

the participating nations. We do not have any conflicts, because the geophysicist is inevitably international—he cannot operate on any other basis; and all considerations other than purely scientific are laid aside as we go ahead and cooperate in this program.

Civilization does evolve largely on the basis of precedents, and it is my hope that this extra-curricular quality of the International Geophysical Year, this wonderful cooperation, will result in further working together of nations in other areas.

*History from the Air**

H. L. CAMERON,

*Head, Photogrammetry Division,
Nova Scotia Research Foundation,
Halifax, Nova Scotia*

ABSTRACT: Nova Scotia was the scene of the earliest attempts at settlement in Canada. It was also the locale of the decisive campaign fought between the French and English for the supremacy of the continent. It is rich in historic sites, many of which are known and marked, but about which little is known in the physical sense. Some restoration has been done but much remains to be accomplished. The present paper deals with the air photography, photo interpretation and preparation of maps by photogrammetric methods, of some of these sites. Grand Pré, the Champlain Habitation area, and Old Louisburg have been mapped. Examples of the standard annotated photos and maps of the three areas are given. At Louisburg, standard medium-altitude black and white, low level Sonne, and medium-altitude infra-red photography were used, respectively, for control, for surface detail, and for sub-surface detail. Photo interpretation of shallow water areas led to skin diving operations which produced interesting relics of ships sunk during the final siege of Louisburg. This research work is being continued. The method is suggested for all historic sites.

INTRODUCTION

AFTER the preliminary period of exploration and skirmishing, the history of eastern North America is resolved into a struggle between England and France for the domination of what was to become Canada and the United States. The struggle was complicated by the fact that European statesmen considered the wars as mere extensions of the European struggle and were prone to trade large pieces of the New World, of unknown value, for small areas in Europe, often of only sentimental value. Louisburg, for example, was captured by a New England expedition in 1745, but was returned to France by treaty.

The French Acadian settlers weathered a number of changes of sovereignty, but were finally expelled in 1755. The repercussions of these events were both immediate and long term, with echoes being heard to the present day.

The Nova Scotia-New Brunswick area, the Acadia of the French settlers, is rich in historic sites connected with the struggle for domination. The better known sites are shown in Figure 1. At Lower Granville, near Digby, Samuel De Champlain built his "Habitation," or fortified farm house, in 1605. This was the first permanent settlement attempted by white men north of the Gulf of Mexico. A few

* Published with the permission of the Nova Scotia Research Foundation. With substantially the same contents, this paper was read at the 24th Annual Meeting.



H. L. CAMERON

miles up the Annapolis River the French built a fort at Port Royal; this Fort was captured in 1710 and renamed Annapolis Royal in honor of the reigning monarch. At Windsor the English built Fort Edward to keep guard on the Acadians at Grand Pré, where diked meadows lay below a village on the slopes above Minas Basin. Forts Beauséjour and Lawrence fronted one another across the marshes of Chignecto, while at Canso lay the ruins of a fort built to protect English fishermen from French privateers, long before Halifax was founded in 1749.

Most historic of all, Louisburg lay at the mouth of Louisburg Harbour, on the southeast coast of Cape Breton or Isle Royale. Built by the French as a base and bastion against British sea power after the loss of the mainland of Nova Scotia in

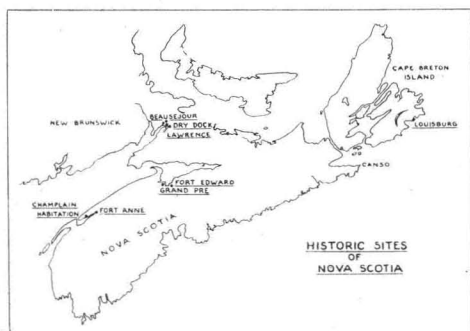


FIG. 1. Historic Sites of Nova Scotia.

1713, it was first captured in 1745 by a New England Expedition under William Pepperell. Given back to France by treaty, it was taken again in 1758 by an expedition under General Amherst and later razed to the ground to prevent any future use by the French. Here was the real fall of French Canada, for it was inevitable that Quebec and the rest of the country should fall after the main naval and military base was captured. Here, too, were sown some of the seeds of revolution which broke out eighteen years later. The New England men had taken the place once, only to see it returned to France. They fought again in 1758 and bore a major share in the final capture. Then they were left to rot in garrison, while the Navy got the meagre prize money and the Regulars went on to greater glory at Quebec. The English cemetery bears mute witness to their casualties from attack and disease—it is as large as that of the French, who occupied the place for forty years.

A veil is drawn over the ramparts which guard Halifax. The largest and strongest of the Citadels was completed in 1805 to guard us—awful thought—from the Americans!

