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ARCHAEOLOGICAL SURVEY METHODS APPLIED AT ROCKY MOUNTAIN HOUSE NATIONAL HISTORIC PARK, 1975 AND 1976

> by DONALD N. STEER

PARKS CANADA DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS PARCS CANADA MINISTÈRE DES AFFAIRES INDIENNES ET DU NORD Archaeological Survey Methods Applied at Rocky Mountain House National Historic Park, 1975 and 1976 by Donald N. Steer November, 1976 The Manuscript Report Series is printed in a limited number of copies and is intended for internal use by the Department of Indian and Northern Affairs. Copies of each issue are distributed to various public repositories in Canada for use by interested individuals.

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Bon nombre de ces rapports paraîtront dans la revue intitulée Canadian Historic Sites/Lieux historiques canadiens, et pourront être remaniés ou mis à jour. Archaeological Survey Methods Applied at Rocky Mountain House National Historic Park, 1975 and 1976 by Donald N. Steer

vi Abstract 1 Introduction 3 Historical Background Survey Methods and Results 5 5 Terrestial Observation 7 Test Excavation 8 Results of 1975 testing 13 Summary of results of 1975 excavations at sites 16R and 15R 16 Results of 1976 testing 19 Aerial Photography and Thermal Remote Sensing Reconnaissance 20 Panchromatic Aerial Photographs 26 Remote Sensing 27 Multispectral Photography 29 Interpretation Thermal Infrared Linescan 34 37 Interpretation Conclusions 40 References Cited 44

Tables

46 1. Site 13R artifact frequency and distribution (14R Area Survey) ceramics, glass, clay smoking pipes, nails, tools, defence and hunting.

iii

- 47 2. Site 13R artifact frequency and distribution (14R Area Survey) personal adornment.
- 48 3. Site 13R artifact frequency and distribution (14R Area Survey) native industries and miscellaneous metals.
- 49 4. Site 13R artifact frequency and distribution (14R Area Survey) faunal remains.

Illustrations

- 51 l Historic site locations within Rocky Mountain House National Historic Park.
- 53 2 Archaeological master grid, Rocky Mountain House National Historic Park.
- 55 3 1966 low oblique aerial photograph of sites 15R, 1R and 16R.
- 57 4 Area priority classification for testing and general ground survey.
- 59 5 Archaeological survey sectors.
- 61 6 14R area survey.
- 63 7 Site 13R test excavation units.
- 65 8 Plan of site 16R archaeological remains, 1975.
- 67 9 Plan, northwest corner bastion and palisades.
- 69 10 Plan, building 1.
- 71 11 Plan, building 2.
- 73 12 Plan of archaeological remains, 1975.
- 75 13 Hudson's Bay Company Land Department plan, 1915.
- 77 14 Aerial photograph showing town of Rocky Mountain House and the national park.
- 79 15 Aerial photograph showing sites 15R and 1R prior to excavation.
- 81 16 Aerial photograph showing excavated remains of sites 13R and 16R.
- 83 17 Aerial photograph showing soil moisture patterns.

iv

85	18	Aerial photograph showing soil moisture patterns.
87	19	Filter configuration, 1 ² S multispectral aerial camera.
89	20	Infrared aerial photograph of sites 16R, 13R, 1975.
91	21	Infrared aerial photograph of site 16R.
93	22	Infrared aerial photograph of site 15R.
95	23	Infrared aerial photograph of site 15R.
97	24	Components of a linescan system.
99	25	Typical linescanner geometry.
101	26	Thermal infrared imagery, sector A.
103	27	Thermal infrared imagery, sector B.
105	28	Thermal infrared imagery, sector C.
107	29	Thermal infrared imagery, sector D.
109	30	Thermal infrared imagery, sector D.
111	31	Thermal infrared imagery, sector D.

Abstract

Archaeological investigations were carried out at Rocky Mountain House National Historic Park during the summers of 1975 and 1976. Forming a major part of the investigations was a survey program aimed at site location. The sites of concern were historic fur trade forts dating to the 19th century. Three principal survey methods were employed and are described herein. They included, ground survey, test excavations, and aerial photography and remote sensing. Ground survey and test excavation produced the best results with two previously unrecorded sites located. Experiment-based aerial photography and remote sensing applications were found to be of very limited value for site location. Introduct ion

During the summers of 1975 and 1976 an extensive archaeological survey of Rocky Mountain House National Historic Park was carried out. The survey had three immediate aims: first, to locate all historic sites within the park; second, to determine through test excavation the physical size of the sites in an attempt to establish how much time would be involved in more extensive excavation; and third, to determine a temporal span for the sites. All aims were met with varying degrees of success.

As several fur trading forts were historically documented in the area bound by the park and possibly in peripheral zones, an extensive survey was felt necessary to meet the immediate aims of the project. Three archaeological survey methods were employed. They included: terrestial observation, test excavation and air photo reconnaissance and thermal infrared linescanning.

The first method, terrestial observation, simply involved covering on foot the study area in an attempt to locate surficial site remains. The second method involved an extensive test excavation program where units were established and excavated in areas showing the most likelihood of site location. The last method included the application of both aerial photography and remote sensing techniques as experimental approaches to site location. Implementation of the first two methods met with a great deal of success, however, the results of the third survey method were not as gratifying as was expected.

In 1975 the site survey was concentrated in the

southeast portion of the 541 acre park. Also involved were areas of high potential for site location. Through terrestial survey and test excavation two historic fur trade fort sites were located during the first field season. The sites were designated 15R and 16R (Fig. 1). Both sites were investigated to determine their size and identity. Site 15R was identified as a Hudson's Bay Company fort dating from 1835 to 1861. Site 16R was not positively identified, however archaeological evidence suggested that the site dated to the first quarter of the 19th century. The location of the two sites brought the total number of located historic fort sites within the park to four. The two other sites had been subject to previous excavation, at which time only one could be validly identified. The identified site was 1R, the final Hudson's Bay Company fort (1868-75) at Rocky Mountain House, which was excavated in 1966 (Vaucher 1968). The other site, 13R, was excavated in 1962 and 1963, and was tentatively identified as the North West Company (1799-1821) - Hudson's Bay Company (1821-1835) fort (Noble 1973).

In 1976 the site survey was resumed. As a result remaining areas within the park were investigated through test excavation. No additional sites were found.

The purpose of this paper is to describe the application of the three survey methods employed in site location at Rocky Mountain National Historic Park. The results of the terrestial observation and test excavation survey methods are presented. As positive results from the aerial reconnaissance techniques employed were very limited, an explanation of the techniques involved is given. Suggestions as to the application of aerial survey techniques for archaeological purposes, not necessarily as relates to Rocky Mountain House are considered.

Historical Background

In 1799 the rival North West and Hudson's Bay companies established trading forts close to one another along the north bank of the North Saskatchewan River near present-day Rocky Mountain House, Alberta. The North West Company's fort was called Rocky Mountain House and the Hudson's Bay Company counterpart was named Acton House. Both forts were in existence until 1821 when the two companies merged. Τt is believed by Dempsey (1973: 30) who was involved in historical research on the Rocky Mountain House area that upon amalgamation the North West Company house was retained and Acton House was abandoned. In 1823 the Hudson's Bay Company Rocky Mountain House was abandoned for two years. The fort was reopened for the 1825-26 trading season and remained functional until the end of the 1831-32 winter trading season. Rocky Mountain House was closed in favour of Peigan Post in 1832. However, in January of the following year Peigan Post was replaced by Rocky Mountain House.

Peigan Post was reopened in September, 1833 but again was replaced by Rocky Mountain House in February, 1834. However, due to the deteriorated state of Rocky Mountain House, plans were made to totally replace the fort rather than renovate and repair it. In 1835 construction of a third self-contained post was initiated. The fort was occupied until 1861 when it was abandoned, principally because of poor fur returns, sustenance problems and hostile natives. Later that same year a group of Blackfoot burned the unoccupied fort. In 1864 a "temporary fort" was established and plans were made to construct a new post at

Rocky Mountain House. During the early part of 1865 initial construction work began and continued until the spring of 1868. The "temporary" establishment was used as a base of operation during the 1865-68 construction phase. The last fort stood until the termination of the 1874-75 trading season. After 1875 no trading activity was evident in the Rocky Mountain House area.

Survey Methods and Results

Terrestial Observation

During the two field seasons at Rocky Mountain House almost all areas of the park were surveyed by foot. Included in this aspect of the survey were areas peripheral to and not part of the park. The park proper included approximately 541 acres, and bordering areas about the same. These areas stretched west of the North Saskatchewan River, from its confluence with the Clearwater to approximately two miles above the confluence (Fig. 2). As approximately 95 per cent of the areas covered were in the past under cultivation and now in grass cover, ground survey was considered to be the most suitable method for site location. Due to disturbance of the ground by ploughing, the chances of finding artifacts and faunal remains associated with a site were greatly However, surface expressions, such as historic enhanced. cellar depressions, pits and chimney mounds, were almost non-existent because of filling, levelling and clearing for farming purposes. In addition to general survey, this method was also used for verification of possible natural and cultural features evident on aerial photographs and remote sensing imagery.

