A CANADIAN OPERATOR'S REPORT ON HELICOPTER TRANSPORT OF SURVEY PARTIES

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EXPERIENCE in the Yukon by two Canadian government departments during the summer of 1950 has produced interesting evidence of the helicopter's usefulness as an aid to quick establishment of ground control for photogrammetric mapping.

Using three Hiller 360 helicopters hired from Kenting Aviation Limited, two survey expeditions working in Canada's Northwest set up helicopter air-lifts for observation parties. The results indicate that, while the helicopter's operating limitations still place some restrictions on its efficiency, nevertheless its employment in rugged country enables one observing party to do approximately the work of four parties using ground transportation.

Two helicopters were used by the Topographical Survey Branch of the Canadian Department of Mines and Technical Surveys, working in an area 100 miles north and east of Mayo, covered by six standard four-mile-to-the-inch sheets between Latitudes 64 and 66 degrees and Longitudes 130 and 136 degrees . . . a total of approximately 24,000 square miles. Heading this party was *A. C. Tuttle*, acting under the direction of *P. E. Palmer*, Chief Topographical Engineer.

The Army Survey Establishment of the Canadian Department of National Defence used one helicopter in establishing horizontal and vertical control for 1/50,000 mapping by Multiplex of a series of sheets straddling the Alaska Highway from Whitehorse to the Alaska boundary . . . a total of some 7,000 square miles. This party was headed by *Capt. W. A. Johnstone*, under the supervision of *Lieut-Col. C. H. Smith*, Deputy Director of Military Survey.

The purpose of both operations was to put in a network of control stations for mapping from photographs taken by the Royal Canadian Air Force, a task rendered more urgent by the strategic importance of the area.

Each of the two jobs made slightly different demands on the helicopter, but in both cases it established an excellent record of utility and serviceability.

Prior to the introduction of the helicopter for transporting observation parties, the short Arctic summer and the mountainous terrain had combined to limit severely the amount of work which survey parties could do in this forbidding area during a single season.

Packhorse trains were used to carry men and some equipment. Most supplies, including feed for the horses, had to be flown in by conventional aircraft and dropped at pre-arranged points. Naturally, progress was slow, even for parties which consisted only of one observer, one recorder, and a few helpers.

The helicopter, used in conjunction with a conventional supply aircraft which can land on suitably located lakes, has vastly increased the mobility of a survey party. It has also increased the working capacity of a single party by making it feasible to increase its size.

The following description of the Mayo project involving two helicopters will serve to indicate the method of operation and the results achieved:

The entire party consisted of the party chief, 4 observers, 4 recorders, 1 cook, 1 cook's helper, 1 radio operator, 1 general helper, 2 helicopter pilots, 2 helicopter engineers, 1 supply aircraft pilot, 1 supply air-craft engineer.

The job of the float-equipped supply aircraft (a DeHavilland Beaver) was to move the base camp equipment and personnel from lake to lake, and to

bring in gasoline and other supplies from Mayo as required. Seven base camps were used during the operation.

The job of the helicopters was to transport the four climbing parties of two men each, with their equipment, from base camp to observation stations.

Between June 15th, when the first helicopter arrived on location and September 10th, when ice formation on the lakes began to hamper the operation of of the conventional 'plane and the party returned to Mayo, 126 hills were climbed, 108 of these being successfully observed at the first attempt. The others required a second trip to complete, usually due to unsatisfactory observing conditions. (It should be noted that, during the complete period of 88 days, over forty days were washed out due to such unsatisfactory conditions—i.e. smoke and/or cloud.) Altogether, horizontal and vertical control information was obtained for slightly more than three standard four-mile sheets, or approximately 13,000 square miles. The two helicopters flew 425 hours, 390 on actual survey operations, an average for the fine days of $4\frac{1}{2}$ hours each. (See Table 1.)

