the bank of the river where the tree growth was very high. We then discovered that the angle irons and bolts for assembling the observation plor had heen lost in the acaident on the petitot River. Jensen and Growther were sent back to Fort Liaxd for two bags of cement and some boards for the construction of a conerete pler. Clouds and rain at night. No stars. |

25 - Sunday. Boat back from Fort Liard at 2 poll. We then erossed the river to a sand bar and freighted over gravel and stones for a conorete pier $12^{\prime \prime} x 24^{\prime \prime} x 48^{\prime \prime}$ imbedded $18^{\circ}$ in the ground. We then built the form, made the neoessary excavation and carried the sand and stones to the pier site. At night get e mood egimuth observetion after which it elouded over and rained.

26 - In the morning we mixed and poured the concrete. In the afternoon the observatory tent and the instruments were set up and adjusted. Later in the night, we got a number of stars for the determination of the instrumental constants.

27 - Commenced the construction of the mound and pits. At night it was olear. Observed a good longituade set end 15 pairs of letifude stars.

June 28 - In the morning, observed looal triangulation to connect station $\% 7$ with Dominion Observatory pier le miles to south which was established in 2082. Tieather very hot and mosquitoes bad. it night it was partially elear. Observed another longitude set and 8 pairs of latitude stars. In the evening a diesel-powered boat and scow owned by Bd . cooper, Fort सfelaon, passed upstream. To 11ghten our load for the forthooning trip to Fort Nelson, we got Cooper to take one aanoe and an erapty ges drum on his soow.

29 - Dull and oloudy. Forked out several pairs of latitude stars which proved to be sbout $59^{\circ} 59^{\prime} 58^{\prime \prime} 0$. At night, heavy rain. No stars.

30 - The weather cleared during the day. Sent Jensen on foot eastward for 4 miles to report on the country. At night olear and bright. observed a 10 star longitude set and 24 pairs of letitude stars.

July 1 - Bright and hot. Powerful diezel boat owned by Barney Streeper, Fort Nelson, passed upstream. At night, eloudy with no stars visible, as we already had about 45 pairs of latitude stars and three good longitude sets, I decided to wait no longer.

2 - Bright and olear. Up early. Packed up and lest for Fort Nelson at 9 a.ll. Due to the adverse current, we only made 3 miles per hour upstream. At night, caraped on a flat island where we found the mosquitoes very bad.

3 - Passed Rudson's Bey Company Post, Nelaon Forks, about noon. Camped near ollie Low trapper's cabin for the night.

4 - Hot burning sun. Temperature about $90^{\circ} \mathrm{F}$. At night, oamped on sand bar one mile upstrean from "Broken Arim".
5 - Up at 5.15 a.m. Lert oampsite at 4.50 a.m. Passed Snake River Indian settlement at 9.30 a.m. Arrived at Fort Nelaon about 3 polin. in heavy rain. Stored the equipment at lir. A. F. George's warehouse. Paid off C.J. Jensen, river pilot and cook.

6 - Ready to make reconnalssance flight over boundary line, but weather sloudy and rainy - no liying. Working on accounts and correspondence.
7 - Made reconnalssance - aerial photographic flight over western part of 60th parallel of latitude. Flew from Fort Felson to station 177 where we took some pietures of the adjacent terrain. We then Klew about 12 mllos westerly almost to the Beaver River. Turning again, we flew eastward, recrossed the Liard River and continued to station $N 8$. Large areas of very wet muskeg north of Maxhanish Lake. We took pietures of terrain adjecent to $\mathbb{N} 8$
and then flew on to $N 8$ which was photographed from 2500 feet．The white ground strip markers previously placed at eech station site showed up well from the air．Mr．glevin，sunoce Vacuum 011 Company geologist was camped at our station 11 9．Arrived back at Fort Nelson at 2.28 p．m．

8 －In the morning，Associated Airways plane went out With an oil company party．We sorted out camp equipment，food and instruments for possible Landing and an observation on Lakes＂ A ＂or＂ $\mathrm{B}^{\prime}$ ． In the evening，we loaded the plane ready for an early start next morning．

9 －Sunday．
Took off at 8.00 a 。n．and fl ew to Lake＂ A ＂whioh proved to be too small for pontoon－plane take off． Horeover mud bara coula be seen just below water surface．We then flew on to Lake＂B＂，where the same conditions obtained．To get a better idea of the country from the ground，we flew 6 miles north and Landed on Lake＂ C ＂．The shore of the lake proved to be sort and aponcy．Set up the small transit and observed the noon transit of the sun for latituae，which proved to be $60^{\circ} 06^{\prime} 16^{\prime \prime}$ ． Took off from Lake＂A＂at 1.00 pom．and arrived baek in Fort Nelson one hour later．

10 －We made the final reconnalasance of the 60th parallel from Lake＂B＂to the northeest corner of the Province of British Columbia．Along this section of the boundary line，there was an unbroken stretch of muskeg which appeared to be soft． Lake＂D＂which is 6 miles $\mathrm{J} . \mathrm{I}_{\text {。 }}$ of the provinoial corner was too small and shallow for a landing． Sent telegram to surveyor Ceneral in ottawa，inform－ ing him of the impossibility of carrying on further with the work during the sumuer months．

11 －Packing up equipment and erating instruments．
12 －Took asnoes for storace in Huason＇s Bay Company warehouse，Fort Nelson．Pald off Rel．Crowther．
13 －Waiting for bi－weekly bus to Dawson Creek．
14 －Left Fort Nelson at E．30 a．m．by bus for Dawnon Greek．Arrived about 7 poll 。
15 －Lert Dawson Greek at 8．50 a．m．on N．Alberta Ry． for Kdmonton．

16 －Sunday． Arrived Kdmonton at 7 a．m．and waited till 9.00 p． for train to Winnipeg．

17 －In route to Ottawa；passed through lininnipeg about $6 \mathrm{p} . \mathrm{m}$.

1950
July 18 - $\quad$ in route Winnipeg to 0ttava.
19 - Vednesding. Arrived Ottawa 6.10 a.II. E.S.2.


[^0]:    1233 17-6

[^1]:    *Approximate value for rough check.

[^2]:    Time - 7 polt to 7.05 Paesrie Standard Tima.
    My sranumistor XLI 32 on a Irequency of 4455 Ka . Continuous wave trangminaton (code only).
    D.0.T. Radio Station VFDE - freguoney 4885 Kc . Tolephose tranculest on ouly.

    At micht made rirat tent of interoommunication over a $8-\ln 20$ aldtane, and found everything satiofaetory.