In combination with information provided by local residents of the Rocky Mountain House area pertaining to where surface finds, depressions and piles of stones existed, the ground survey provided valuable information about site location. Two large fur trade fort sites were found within the park the first field season. They were

designated sites 15R and 16R. Site 15R, a Hudson's Bay Company fort dating to the second and third quarters of the 19th century, was found approximately 100 m north of site 1R (Fig. 2). Though a large number of artifacts and bone fragments were evident on the surface indicating an historic site, the general location of the site was first pin-pointed accidently by the writer on a low oblique panchromatic aerial photograph. The photograph was taken by the archaeologist in charge of the 1966 site 1R excavations (Fig. 3). The surface expressions, notably crop and shadow marks, indicating palisade lines, pits and cellar depressions, were overlooked by the photographer who was concerned with site 1R as his principal subject. The writer has not seen a better aerial photograph pertaining to fur trade archaeology which so well highlights a site through crop and shadow marks. Further discussion of this photograph and site 15R will be included in the section on application of aerial photography and remote sensing to the archaeological survey.

Site 16R, the second major site to be located, was found in the "Old Brierley Farmyard" situated on a high fluvial terrace about 300 m north of site 13R (Fig. 2). This site was found to be contemporary with site 13R, dating to the 1st quarter of the 19th century as indicated by the artifacts. As yet the site has not been positively identified. Very slight depressions and mounds gave a clue to the existence of the site. No artifacts or other surface finds were present. The site had several 20th century buildings situated upon it and was quite disturbed by farmyard activity. Both sites 15R and 16R were immediately classified as high priority areas and were extensively test-excavated to confirm fort location in 1975.

No additional sites were found by the ground survey in 1975 or 1976. Artifacts and faunal remains were found

throughout the park, the locations of which were noted and became the subject of test excavation during the two field seasons.

Test Excavation

Through ground survey and interpretation of aerial photographs, the study area was assessed as to what priority, i.e., high, moderate or low (see below) was to be given to each zone for closer scrutiny, specifically through test excavation.

Testing included the establishment of an overall control baseline which passed through the park almost paralleling the North Saskatchewan River (Fig. 2). From this baseline and associated control datum points, test units measuring 3 m by 1.5 m or 3 m by 3 m were systematically established throughout the study area. The amount and intensiveness of the testing was dependent on the potential a zone showed for site location. In general, the strategy was to lay-out and excavate test units at given intervals, such as, at every 9 m, 18 m, or 36 m, working on the assumption that a site would be no smaller than 40 m The writer's experience with other fur trade sites square. in the western Canadian prairies supports such conclusions. Also the two previously excavated sites at Rocky Mountain House were over 50 m square, and available historical documentation on all sites in the area suggest large palisade-bound forts. The writer has also observed that in most cases a site of the nature mentioned here is often double the size of the fort proper (the palisade area) when considering distribution and scattering of artifacts and faunal remains. With these points in mind it was felt that if any other fort sites or other types of sites were present in the park they would be discovered. The types of tools

used in the excavation of each unit were dictated by the potential the area showed. Trowels, hoes and shovels were employed with reasonably good control, for though site location was of top priority, pedologic, stratigraphic and floral information gathering was also of importance.

Acting on the basis of archaeological probability, extent of ground to be covered, and the localized physical environment, a speculative priority classification of the park was made.

The park was classified into three zones of priority high, moderate and low (Fig. 4). High priority zones were areas considered to be more likely candidates for site location, i.e., well-drained, generally level, and in close proximity to the river. In these zones testing became more intensive and concentrated. Moderate priority zones involved areas showing slightly greater irregularity of surface expression, and areas less accessible to the river, i.e., not a reaonable distance to the river. These moderate priority zones were tested but not given the concerted effort afforded the high priority zones. Low priority zones were established as areas which were not thought to hold any potential for site location. These areas included organic terrain, principally bogs, extremely rugged areas, and areas some distance from the river. In most cases testing was not carried out in these areas and the survey fell into the general terrestial observation approach. To facilitate description of the testing and findings, the study area was divided into six survey sectors (A-F) (Fig. 5). Four sectors are situated within the park boundaries (A-D) and two outside (E and F). Figure 5 lists and geographically locates each sector.

Results of 1975 Testing Test excavation began in the south end of the park in 1975.

Of initial concern was an 80-acre previously cultivated and grass covered field south of the 'Old Brierley Farmyard' (Sector A). In the northern half of the field site 13R was located. The field occupied a lower or first terrace of the North Saskatchewan River and was within the park boundaries. The terrace was part of a relatively flat open flood plain marked by meander and current scars, evidence of past shifting of the river channel. Most of the field was given high priority classification, particularly that portion paralleling the river the full length of the field and approximately 210 m, on the average, back from the present river bank. That portion was quite flat except for a slight knoll just south of site 13R. The area was well-drained, afforded a good view of the river, and was quite accessible to the river, therefore being a prime area for potential site location. In addition to these characteristics, the area surrounding site 13R was of principle interest. During the excavation of the site in 1962-63 only the interior of the fort was excavated. Therefore it was the aim of the 1975 testing to check the immediate area for outlier structures, burials and other features linked with the fort.

Most of the western portion of the field was assigned moderate priority classification and received only limited test excavation (Fig. 4). This area was marked by a more undulating and slightly more irregular surface caused by the presence of more deeply incised meander scars (partially filled with abandoned channel deposits or high in water content) and damp, not too well-drained hummocky areas caused by groundwater saturation. The latter was notably evident just at the base of a second higher river terrace situated along the eastern periphery of the field. The soils of the entire field consisted of very silty sands and sandy silts, and in some areas plastic clays, the latter of which when exposed to the sun would dry to a hardpan.

Beneath these finer superficial alluvial sediments coarse sand, gravel and cobble deposits appeared. They were found at depths below surface of between 20 cm and 2 m. The overlying cultivation layer was relatively thin, evidence of limited ploughing over the past years.

Ninety-four 3 m by 1 m or 3 m by 3 m test units were systematically laid out and excavated in the field, of which, approximately 25 per cent were concentrated in the vicinity of site 13R (Figs. 6, 7). The larger units were employed at the site for greater coverage in the area. As to be expected artifacts associated with the fort were found in increasing numbers as work progressed nearer the site. Only isolated late 19th century and 20th century materials were found in any of the test units situated in excess of 25 m from the site.

A detailed descriptive analysis of the artifacts found associated with site 13R is not presented. Instead artifact frequency and distribution tables have been prepared showing the types, quantities and distribution of artifacts (see Tables 1-4). Most of the artifacts were recovered from a large midden (refuse pile) situated approximately six metres southeast of the fort. All artifacts date to the first quarter of the 19th century. Four hundred and eighty-nine artifacts were found of which 45 per cent were small trade The other materials included white salt-glazed beads. stoneware and creamware fragments, clear bottle glass fragments, pharmaceutical bottle glass fragments, three window glass fragments, clay smoking pipe fragments, hand wrought nails, a flat bastard file fragment, four spall type and five blade type gunflints, mustket balls, lead shot, pieces of a canoe knife, clasp knife, serpentine side plate and trigger, a gun jaw screw and one metal projectile point. In addition several small metal buttons, a silver brooch, a cooper tinkle cone, a brass shoe buckle tine, a tin charm,

vermilion, miscellaneous metal fragments, and several artifacts of native origins appeared. The artifact collection is not unlike that which originated from the 1962-63 excavations of the interior of the fort.

Very few artifacts were recovered along the north and west sides of the fort. In addition to the midden, units excavated along the south and east sides of the fort evidenced the most material remains.

Faunal remains were found in almost all excavated units. The greatest concentration was found in association with the midden. Bison, deer, canine, beaver, several unidentifiable mammals and an unidentifiable bird were represented.

In addition to the location of a midden and recovery of additional site 13R artifacts, information pertaining to the historic forest cover and wood species available to the fur traders in the area was accumulated during archaeological testing.

Before and during the occupation of site 13R the entire area was heavily vegetated. The large fluvial terrace upon which the fort rested evidenced a good vegetation cover with stands of White Spruce (<u>Picea glauca</u>), Engelmann Spruce (<u>Picea engelmannii</u>), Lodgepole Pine (<u>Pinus contorta</u>), Jack Pine (<u>Pinus banksiana</u>), Trembling Aspen (<u>Populus tremuloides</u>) and Balsam Popular (<u>Populus balsamifera</u>) with a sprinkling of Douglas Fir and Ponderosa Pine (<u>Pinus ponderosa</u>). To the west and southwest in the less well-drained areas, Black Spruce (<u>Picea mariana</u>) and Tamarack (<u>Larix laricina</u>) predominated (Hosie 1973). During the occupation of the fort small stands of aspen and popular would have thrived as the first species to appear after initial leveling of the forest in the immediate area of the fort.