YUKON HELICOPTER OPERATION

SIGNALS – S
BEAVER – B
TOPO SURVEY – T

WEATHER FIT ☐ UNFIT ▨

SERVICEABLE ☐ UNSERVICEABLE ▨

MONTH	DATE	WEATHER		FLYING HOURS		SERVICEABLE		STATIONS	MONTH	DATE	WEATHER		FLYING HOURS		SERVICEABLE		STATIONS
		FLYING	OBSERVING	GKF	GKJ	GKF	GKJ	OCCUPIED			FLYING	OBSERVING	GKF	GKJ	GKF	GKJ	OCCUPIED
JUNE	15			:50	—		—	RECCE	AUGUST	1		▨	—	—			0
JUNE	16			4:00	—		—	2	AUGUST	2			—	—			0
JUNE	17			—	—	▨	—	0	AUGUST	3			3:35	3:35			2
JUNE	18			2:10	—		—	1	AUGUST	4		▨	5:05	4:55			2+1
JUNE	19			4:35	—		—	1	AUGUST	5	▨	▨	1:25	1:40			3.S.
JUNE	20		▨	3:05	—		—	1	AUGUST	6			4:35	4:35			3+1
JUNE	21			5:20	—		—	2	AUGUST	7			7:15	7:15			4
JUNE	22			4:45	—		—	2	AUGUST	8		▨	—	—			0
JUNE	23			9:00	—		—	3	AUGUST	9		▨	—	—			0
JUNE	24		▨	:35	—		—	0	AUGUST	10		▨	—	—			0
JUNE	25			4:35	—		—	2	AUGUST	11		▨	3:45	3:45			4
JUNE	26			3:45	—		—	2+1	AUGUST	12	▨	▨	3:10	3:15			2
JUNE	27			5:45	—		—	3+1	AUGUST	13	▨	▨	3:35	3:45			1
JUNE	28			5:40	—		—	3	AUGUST	14			3:55	3:50			2
JUNE	29			6:15	—		—	3	AUGUST	15			—	3:05	▨		2
JUNE	30		▨	—	1 20			0	AUGUST	16	▨	▨	—	—	▨	▨	0
JULY	1		▨	2:10	—		▨	1	AUGUST	17			—	—	▨	▨	0
JULY	2		▨	3:35	—		▨	0	AUGUST	18		▨	—	—	▨	ENGINE CHANGE	0
JULY	3		▨	—	—			0	AUGUST	19		▨	—	—	▨		0
JULY	4			4:20	5:40			3	AUGUST	20		▨	—	—	▨		1. B
JULY	5			4:05	3:55			2	AUGUST	21	▨	▨	:20	—			0
JULY	6			5:10	3:20			3	AUGUST	22	▨	▨	—	—		▨	0
JULY	7			1:05	1:15			1+1	AUGUST	23	▨	▨	—	—		▨	0
JULY	8			5:00	4:55			3	AUGUST	24	▨	▨	—	—			0
JULY	9			4:00	4:00			3	AUGUST	25	▨	▨	2:25	2:25			B.T
JULY	10			4:30	4:30			2	AUGUST	26		▨	4:10	4:30			1+2
JULY	11		▨	—	—			0	AUGUST	27			5:35	5:30			4
JULY	12	▨	▨	—	—			0	AUGUST	28			6:40	6:45			4
JULY	13		▨	:45	:45			1	AUGUST	29		▨	3 55	4:00			1+2
JULY	14		▨	4:50	4:55			3	AUGUST	30		▨	5:15	4:35			2
JULY	15		▨	—	—			0	AUGUST	31			6:25	6:25			3
JULY	16		▨	2:10	2:10			1	SEPTEMBER	1		▨	—	4:30	▨		1
JULY	17		▨	:25	:25			0	SEPTEMBER	2	▨	▨	—	—	▨		0
JULY	18		▨	5:35	4:50			1	SEPTEMBER	3	▨	▨	—	—	▨		0
JULY	19		▨	3:40	3:45			2	SEPTEMBER	4	▨	▨	—	3:05	▨		2
JULY	20		▨	2:40	2:40			0	SEPTEMBER	5	▨	▨	—	—	▨		0
JULY	21		▨	—	—			0	SEPTEMBER	6		▨	—	2 45	▨		4
JULY	22			3:35	3:15			4	SEPTEMBER	7			—	6:00	▨		3
JULY	23			4:50	5:00			4	SEPTEMBER	8			5:35	4:55			4
JULY	24			7:05	6:40			4	SEPTEMBER	9			4:40	—			4
JULY	25			4:35	4:35			3	SEPTEMBER	10			3:45	3:45			—
JULY	26		▨	2:00	—		▨	1									
JULY	27	▨	▨	—	—			0				TOTAL	223:10	168:25			137
JULY	28	▨	▨	—	—			0									
JULY	29	▨	▨	—	—			0									
JULY	30		▨	1:40	1:40			2									
JULY	31		▨	—	—			0									