During the excavation of the midden several large tree stumps were uncovered in situ. These stumps were what

remained of trees cut close to the ground with an axe and later burned. Samples taken from the remains identified the trees as Douglas fir (<u>Pseudotsuga menziessi var, glauca</u>). Though no wood samples were taken during the 1963 excavations it is believed that this tree species was used for building purposes associated with site 13R. Larger structural elements, such as support posts for the fur press and "post-in-ground" vertical building elements may have been made of Douglas fir. It is noteworthy to mention that no fir was used on any of the features so far exposed at sites 1R, 15R and 16R; spruce and Ponderosa pine predominated.

Near the termination of test excavations in the south end of the park (Sector A), investigations of a similar nature began in the vicinity of the "Old Brierly Farmyard" (Sector B). Several 3 m by 3 m test units were established in an area believed to contain a site. Depressions and mounds were tested in hope of finding building remains. Upon confirmation of a site, testing operations were ceased and a more extensive excavation program was initiated. The principle aim of these excavations was to determine the size of the fort and identify it. The site was designated 16R.

Concurrent with the investigations at site 16R, testing was begun approximately 140 m north of 1R, in the area where the outlines of a fort were indicated on the black and white aerial photograph taken in 1966 (Sector D). Again after artifacts and features appeared, testing was expanded to more extensive excavation. It was apparent that this site, designated 15R, was much larger than site 16R, so efforts were concentrated in the areas of palisade lines and corners in an attempt to outline the fort and determine its overall dimensions and configuration.

At this point during the first field season the test

excavation program was completely terminated and work carried out at sites 15R and 16R. Slightly less than one-third of the high to moderate priority areas were tested. It was therefore decided that the testing program would be resumed at the beginning of the 1976 field season, and completed during that season.

Summary of results of 1975 excavations at sites 16R and 15R Site 16R (Fig. 1) received the most attention of the two sites excavated. Approximately 50 3 m by 3 m units were excavated concentrating in three specific areas: the palisade lines and two large building structures. The south, west and north outer palisade lines were located, along with an interior north line (Fig. 8). The latter line probably cordoned off a garden or formed an animal stockade The east palisade was not excavated area within the fort. because a municipal grid road covered and in some places cut the entire feature. In the northwest corner of the fort, bastion remains were found (Fig. 9). The structure appeared to have been very substantially constructed of large vertical members placed in a prepared trench. That the structure had at least two levels is suggested by the presence of two large 30 cm diameter support posts situated just inside the north and south walls. The bastion was the best preserved feature so far encountered on the site. In comparison to the well-preserved bastion posts, remains of verticals along the palisade lines were almost nonexistent. Except for the exposure of approximately 5 m of post remains in the builder's Trench along the south palisade line near the southeast corner of the fort, virtually no other posts, post holes or postmoulds were found. This occurrence suggests a dismantling of the palisade at the time of abandonment or shortly thereafter.

Within the main courtyard area of the fort, two large buildings were located and partly outlined (Figs. 10, 11). One structure (Building 1) was located about 8 m from the interior north palisade line. The other structure (Building 2) was situated immediately inside the south palisade line. Both buildings were set square to the palisade lines and were situated in the west half of the fort, almost directly across from each other. That the structures were multiroomed is suggested by their size and associated Though the buildings were not completely and features. accurately delineated during the 1975 field season, it was found that they were at least 11.5 m long. Building 1 had two fireplaces situated along and within its north rear wall. It also had three independent cellar depressions: a large central cellar and two small depressions to the east and west. Building 2 received less concentrated effort during the summer and therefore was not as fully excavated. Within this structure, one fireplace and a cellar depression were discovered. Both features were only partially excavated. Building 2 had the best preserved flooring remains of the two structures. Floor boards running north-south were nailed to sleepers that abutted the peripheral basal sills. It was evident that both buildings were probably rather crude in appearance with minimal effort put into finishing.

Site 16R was greatly disturbed by over 50 years of previous farming activity. Farm construction and occupation brought about the dumping of 20th century refuse and fill in the abandoned 19th century cellar depressions, digging of pits on the site to deposit refuse, mixing of 19th and 20th century artifacts and damage of historic architectural features and artifacts. Coupled with the above, three 20th century farm buildings were located directly on top of the site. At least two other structures once stood on the site,

but were subsequently removed.

The artifact collection from site 16R suggests that the site dates to the first quarter of the 19th century. The artifacts are not unlike those recovered from Noble's excavations of site 13R (Noble 1973). A quantity of trade silver, including hair brooches, earrings and a crucifix, were found. A number of bone and antler artifacts were also found, along with trade metal projectile points, a lead inlaid red catlinite pipe bowl, fragments from grey steatite pipe bowls, and other artifacts common to early contact trading sites on the prairies. In addition, a complete Robert Turlington's Balsam of Life bottle was recovered from the Building 2.

The site designated as 15R (Fig. 1), situated in a previously cultivated grass-covered field, was discovered through the use of a low oblique panchromatic black and white aerial photograph. Through crop and shadow marks the photograph revealed a palisade outline and depressions associated with a fort (Fig. 3).

The 1975 program at this site primarily focussed on determining the size of the fort, specifically through locating the palisade lines (Fig. 12). No excavation took place in the interior of the fort. Thirty-one 3 m by 3 m units were excavated to the upper surviving reaches of the palisade builder's trenches and posts. It was found that previous cultivation of the field caused extensive damage to both the palisade and artifacts. No doubt future work will reveal that existing interior structures will also have been greatly disturbed. Because of the shallow nature of the remains, in many areas of the site the plow zone reached the undisturbed horizon, the palisade trenches and other depressions were all that survived. During the course of the summer all but the northeast corner of the outer perimeter of the fort was determined. The excavations

provided information pertaining to definite construction periods associated with the fort, particularly on the west side. Three almost parallel builder's trenches were evidence of the removal and erection of at least three palisades along the west side of the fort. In addition to defining the outer perimeter of the fort, at least one interior palisade line was located, along with data suggesting that bastions were located in the southeast and southwest corners of the fort.

The number of artifacts from the site was very high in comparison to the number recovered from site 16R. The artifacts were good indicators of the date range of the site, suggesting a second to third quarter 19th century establishment.

Results of 1976 Testing

Test excavations were resumed within the park in 1976 between 31 May and 30 June. During that period all remaining high and moderate priority areas north of site 16R were investigated (Fig. 4). Four archaeological survey sectors were involved - B, C, D and F (Fig. 5). A similar strategy as that employed in Sector A the previous year was followed, whereby test excavation units were established at pre-determined intervals allowing for valid testing of an area. Also testing became more concentrated near known sites, such as 16R, 1R, 15R and 17R, in an attempt to locate outlier features.

No additional sites were found during the 1976 survey. However, additional information on known sites in the park was recorded. Concentrated testing immediately north and west of site 16R showed that limited historic activity took place in those areas. Only a limited number of faunal remains were recovered, along with a single small turquoise

trade bead. It would seem that fort-related refuse was not deposited in those areas. More than likely refuse was thrown directly over the steep cut-bank to the east of the site.

No historic artifacts and only a few faunal remains were recovered in other areas of Sector B.

In Sector C testing was carried out directly west of site 1R. A number of artifacts and faunal remains associated with the 1868-75 Hudson's Bay Company fort were found. No outlier features were encountered. Most of the cultural materials were recovered in the cultivation layer. Materials included, machine cut nails, dark olive green liquor bottle fragments, small trade beads and transfer-printed earthenwares.

Sector D was of prime interest to the 1976 survey. It was in this Sector that additional sites could appear. Also the immediate area around the Seafort Burial Site (17R) was examined for possible extension of the site.

Several sketch plans produced by Canadian National Railways dating from 1909 to ca. 1915 show the location of a site labelled "Rocky Mountain House Ruins" on the lower river terrace just east of site 15R. One map has been reproduced (Fig. 13). It was hoped that this was the location of the recorded "temporary fort" dating to 1864-68. However, extensive testing in the area revealed no structural remains and only a few historic artifacts. The area in question has been and still is subject to major fluvial erosion. It is estimated that between .3 to .6 m is lost to the river annually. Using the plan's scale, the site in 1915 would have been no more than 17 m from the existing river bank at the time. Therefore, the possibility exists that the site, if it were not of sufficient size, could have been completely eroded by the river.