TABLE I

With regard to helicopter maintenance, it is worthy of mention that only three major delays were caused by aircraft. In one case, a complete engine change was carried out in the field; whereas on both other occasions the difficulty was one of supply rather than maintenance, as repairs requiring only an hour's work had to wait for days, for spare parts to be air-expressed by the manufacturer. Any aviation engineer will confirm the fact that this is a remarkable record for bush country operation.

The area in which this project was carried out was not specially chosen for the test. It was a section due to be covered in the normal course of Canada's mapping program, and it proved to be a most difficult one. The southerly two-thirds of the area are extremely rugged . . . mainly rocky, knife-edged ridges, rising to elevations of 6,000 to 7,000 feet, the main tops being about 8,000 feet. Valleys, except for the major river beds, are narrow and steep. Such country provided a really rigorous test for the helicopter, and magnified the importance of its operating limitations.

Under conditions existing in the mountainous areas, it was found that each machine could carry one man plus his instrument pack of about 35 or 40 pounds, and make a landing, if a suitable ridge or shoulder could be found, up to an elevation of about 5,500 feet. The two helicopters, flying in formation, could thus land a two-man climbing party with all necessary equipment (about 70 lbs.) at one place and time. Usually climbing parties could only be landed on upland creek beds at places where sufficient space was available to manoeuvre the helicopters, and a full day was required for one party to complete each station. Landing and take-off from such places was, of course, further complicated by uncertain air currents and turbulence. It is doubtful if a single, larger machine, capable of carrying the whole climbing party, could have landed close enough to the observing stations to enable work to be completed in a day.

The northern part of the area was less difficult, being quite low and comparatively flat. It proved even more suitable than the southern section for helicopter operation, and in one instance here, four stations were observed in one afternoon. However, a scarcity of suitable lakes for base camps in the area necessitated working beyond ideal helicopter range for high altitude landing,

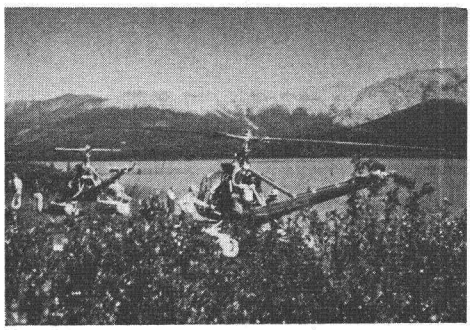

FIG. 1. Elliott Lake, Yukon Territory, with the two Hillers at their landing ground.

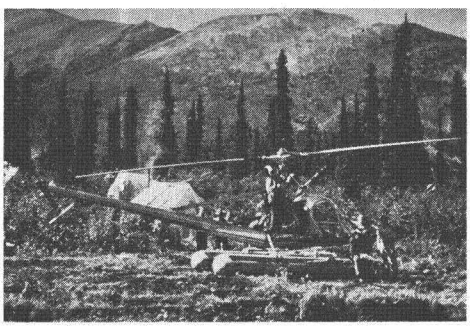

FIG. 2. The Base Camp & Landing Area at Elliott Lake, Yukon Territory.

on one occasion the most distant station being something over 100 miles from camp. In some areas where the machines could put the observer right on the hill-top, it was found expedient to use a one-man observing party.

The planning and execution of each day's operations followed a fairly regular pattern. On the preceding evening, the survey chief and helicopter crews

would meet and choose five hills in the area to be worked. Vertical photography previously taken by the Royal Canadian Air Force was available for the entire area, and mosaics had been prepared for field use at a scale of one inch to three miles. By stereoscopic examination, the relative height of the hills and their accessibility was determined.

Wherever a convenient lake could be found, a combined operation, using both the conventional Beaver aircraft and the helicopters, was planned. The work on August 27th provides a good example. The helicopters put Party "A" (two men) on Hill 1, then carried on to a suitable lake. Parties "B" and "C" plus a helicopter engineer and gasoline, had been moved to the lake by "Beaver."

Party "B" was then taken to Hill 2 and Party "C" to Hill 3. The helicopters waited while observations were taken from Hill 3, then moved Party "C" to Hill 4. They then went to Hill 2 and brought Party "B" back to the Lake. Party "C" was next brought to the lake and after fueling, the helicopters went back to Hill 1, picked up Party "A" and returned to camp. Parties "B" and "C" and the engineer were brought back by "Beaver."

Hill 1 was about twenty miles from camp, and the lake 13 miles farther away. From the lake, Hill 2 was 11 miles, Hill 3 was 18 miles, and Hill 4 was 5 miles. Total flying time, 11:05 hours. Parties "A" and "B" were landed on hills where they had to climb only about $1\frac{1}{2}$ hours to reach their stations.

In spite of the ever present possibility of mechanical difficulties and/or bad weather closing in during the day, only once were parties forced to remain out over night, and that was because of low clouds and rain.

FIG. 3. The Hillers returning to Elliott Lake after a day's work.

The Army survey party employed only one helicopter, and was thus relatively handicapped from an efficiency standpoint. The normal load to be ferried to each observing station was two men and some 50 pounds of equipment, with most landings being required above the timberline (4,500 feet). This meant that a double trip was necessary to each station involving some waiting time, and it was sometimes difficult to operate at both the required range and altitude.

From the operator's point of view, both jobs were satisfactory both financially and technically. The Hillers proved to be versatile, safe, and ideal from the standpoint of field maintenance. Their limitations, ceiling and load, have to be weighed carefully against size and manoeuvreability, and from the operator's standpoint, the balance is in favour of the small machine. The added margin of safety attained by means of a two aircraft operation is worth some percentage of its extra cost.

The surveyor, although his viewpoint is different, reaches essentially the same conclusions as the operator on the question of the usefulness of the helicopter as a tool.

P. E. Palmer, Chief Topographical Engineer of the Department of Mines and Technical Surveys, states that, although helicopter operation might not be economical if other suitable means of transport were available, it appears to offer the best and fastest method of working in the kind of difficult terrain char-

acteristic of much of Northern Canada. He adds that in country of moderate relief, where the helicopter can operate with less difficulty, there is no question of its value as a survey tool. Says Mr. *Palmer:*

"I would emphasize that the main problem in helicopter work is one of operation. If the aircraft used this year had been able to land one man with seventy pounds of equipment at elevations up to 7,000 feet, it would have been possible to cover at least 75% more country without materially increasing the flying time or cost."

Lieut-Col. C. H. Smith, Deputy Director of Military Survey, comments that financial limitations on the Army Survey project, plus the cost of helicopter operation, made it necessary to reduce the density of control with consequent added expense at the map compilation stage. "On the other hand," he says, "it was successful in that one survey party was able to accomplish as much as four survey parties could have, using conventional transport. Since we do not have the trained personnel to man these extra survey parties, the use of the helicopter advanced our mapping programme in a substantial manner."

Both Topographical Survey and Army Survey personnel are convinced that the helicopter offers the best and perhaps the only solution to the problem of fast transportation of observing parties to relatively inaccessible stations.

With an already assured place in the field of survey, the helicopter's future contribution can be forecast as one of ever-increasing efficiency and economy.