In 1969 and 1971, Mark Skinner from the Department of

Anthropology, University of Alberta, Edmonton, carried out archaeological investigations at site FcPr-100 (17R), the Seafort Burial Site (Fig. 1). The site located on a high river terrace in the northeast portion of the park produced 13 historic burials (Skinner 1971, 1972). The burial ground was probably used by the Hudson's Bay Company during the occupation of the 1835-61 fort (15R) and may have been a graveyard referred to in 1857 by Woolsev as "one of the cities of the dead." Woolsey further stated that it was one of the largest graveyards he had yet encountered (Woolsey 1858: 256). In anticipation of finding additional burials associated with site 17R testing was carried out north-west of the Seafort Gas Plant in a flat cultivated field. The plant rested upon the known extent of the site. Approximately 25 1 m by 3 m test units were established in the area, however, no additional burials were found.

Several test units were excavated around the known periphery of site 15R (Fig. 1). A number of artifacts were recovered from excavations north, south and east of the fort but no features were found. Most of the materials were found in the disturbed cultivation layer. Excavations immediately west of the fort revealed several large refuse pits concentrated with faunal remains and artifacts. Only the upper reaches of the pits were disturbed by cultivation.

Upon completion of the 1976 14R area survey efforts were turned to the excavation of sites 15R and 16R. During the course of the field season excavations at site 15R centred on the north, south and west palisades to determine the true fort shape. At site 16R almost 95 per cent of the fort was investigated. All the palisades, a northwest corner bastion and several buildings were revealed and recorded.

Aerial Photography and Thermal Remote Sensing Reconnaissance The 1975 survey involved a detailed study of available aerial photographs of the area. In addition a contract was arranged to have the park scanned by airborne remote sensors.

Three specific formats were used to survey the study area from the air. These included conventional black and white aerial photographs, multiband or multispectral photographs and thermal infrared imagery. For the general purpose of this paper the latter two formats are considered the results of remote sensing.

Few archaeological field research projects are carried out today without recourse to at least a few available conventional black and white aerial photographs. In most cases the photographs are used basically as reconnaissance tools and mapping aids. The writer believes that air photo and imagery interpretation studies have many direct applications to historic sites archaeology. Such studies are flexible in that they can be tailored to the individual job and can be used successfully on jobs implemented with either large or small budgets. If large tracts of land are involved in an archaeological survey, photo imagery-analytical techniques when applied by an experienced specialist can represent a rapid information and recording device. Often in the long run such applied techniques are economical in terms of time spent, money required and staff needed.

It has been proven over and over that the airphoto, and more recently thermal imagery, are effective means of recording field data concerning both cultural and natural landscape details. Studies of surface traces evident on various formats established by airborne platforms enable an archaeologist to make an intelligent appraisal of his project before or after its initiation. Aerial photographs

and thermal imagery are not restricted to the discovery of sites, for they can in some instances enable the archaeologist to draw plans of features associated with the site. In some cases such features are only visible from the air because of their slight to non-existent surface expression. Air photos and images also enable the archaeologist to interpret geological, geomorphological, pedological and vegetational characteristics of the region around a site. All of these phenomena are involved in the archaeological investigation of a site. Furthermore, aerial reconnaissance can provide an excellent means of checking, backing-up and organizing ground surveys. A prime example is seen in the use of the black and white low oblique aerial photograph which revealed site 15R (Fig. 3). When large time-consuming and expensive ground surveys are planned aerial reconnaissance can be employed to reduce expenses and time spent. This is especially evident in regards to surveys of less inaccessible and isolated areas.

Though aerial reconnaissance has been proven many times to be a valuable aid to archaeological research, it cannot be regarded as a complete substitute for fieldwork. Ground surveys and test excavation should follow the aerial interpretation to verify findings.

Panchromatic Aerial Photographs

All available conventional aerial photographs of the Rocky Mountain House National Historic Park and surrounding area were acquired before the beginning of the 1975 field season. The results of overflights from 1925 to 1974 were viewed stereoscopically and interpreted. The photographic scales varied from 1,800 feet (548.7 m) per inch to 26,800 feet (8168.8 m) per inch. The aerial photographs were to perform three functions: to help in locating undiscovered sites and

outline previously known sites, to view the lateral shifting of the North Saskatchewan River over the past 50 years to make predictions on possible site erosion and disappearance, and to familiarize the investigators with the general area, its vegetation, soils and geomorphological character. When employing conventional vertical photographs for site location three surface related patterns can be present evidencing a site. They include shadow, crop and soil The surface expression and vegetation cover at Rocky marks. Mountain House was ideal for photography from the air. The area was relatively level except for shallow meander scars, the vegetation was limited to various long and short grasses. If the landscape was much more irregular, or more so, heavily treed, the chances of site location would be minimized. Reliance on soil-marks at Rocky Mountain House for site location was limited because of grass cover.

The major disadvantages of using conventional panchromatic photographs for archaeological site survey and interpretation are lack of a proper scale and details exemplified by black and white formats. In most cases panchromatic photographs are available in small scale (Fig. 14) with only some moderate large scale formats to be found (Figs. 15 and 16), Scales of available conventional panchromatic photographs may in most cases be suitable for the forestry, soils, or geology researcher but not the archaeologist concerned with detailed site studies. However this must not be taken as a final conclusion, for small-scale photography can provide a synoptic view of areas under study for delineation of regional land form types and relationship which are often directly related to site locations. That is to say, for example, a fort site is in most cases going to be found in a good, logical location taking advantage of its natural surroundings. A scale of 1:20,000 is a very common one in photography flown by

federal agencies in North America, and is excellent for studying the physiographic characteristics of an area around a site. It must also be noted that large scale photography has its disadvantages also, especially in regards to widespread site surveys. Often to carry out large-scale photography it is found that the costs become too high because of the greater number of photos taken, the additional time required to work with the increased number, and the inconvenience of handling and storing the increased bulk. In addition large-scale photographs restrict a synoptic view of an area.

The most important factor when interpreting details on aerial photographs is ground resolution. Ground resolution is defined here as the "measure of the smallest object on the ground which can be detected in the photograph at a given contrast ratio" (Roscoe 1960: 740). Ground resolution is closely related to scale and is expressed in feet and most important, affects the interpretability of the In regards to conventional aerial photographs photographs. ground resolution is often less than adequate for good interpretation. Coupled with ground resolution on aerial photographs is tonal contrast and sharpness. By the former is meant the difference in brightness between an image and its background. Sharpness on the other hand is the abruptness with whch the tonal contrast appears to take place on the photograph. In most cases conventional aerial photographs at small-scale do not allow for the best tonal contrast and sharpness, therefore the chances of detecting archaeological features on the ground are further minimized. Blowing-up or enlarging specific areas of a photograph to aid in feature detection often leads to further frustration for contrast and sharpness are greatly affected. In the final analysis if black and white photographs are to be employed for more detailed site studies larger-scale formats

are needed to provide good ground resolution, tonal contrast and sharpness.

A single black and white photograph was found by the writer in the field photographic collection from site 1R which allowed for the precise locating of the site 15R fur trade fort (Fig. 3). The photograph was taken in August of 1966 by C. Vaucher the archaeologist in charge of the excavations of site 1R. The remains of a site were inadvertantly recorded on a low oblique aerial shot and not detected by the photographer when he was in the process of photographing site 1R. A portion of site 15R was also recorded on a colour slide taken during the same flight. The aerial photograph was quite unique for few exist which show details of features as well as the Rocky Mountain House shot. The photograph presents a valuable record to the archaeological project.

The photograph was taken on a sunny day in the middle to late afternoon as the sun was descending. It was taken facing to the west. It is interesting to note that several other photographs were taken of the site area from different directions, but did not reveal any detail of the site's features. The photograph shows a municipal grid road passing through the picture, the North Saskatchewan River to the left, site 1R under excavation (centre), the "Old Brierley Farm" located on Site 16R (background), a field with recently cut and raked grass (to left of road) and two large grass covered haying fields (to the right of the road). One cut around the periphery of each of the fields has been made by a mower. In the lower grass-covered field the site appears with feature details highlighted by crop and shadow-marks.

The features include a south palisade, an interior south palisade (both partition off a probable garden or animal confine), an interior north palisade (paralleling the

former two), a north palisade (not paralleling the other three lines), traces of a west palisade, interior north-south-oriented separation in the garden area (near west line), and several depressions (cellars, refuse pits, None of the features are evident on the ground. etc.). The grass was probably about 1 m high with very slight differences in height in the feature areas resulting in visible differences between the vegetation over features and that of the surrounding area. The differences in height are probably due to three factors. They include: (1) Buried organic materials - along the palisade lines completely decomposed and rotting pickets contribute additional nutrients for plant growth; in depressions refuse and collapsed building elements are influencing factors. (2) Loosened soil - along the palisades lines backfill from the original filling of the builder's trench; in depressions backfill from the natural and more recent 20th century leveling of the site.

(3) Accumulation of water - along the palisade lines where moisture is retained in a reservoir situation in the builder's trench; similarly in the depressions. All these factors stimulate the growth of the plants creating positive crop marks. The presence of grass as a cover in the field also enhanced the possibility of crop marks, for grasses, as do cereal crops, exhibit density of growth and sensitivity to variations in soil texture and composition, not seen with other vegetation covers.

In the case of the single oblique aerial photograph features would not have been observed if it were not for the influence of another factor - the sun. The bearing and altitude of the sun at the time the photograph was taken in combination with the crop-marks further enhanced site patterning. In the Rocky Mountain House case, light parallel to the length of the straight palisade lines (west

and east) did not distinctly cast a shadow; however, light falling along the south and north palisade lines cast shadows. Similarly, if the altitude of the sun were too high shadows would be less distinct, but with a low sun, shadows will be prominent. In the Rocky Mountain House case, the sun was sufficiently low to create the needed shadow.

Except for the 1966 aerial photograph which showed site 15R, only one other conventional black and white photograph gave any indication of possible site locations within the park (Figs. 17, 18). A 1951 Alberta Provincial government photograph indicates interesting soil-moisture patterning in three specific locations. Both the sites of 13R (previous to excavation) and 15R can be seen, as well as a third well-defined patterning (see A) where the Seafort Gas Plant was subsequently situated. Details of sites 13R and 15R cannot be seen because of the small scale. The patterning at point A was pointed out by Skinner in 1971 following excavations of the Seafort Burial site (17R). Skinner after photo enlargement of the area in guestion described the pattern as 'roughly quadrangular' (Skinner 1971) and considered the occurrence as a possible fort site location. Upon interpretation of the photograph it was felt that the patterning did not indicate a fort site location. The following points can be cited in support of that interpretation:

(1) The patterning was far too irregular to indicate a site.
(2) In 1971 Skinner investigated the area and stated that
"(approximately 5%) of the suspected locale of the fort..."
was tested. The small area tested yielded nothing although
the subsoil in the immediate area was extremely dark, almost
black, which might account for the darker, "stained" areas
visible (Skinner 1971: 240).

(3) Test excavations in 1976 were carried out on the lowest

terrace of the area a short distance from the possible site. Excavations could not be carried forth directly in the area because of the presence of the gas plant. However, as was the case with Skinner's findings no cultural remains were found.

Remote Sensing

In addition to study and interpretation of conventional aerial photographs, multispectral photography and thermal infrared linescanning was carried out and used as interpretative aids to the survey of Rocky Mountain House National Historic Park. Intera Environmental Consultants Limited of Calgary, Alberta was approached to do the overflights. It was decided that the work would be clearly in the field of experimental research as varying degrees of success had been reported for archaeological research of the type proposed. It was believed that thermal linescanning (and multispectral photography) could be valuable tools for archaeological site location and delineation.

The study area was considered ideal for such a remote sensing experiment for vegetation and terrain would not pose any problems for overflights. At the time overflights were made (late August and early September, 1975) most of the grass cover in the area had been removed by haying Two overflights were carried out concurrent operations. with minimum and maximum surface temperatures. If surface disturbance were sufficient to be detected thermally, the chances of detecting a resultant thermal anomaly would be maximized at those times. The overflights were safely conducted at 900-1000 feet (274-304 m) AGL. It was felt that at that altitude good resolution of small targets could be accomplished.

Multispectral Photography

Multiband spectral reconnaissance of the study area was carried out in the late morning of 2 September. It involved a single pass over the area employing a four-band multispectral aerial camera designed to produce imagery from different parts of the electromagnetic spectrum. The aircraft used was a Piper Turbo-Aztec "D," twin engine land monoplane. An 1 S Multispectral camera was used employing Kodak 2424 Pan IR film. The filters included Wratten 47B, 57A, 25 and 88A, bands 1-4, respectively (Fig. 19). During the day of the flight the ceiling and visibility were unlimited. The flying altitude was 10,000 feet (3048 m) A.M.S.L. with a flying speed of 160 knots.

The following information was supplied by Intera as an explanation to the technical aspects of the multispectral system:

The major elements of the multispectral imagery acquisition and display system consists of: (a) The Four-Band multispectral Aerial Camera; (b) IR black and white film for recording data; (c) standard laboratory processing for film, and (d) the Additive Color Viewer.

Multispectral imaging, and the data acquired through its use, involves the acquisition and comparison of two or more images of the same scene, usually recorded simultaneously in different regions of the electromagnetic spectrum. Comparison of the relative amounts of spectral energy reflected or emitted by discrete objects in the scene is used to identify specific subjects and phenomena.

In the photo-sensitive spectrum, extending from

the ultraviolet to the near infrared, natural and false-color infrared films operate by exposing three separate spectral regions with tri-pack emulsions, which form dye images when processed, to form the familiar results obtained with films such as Kodachrome, or Color IR. Natural color films sense in the blue, green and red, while false-Color IR utilizes the green, red and IR regions.

Multispectral imaging permits much greater flexibility than black and white, natural color, or IR color for the scientific user, in that each spectral band may be selected, both as to passband width and its position in the spectrum. The images are obtained on black and white emulsions, with their simplifed, economical, and more readily controllable processing and reproduction.

The most widely accepted multispectral configuration is based on recording the scene in four spectral bands: blue, green, red, and infrared. With this combination, both natural and false-color images can be recreated by methods such as additive color projection. The blue, green and red records, when projected through filters of the same color, and superimposed on viewing screen, form a natural color image. Also, when the green, red and infrared records are projected through blue, green and red filters, false-color infrared effects are obtained. Unlike the color film transparency image, however, where all colors are frozen unalterably, the set of multispectral black and white images permits an extensive range of variations in color hue, brightness, and saturation, since during projection with properly designed equipment, the operator can change both the intensity and color of the image by adjusting the illumination and filters for each of the images which form the composite (J. Crowley, pers. comm., 1975).

Interpretation. It was felt that infrared black and white and infrared colour would be of most value in interpreting terrestial images because of their ability to detect more subtle soil-moisture changes. As such, several photographs were reproduced for interpretative purposes. In addition to this, reproduction images were viewed in the Additive Colour Viewer. In the viewer various hues could be added obtaining different displays enabling the interpreter to more finely scan areas of interest.

In reality infrared black and white photography can be more properly termed near-infrared or photographic infrared for in most cases exposures utilize only a minute band of infrared radiation (740 to 1000 nanometres).

The grey tonal display on infrared photographs originates from the degree of infrared reflectiveness of an object instead of from its true colour (Figs. 20, 21, 22, 23). The most obvious display on the photograph is the character of vegetation. Coniferous vegetation tends to absorb infrared radiation, registering dark tones, while on the other hand, deciduous vegetation is highly reflective and consequently photographs in light tones. Mature grasses also have moderately high reflective characteristics and appear light toned. Freshly cut grasses appear as a medium
grey tone (Fig. 20). Using these vegetation tonal differences as a base, an attempt was made to locate archaeological features, specifically palisades and depressions associated with a site.

Water and areas of moisture concentration have a distinct tonal display on black and white infrared film. Because infrared light is absorbed by water and areas of moisture concentration to a relatively high degree, darker tones are registered on the film. Also different soil types have different tonal contrasts. Therefore both moisture and soil texture also became important to the interpretation of archaeological features.

In the park well-drained sands and gravels appear light toned; silts and clays darker tones. Moisture-laden silts and clays and water saturated organic deposits also show as dark tones. Meander scars associated with the North Saskatchewan River flood plain are quite evident on the black and white infrared photographs (Fig. 20). They have a light tonal display which is a function of almost exposed, coarse-textured and well-drained sub-surface gravels, sands and river cobbles. On the other hand, if the scars were filled with silts and clays and less well-drained, tones would have been darker. Considering the above tonal contrasts pertaining to soil types it was hoped that archaeological remains could be identified on the photographs. Of principal interest were negative anomalies i.e., palisade trenches and depressional features such as cellars and pits. The tonal configuration of such features will depend on the type of soil used as a backfill. It also depends on the saturation quality of the base material into which the features were excavated. Regarding the latter, if a palisade trench were dug into a moisture-retaining clay or silt, the trench should show up as a dark toned linear feature. Different shades of grey would predominate

depending on the fill, i.e., darker if silt or clay fill were used and lighter greys with sand and gravel fill. On the other hand a well-drained gravel or sand-filled trench set in a similar textured sub-surface base would appear light toned due to a lack of water retention. Nevertheless, no matter what the texture and moisture differences, a tonal contrast highlighting features would seem a certainty.

After close scrutiny and interpretation of the infrared black and white photographs with consideration given to tonal contrasts related to vegetation, moisture and soils, no archaeological features could be delineated. And to add to the disappointing results, distinct tonal contrasts associated with features from known sites, such as 1R, were non-existent.

An explanation for such negative evidence can be offered. As vegetation vigor and density growth characteristics were the principle indicators of archaeological features on photographic infrared film, the recent mowing of the grass within the park for haying purposes may have been the major contributor to the negative results. As the multispectral overflight was not planned, but rather a spur-of-the-moment affair, by the overflight contractor biased results were not completly ruled out. In the final analysis the multispectral reconnaissance was in direct conflict with the thermal infrared linescanning for it was suggested by Intera that as a prerequisite to the thermal linescanning and for best results the overflights be conducted once the hay crops within the park were removed. In this case soil-moisture related thermal anomolies were of interest rather than vegetation related anomolies.

Considering the difficulties encountered at Rocky Mountain House regarding the mowing of crops and time of the multi-spectral reconnaissance, certain recommendations can be forwarded. It is suggested that reconnaissance be

carried out at two specific times of the year. The first being the early spring after the grass has begun to grow, and the second just before the grass is cut for hay. At these times subtle differences in grass cover effected by underlying archaeological features will be most likely recorded on infrared film.

A strong reliance on soil marks to highlight archaeological features at Rocky Mountain House was not possible. The absence of fallow fields and the presence of grass cover minimized identification of soil marks. It was observed during excavations throughout the park that almost the entire area was under cultivation at one time or the other. Subsequently, a cultivation layer of uniform thickness (10-15 cm), soil texture and soil type covered the study area. It is believed that this layer masked to some extent existing sub-surface archaeological features.

In addition, the flying altitude of the multispectral overflight was too high (3048.0 m A.G.L.) to register subtle archaeological features. After photographic reproduction, known archaeological sites in the area covered no more than 13 mm square on the available format (Figs. 20, 22). A palisade trench not exceeding 60 cm in width as measured on the ground would be almost impossible to identify. Enlarging specific site areas on the photograph offered some improvement but was still too small of a scale (Figs. 21 and 23). Resolution and associated details were effected by enlargement. It is suggested that a flying altitude of at least 300 m A.G.L. be used in surveys of similar nature to Rocky Mountain House.

Infrared colour photographs of the study area revealed no real hard evidence for site location (no infrared colour photographs have been reproduced in this report). Infrared colour photography was originally designed to emphasize the difference in infrared reflectance between live, healthy

vegetation and less healthy or diseased vegetation. Natural thriving vegetation (trees and grasses) appear in various shades of red; less healthy, diseased or dead vegetation appear red-brown to white-brown. In regard to trees, there is a near similarity in visual colour between deciduous and coniferous trees. Because thriving deciduous trees have a much higher infrared reflectivity than healthy conifers, there are distinct differences between the colours of these tree types as observed on the photograph. Deciduous species appear red and "blurred" and conifers dark red. Grasses, on the other hand, show similar tonal renditions. Healthy grass cover appears a homogeneous bright red colour, while cut and dying grasses appear red-brown to red-white.

As with the infrared black and white, it was felt that infrared colour film because of its sensitivity to differences in vegetation cover, and the capability of registering such, that it would aid in delineating archaeological features. Palisade trenches and other depressions because of their moisture retention qualities and/or their nutrient-rich soils compared to the surrounding area soils would be ideal to promote stronger vegetation growth. In other words, a contrast of red shades of colour would be in evidence between the archaeological features and the surrounding area.

As was the case with the infrared black and white, no positive evidence for site location was observed. Again the sites known to the writer, and notably site 15R situated in an open, level field, evidenced no hint of an existing site. Recently exposed excavation units were readily distinguishable on the photographs as cyan in colour.

Certain explanations for the lack of evidence can be offered which are basically the same as those presented for the infrared black and white film. The major problem for site 15R is considered to be mowing of the grass previous to

the overflight. Plant indicators or crop marks were obliterated. Coupled with the overall mowing of the entire field for haying purposes, the archaeology crew close-cut the area immediate to the site for ease of survey and excavation. A similar situation was present in regards to the delineation of site 16R. In this case a combination of grass cutting and heavy activity in the site area by the archaeological crew and farmers hindered any chances of locating archaeological features through crop marks on the aerial photographs.

In addition to the two major test areas (15R and 16R) a third area was of concern. This area was a field located across the road and east of site 15R (Fig. 22). Historical documentation suggests another historic fort may be located in the area. However, again as was the case with all the sites, haying operations by local farmers removed all chances of making a valid interpretation of the area, let alone locate a site.

Suggestions for future reconnaissance of this type are similar to those forwarded for infrared black and white photography, i.e., overflights during the spring once the grass has had a chance to commence growing and/or during the early part of September before haying operations; low level overflights should also be considered.

Thermal Infrared Linescan

The following information was provided by Intera in regards to methodology associated with thermal infrared imagery data acquisition:

Although films and cameras are widely used, they are limited to the sensing of visible and 'photographic IR' energy. The total energy available for detection is much broader,

including long wave ultraviolet, much of the infrared, nearly all of the microwave and the longer radio wavelengths. Atmospheric attenuation limits the quality of detectable energy to the certain wavelengths. ...for wavelengths longer than 3 microns, emission rather than reflection is measured.

The atmosphere is virtually transparent to 1R energy in the 3.5 to 5.5 and 8 to 14 micron ranges. To detect this emitted energy, rather exotic super-cooled alloys and mixtures of rare elements are required such as in a linescane system. The 'linescanner' contains a unique optical system, composed of a rotating mirror and additional folding mirrors. A sensor (detector) is placed in the prime focus of the optical system so that 1R energy from the part of the scene in the view of that mirror is focussed onto it as the rotating mirror scans the scene below [Fig. 24]. Sensor output is usually recorded on magnetic tape for subsequent processing by computer or special printer. The geometry of the system is such that the forward motion of the aircraft coincides with the successive scans of the rotating mirror, and the scene is examined one line at a time, as shown in [Fig. 25].

A plant or a stand of plants radiates infrared energy according to the fourth power of the absolute temperature. The amount of energy flow between the plant and its environment affects the plant temperature. Three basic

processes (solar and thermal radiation, free and forced convection, and transpiration) contribute to the energy budget of a plant and affect the plant temperature.

When a plant experiences a chemical surplus or deficiency, insect damage, disease, moisture stress, heat stress or other abnormality, the optical properties of the leaf change, and also the leaf temperature relation to the incident energy absorbed and to the transpiration rate. Any abnormality which affects its absorptivity to incident sunlight will affect the energy budget and hence the leaf temperature. A change in chemical composition of the leaf may affect the mesophyll or stomatal development; thus the transpiration rate is affected and hence the leaf temperature. Temperature changes as small as 0.5°C can be detected with the thermal infrared linscanner; by comparing imagery with a 'normal' plant response (either visually or by machine processing), incipient stress of many types can be detected in a plant stand.

Linescanning and photography produce completely different kinds of information, so a careful choice between these techniques must be made. Many kinds of environmental stress which are discernible with a linescanner cannot be recorded on film. Under other conditions, FCIR [False colour Infrared] or other films can provide the data required (J. Crowley, pers. comm., 1975). Interpretation. Since thermal infrared imagery can be transferred from data tapes to a standard photographic film, there is an immediate attempt on the part of the interpreters to compare infrared imagery with visual photography. Such a move can bias interpretative results. The interpreter has to be aware that data recorded on the tapes is based on thermal radiation emittance characteristics of surfaces instead of their light reflective photographic qualities. As such the amount of infrared energy transmitted is proportional to the object's emissivity and temperature (Avery 1970: 145).

Figures 26 through 31 are positive prints made from thermal infrared imagery acquired at Rocky Mountain House National Historic Park in the early afternoon of 27 August 1975. These images present information obtainable at maximum surface temperatures. Because of the poor quality of the imagery from the early morning overflight (minimum surface temperatures), positive prints have not been reproduced. It was believed that if surface disturbance, i.e., due to historic feature construction, was sufficient to be detected thermally, the chances of detecting a resultant thermal anomaly would be maximized at those times. Variations in soil temperature and their detection were of principle concern. Differences in plant infrared energy emittance was of less concern for the linescanning operation. In anticipation of the best results, the

linescanning was carried out after the fields were mowed and baled. In this manner vegetation cover would not significantly obscure soil temperature emittance qualities. With soil temperatures of importance the following theory is presented: A negative anomaly, such as a palisade trench, in all likelihood having differing soil texture and moisture retention qualities from its surrounding soil, will register on the thermal data tapes as a different tone. In reality

bodies of water have high capacities for storing heat. Water surfaces and moisture-laden areas heat up slowly during the day, and conversely release heat at a much slower rate during cooling (night) than the adjacent land (soils). Soils react more rapidly to temperature changes, heating up rapidly during the day and cooling off guickly at night. Areas of intense radiation are relatively light in tone (hot); those of relatively weak radiation are dark in tone (cold). In other words, surfaces warmed by the sun appear as relatively bright tones, therefore, during the warmest part of the day the dry soils will register lighter tones and moisture saturated soils will register as darker tones. In the case of a moisture-laden palisade trench (providing they exist at Rocky Mountain House) the feature would show up as contrasting linear dark tones at maximum daily temperature. During minimum daily temperature (early morning) the tonal display would be reversed because of the 'warmer' trench fill as opposed to the cooler surrounding soil.

Though the linescanning system worked properly and gave the researcher an appreciation of its capabilities, no positive site identification could be made. One major explanation can be cited - previous cultivation. It is believed that the 10-15 cm cultivation layer was deep enough to significantly skew the thermal infrared imagery. The layer essentially masked the underlying features by creating a relatively uniform temperature layer. Any temperature differences, however minor they may have been, could not be detected without more advanced technical manipulation of the imagery.

Soil texture-moisture qualities may not have been as ideal as would have been preferred for the linescanning operation at Rocky Mountain House. This aspect of the remote sensing reconnaissance may have been flown at the

wrong time of the year. July through September represents the driest season of the year. Moisture retention by the negative anomolies associated with a site would be minimized at that time and therefore, distinct temperature differences would be less detectable. Early spring, shortly after the snow cover disappeared in the area, would probably represent the best time to carry out the linescanning.

To take advantage of vegetation cover emittance characteristics it is suggested that additional overflights be carried out simultaneously with the two specific times for the multispectral reconnaissance. That is, in the spring when the grass has started to grow, and shortly before the grass is cut in late summer. Rigorous plant growth along palisade trenches and in depressions should be readily detectable with thermal infrared imagery.

It is believed that the flying altitude for the two thermal infrared imagery overflights (274-304 m A.G.L.) was suitable for archaeological purposes. Conclusions

After applying various forms of airborne sensors to Rocky Mountain House National Historic Park and interpreting the results certain points can be concluded. Such conclusions centre on scale, film/filter combination, and time of reconnaissance. Of the first the following can be said: small-scale photography and imagery provides a synoptic view for determining regional geomorphology and other environmental data, while large-scale photography and imagery is required for detailed analysis. Small-scale work can be applicable for grandiose archaeological surveys where hundreds of square miles are of concern, notably for making predictions on potential site locations after which ground verification becomes paramount. But again in this situation the interpretation of landforms becomes of prime importance for landforms are what determine site locations. Because archaeological sites are in general small, particularly in regards to prehistoric sites, large-scale must be considered over small-scale work if a more detailed study of an area and/or its individual sites is to be made. In fact, the scales will in most cases be so large that landforms and surrounding environs will be obscured. Therefore, it is suggested that when carrying out archaeological surveys and detailed site studies from the air various scales should be employed (depending on the nature and objectives of the work) ranging from small to large.

Film type is also of prime importance in airborne archaeological work. Though it did not come out and was not

as useful as expected in regard to the Rocky Mountain House, various film/filter combinations have proven to be useful on other studies. Panchromatic photographs do not show the subtle changes in vegetation cover and soils which often delineate sites. However, it must be noted that the panchromatic photographs range from a medium to small scale, therefore resolution can vary significantly and can be used appropriately. A specially flown large-scale series throughout the Rocky Mountain House area may have given other information not registered on the available small-scale photographs.

The low oblique black and white photograph showed what a combination of angle and altitude could produce. An oblique shot taken at a higher altitude would not have shown the detail exemplified in the 1966 photograph. However, in the latter just the right angle of the airborne sensor, the altitude of the sun, the proper time of the year, and variations in crop height all were such that they allowed for a permanent record of certain features related to the historic site to come to light. Again of principle concern were crop- and shadow-marks.

Though the results of the multispectral and thermal infrared imagery reconnaissance were not gratifying, the negative results did throw light on the capabilities of the system for archaeological site survey. These airborne surveys were considered of an experimental nature.

When carrying out research such as this many variables must be considered - soil types, moisture conditions, atmospheric conditions, vegetation cover, and cultural disturbances. In all likelihood, an ideal situation and time can never exist to give valid results.

In the final analysis it is suggested when applying remote sensors to archaeological research that certain points be considered. First, fully realize the capability

of the systems you wish to employ. There is not much use in using a more costly system over a less costly system when similar results can be given. Also the application of a certain system to a project may not give results in line with project aims. As an example, it would not be appropriate to use thermal infrared imagery for a large area survey for site location when conventional black and white photography would give better results.

Second, discuss in detail with the overflight contractor the environmental variables associated with the study area. Consider the soils, moisture, floral and cultural conditions which can directly influence results and interpretation. For example, a full understanding of how a soil type will register on the photograph or imagery is essential. The latter coupled with recent cultivation appeared to be of significance in regards to the thermal infrared imagery reconnaissance caried out at Rocky Mountain House. On the other hand, vegetation cover seemed to be the influencing factor pertaining to the multispectral work.

Third, determine the most appropriate flying altitude (large or small scale) for the work. Large area surveys in most cases are flown at high altitudes giving small scale photographs. Usually of concern here are landforms, their situation and conditions for possible site location. On the other hand when very small area surveys or individual sites are the subject of investigation, large scale reconnaissance is in order. For multispectral and thermal infrared imagery work flying altitudes of less than 300 m A.G.L. are suggested. If altitudes of between 150 m and 250 m A.G.L. are feasible the chances of obtaining better results are multiplied. However, it must be noted that the airborne platform (plane) has its limitations.

Finally, the time of the year airborne reconnaissance is carried out is very important for archaeological site

location purposes. This is of particular consequence when considering multispectral reconnaissance and thermal infrared linescanning. It has been suggested that the early spring would be an ideal time. Thermal linescanning can be carried out shortly after the snow cover has disappeared taking advantage of soil-moisture retention characteristics, and later on, once the grass has started to grow of thermal emittance by vegetation cover. Similarly overflights can be carried out in the late summer before the grass is removed or dies. Multispectral photography should take place in the early spring once the grass has appeared and again before the grass is cut. It is further suggested that for more valid results, more than one overflight be made using each system, i.e., at different times of the season. Many environmental factors come into play, therefore, the results of each overflight should be compared and interpreted concurrently for a better understanding of the study.

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Table 1.	Site 13R Ar	rtifact Freque	ency and Distr	ibution (14	Area Survey)
	Ceramics, G	Glass, Pipes,	Nails, Tools,	Hunting an	d Defence

ARTIFACT CATEGORIES	DISTR								JUTION						
	19C	19F	2	OC	_ 20	OF	21B	23A	2	9A	_ 31	A	100A		
		1	1	2		2	1 2	1	1	2	1	2	1		
CERAMICS White salt-glazed stoneware Creamware				2	1						1		1		
GLASS Olive green bottle glass fragment (liquor) Clear bottle glass fragment Phar. bottle fragments Window glass fragments		2		1	3	1	1		1			1			
SMOKING PIPES Stem Fragments Bowl Fragments			11 4	10 3	4 2	4		1	2 1	7	7 1	11	3		
NAILS Hand wrought (complete) Hand wrought (incomplete)	1 2	2	2	2 4	3 3	1 1	1		2 6	3 5	1	1 3	1		
TOOLS Flat bastard file fragment				1											
DEFENCE AND HUNTING Gunflints spall type blade type Musket balls				2	1	1			2	3 1 3		1	1		
Lead shot Clasp knife fragment Trigger fragment Jaw screw			1	14 1 1 1	ī	ĩ			4	22		-	1		
Serpent side plate Metal arrowpoints				-					1 1						
NOTE: 19C, 19F etc. represent natural soil layers.	test ex Lots 1 2	cavatio - cult - undi	on un ivati sturb	its (on la ed la	sub-o yer yer	opera (cul	ations). tural)	One (]) an	d 2 re	eprese	nt			

Table 2. Site 13R Artifact Frequency and Distribution (14R Area Survey) Personal Adornment

ARTIFACT CATEGORIES	DISTRIBUTION													8				
	19C	19D	20A	2	0C	2	OF	2	1B	22B	2	9A	3	AO				
	1	1	1	1	2	1	2	1	2	1	1	2	1	2				
PERSONAL ADORNMENT Small trade beads (various colours)	1	2	2	7	56	14	44	2		6	18	38	15	16				
BUTTONS												_						
Brass					-		-					1						
Lead and Iron					Ţ		T				1							
Pewter and Glass													1					
Silver brooch					1													
Tinkle cone											1			-				
Shoe buckle tine														1				
Charm (sneet tin-nole for						7												
Vermilion						1												
NOTE: 19C, 19D etc. represent to natural soil layers.	test ex Lots l	cavatio - cult	n unit ivation	s (s n la	ub-o yer	pera	tion	5).	One	(1) and	12 r	eprese	ent					
	2	– undi	sturbe	d la	yer	(cul	tura	L)										
All beads are tubular and	less t	nan 3 m	m in d	lame	eter.													

ARTIFACT CATEGORIES	DISTRIBUTION												
	19C	19F	20	C	2	OF	22B	24A	29A		30A		100A
	1	1	1	2	1	2	1	1	1	2	1	2	1
NATIVE INDUSTRIES Antler plug Worked antler tine				1					1				
Flakes Scraper-graver Sandstone sharpening tool	1					2				1		1	1
MISCELLANFOUS METALS													Ĩ
Tin finger grip for a tin cup	17					2			1	2			
Lead fragments	11		,	2	2	2	-		3	2			
Copper fragment with copper			T		2		T		Z				
pin (unidentifiable) Wire fragment		1											1
Iron fragments Sheet brass fragment				2	1 1	2			1	2	2	2	2
NOTE: 19C, 19F etc. represent natural soil layers.	test Lots	excavatio 1 - cu 2 - uno	on ur ltiva distu	nits atio urbe	(s n 1 d 1	ub-op ayer ayer	erations (cultural). One 1)	(1)	and	2 re	eprese	ent

Table 3. Site 13R Artifact Frequency and Distribution (14R Area Survey) Native Industries and Miscellaneous Metals

ARTIFACT	CATEGORIES				DISTRIBUTION																
		19C	19D	19E	E 20A	2	0C	C 20F		21A	21	В	22A	22B	22D	23A	23B	2	9A	30	A
						1	2	1	2		1	2						1	2	1	2
FAUNAL R Bison bo Deer Dog or W	EMAINS ne fragments olf	12	10		1	14	89		85	15	2	4	7	7	3	1	1	15 1	70 2 5	10	1
Beaver Fresh wa Unidenti Unidenti	ter clam fiable mammal fiable bird	3			2	1 6 1	17		8			1					3				
TEETH Bison Beaver Bear Unidenti	fiable Mammal	1 3	4				5		4		4									1	1
NOTE: 1 n	9C, 19D, etc. atural soil la	represen yers.	t test Lots	excav 3 1 - 2 -	ation culti undis	uni vati turb	ts (on 1 ed 1	sub aye aye	-oper r r (cu	ation ultura	s). 1)	One	e (l) a	ind 2 r	eprese	nt					

Table 4. Site 13R Artifact Frequency and Distribution (14R Area Survey) Faunal Remains 1 Historic site locations within Rocky Mountain House National Historic Park.

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* IDENTIFICATION NOT CONFIRMED

2 Archaeological Master Grid, Rocky Mountain House National Historic Park.



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3 1966 low oblique black and white aerial photograph, looking south, of sites 15R, 1R and 16R: palisade lines and depressions of site 15R highlighted by crop and shadow marks (foreground); site 1R during excavation (centre), and site 16R ("Old Brierley Farm" in background). Photo catalogue number: 1R-241M.



- 4 Area priority classification for testing and general ground survey.
 - H High priority zones
 - M Moderate priority zones
 - L Low priority zones

15R Archaeological Site, Rocky Mountain National Historic Park boundaries. National Air Photo Library Photos: A23902 - 3 and 4, 20 September 1974. 2286.0 m A.G.L.



5 Archaeological survey sectors Rocky Mountain House National Historic Park.

Sector	Location	Sites
A	South section of park	13R
В	South-central section	
	of park	16R
С	North-central section	
	of park	lR
D	North section of park	15R, 17R
Е	Southwest of park	
F	Northeast of park	



* IDENTIFICATION NOT CONFIRMED

6 14R Area Survey. Southwest corner of Rocky Mountain House National Historic Park.



7 Site 13R test excavation units (14R Area Survey) LEGEND

Limits of 1963 excavations

20A Test excavation units (1975) 14R Area Survey baseline Fence

Tables 1-4 should be consulted for artifacts recovered from each of the sub-operations indicated. All sub-operations and associated artifacts were assigned 14R Area Survey numbers.



Metres

8 Plan of site 16R archaeological remains as revealed during preliminary excavations in 1975.


9 Plan of the northwest corner bastion and portions of the north, north interior and west palisades, site 16R. LEGEND

	Post
	Ash
	Wood
	Posthole
	Stone
	Palisade and bastion builder's trenches
	(unexcavated)
	Palisade builder's trench (excavated)
	Corner of 3 m by 3 m sub-operation
	Limits of excavation
16R16G	Sub-operation
	True north



10 Plan of archaeological remains associated with building 1, site 16R, showing north basal sill, three cellar depressions, two fireplaces and flooring remnants. LEGEND

	Wood
	Post
	Stone
	Posthole
	Cellar depression
	Soil Colour changes
16R10J	Sub-operation
	Corner of 3 m x 3 m sub-operation
	Limits of excavation
	Palisade builder's trench (North interior and
	west lines)
	True north



11 Plan of archaeological remains associate with building 2, site 16R, showing the south basal sill, a fireplace, a partially exposed cellar depression and flooring remnants. Also showing are portions of the west and south palisades. LEGEND

Wood Post Stone Cellar depression Soil colour changes 16R2F Sub-operation Corner of 3 m x 3 m sub-operation Limits of excavation Palisade builder's trench True north



12 Plan of site 15R archaeological remains as revealed during preliminary excavations in 1975.



13 Hudson's Bay Company Land Department plan of the company reserve at Rocky Mountain House, ca. 1915, indicating ruins at location of site 1R ("H.B. Co. Ruins") and downstream of site 1R ("Rocky Mountain House Ruins"), in southeast corner of the reserve. Original source of plan was Hudson's Bay Company (Winnipeg): copy on file in back correspondence files, National Historic Parks and Sites Branch, Parks Canada.



14 Conventional small scale black and white aerial photograph showing the town of Rocky Mountain House (A) and the national park (B). The photograph shows the value of its scale for presenting a synoptic view of the survey and surrounding areas. However, it is of little value for detailed site location. National Air Photo Library photograph: All118-114, September 1947; 5120.7 m A.G.L.



- 15 Conventional black and white aerial photograph showing sites 15R and 1R prior to excavation. Details of site remains are not indicated. National Air Photo Library photograph: A18576-35, September 1965, 548.7 m A.G.L. LEGEND
 - A Site 15R
 - B Site 1R



- 16 Conventional black and white aerial photograph showing the excavated remains of site 13R and site 16R, the "Old Brierley Farmyard." National Air Photo Library photograph: A18576-63. September 1965, 548.7 m A.G.L. LEGEND
 - A Site 13R
 - B Site 16R



17 1951 black and white aerial photograph showing soil-moisture patterning where the Seafort Gas Plant was subsequently located (see A). The irregularity of the patterning and test excavations in the area identified the occurrence as natural. Also indicated on the photograph are the locations of sites 13R and 15R. Scale - 1:15,840 Department of Energy and Natural Resources photograph (AS 529 5216 36).



18 1951 black and white aerial photograph (enlargement) showing soil-moisture patterning where the Seafort Gas Plant was subsequently located (see A). Department of Energy, Mines and Natural Resources photograph (AS 529 5216 36).



19 Standard filter configuration for a 1²S Multispectral Aerial Camera. Source: J. Crowley, pers. comm. 1975.



- 20 Infrared black and white aerial photograph of site 16R (farmyard) and site 13R, September 1975. Observed features verified by terrestial observation:
 - A. Freshly cut grass (open field)
 - B. Freshly cut grass (site 16R)
 - C. Mature and uncut grasses
 - D. Coniferous vegetation
 - E. Deciduous vegetation
 - F. Meander scar
 - G. Water
 - H. Site 13R



21 Infrared black and white aerial photograph of site 16R (enlargement).



- 22 Infrared black and white aerial photograph showing site 15R during excavation. September 1975. LEGEND
 - A Site 15R
 - B Site 1R
 - C Site 17R (Seafort Burials)
 - D Recent survey cut lines (site 15R)
 - E Meander Scar
 - F Buried pipelines
 - G Site 15R spoil pile



23 Infrared black and white aerial photograph (enlargement) showing site 15R during excavation. September 1975.



24 Essential components of a linescan system. Source: J. Crowley, pers. comm., 1975.



25 Typical linescanner geometry. Source: J. Crowley, pers. comm., 1975.



- 26 Thermal infrared imagery (positive print) Location: Sector A (see figure 5) LEGEND
 - A Site 13R
 - B Test excavation units situated throughout area
 (white dots)


- 27 Thermal infrared imagery (positive print) Location: Sector B (see figure 5) LEGEND
 - A Site 16R excavations ("Old Brierley Farmyard")
 - B Uncut grass-covered field (dark tone)
 - C Cut hay fields (grey tone)
 - D "Hot spots" (white roofs and slopes facing sun)
 - E Recent cut line (14R Area Survey baseline)



- 28 Thermal infrared imagery (positive print) Location: Sector C (see figure 5) LEGEND
 - A Site 1R
 - B Recent cut lines (14R Area Survey baseline)
 - C Man-made river cobble berm
 - D Dirt piles
 - E North Saskatchewan River



29 Thermal infrared imagery (positive print)
Location: Sector D
LEGEND
A Site 15R Excavation Units



30 Thermal infrared imagery (positive print) Location: Sector D (see figure 5) LEGEND

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A Open field east of site 15R

B Seafort Gas Plant



- 31 Thermal infrared imagery (positive print) Location: Sector D (see figure 5) LEGEND
 - A Seafort Gas Plant
 - B Site 17R (burials)
 - C Buried gas pipelines