PHOTOGRAPHY

In 1951 a preliminary map of Grand Pré was made from R.C.A.F.—1"=1,320' photos. The possibilities demonstrated by this work led to very detailed experimental photography of Old Louisburg by the R.C.A.F. Central Experimental and Proving Establishment, in May 1953. This included black and white coverage at 1"=500' for control; black and white Sonne stereo photography at 1"=100' for surface detail, and infra-red 1"=250' for subsurface features, if present. It is of interest that this is, as far as the author knows, one of the first attempts anywhere to obtain Sonne coverage of an area by laterally overlapping strips. Special thanks are due to W/C J. A. E. Schwartz and S/L D. McKee of the R.C.A.F., who took a great interest in this experiment.

In 1954 conventional black and white coverage at 1"=400' was obtained at Grand Pré by the Nova Scotia Research Foundation.

The R.C.A.F. Maritime Command re-photographed the Champlain Habitation and Fort Anne in 1955 as a practice exercise.

In September 1956 the R.C.A.F. re-photographed a number of sites using infra-red film, but, due to an unfortunate misunderstanding, the scale was quite small. Despite the small scale, a number of new details have been noted at Grand Pré, Fort Beauséjour and Fort Lawrence. This work was done at the request of the Historic Sites Division, National Parks Branch, Department of Northern Affairs and Natural Resources, Ottawa. It is hoped to have this work repeated at a scale of $1'' = 500'$.

A large number of terrestrial photos have been taken of various features seen in the air photographs. A number of them are given in the illustrations which follow.

The aerial photography was mainly standard in techniques. The infra-red camera had a specially calibrated lens and was used without a filter. This was some of the most interesting photography as sub-surface details were revealed in a number of places. The Sonne was fitted with an 88 mm. stereo cone and Super XX Aero-graphic film was used. The detail, as in most Sonne, is very clear, and it is no

exaggeration to say that every stone in the old city is visible.

The photographic aircraft was a modified Mitchell bomber and the whole *Operation Historic* was admirably carried out under the command of F/L (now S/L) F. Fisher, R.C.A.F. One of the amusing sidelights of the operation was a trip down a sub-sea coal mine in the Sydney area, undertaken while awaiting photographic weather. After seeing the R.C.A.F. badges, one open mouthed miner was heard to mutter, "You boys are really flying low."

CARTOGRAPHY

From the photo coverage just described, maps were prepared of the Habitation area, Grand Pré and Old Louisburg. These are shown in Figures 2, 3, and 4.

An annotated photograph of the Champlain area is shown in Figure 5. The replica of the Habitation was constructed on the site of the original, which was discovered by careful trenching.

The most interesting section of Grand Pré is illustrated in Figure 6. The Memorial Park, the first dike built by the Aca-

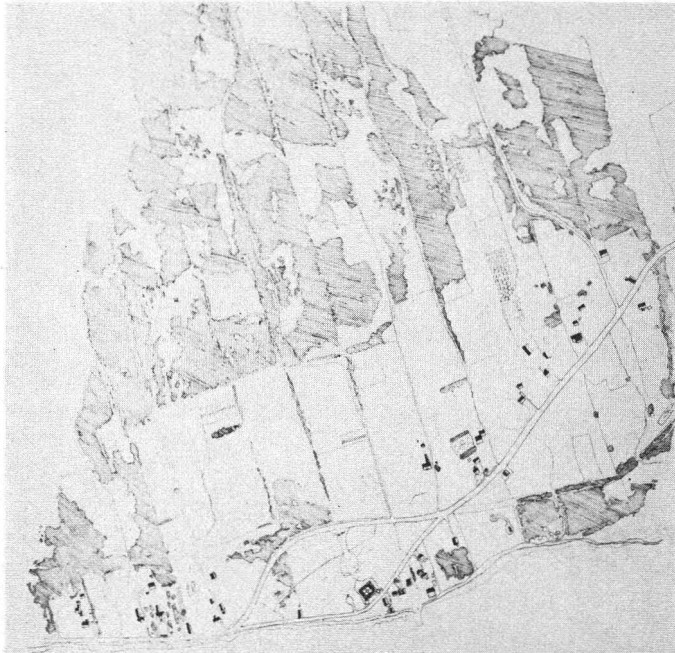


FIG. 2. Port Royal Habitation Site. Lower Granville, Nova Scotia. Prepared by Photogrammetry Division, Nova Scotia Research Foundation. Constructed by photogrammetric methods from R.C.A.F. (Eastern Command) Photographs (1955) June 30, 1956. Scale $1'' = 200'$. Max Sutherland.



FIG. 3. Grand Pré Area, Nova Scotia. Scale $1'' = 660'$. Compiled and drawn by Photogrammetry Division, Nova Scotia Research Foundation from aerial photographs taken for Forest Inventory—1955. Airphoto interpretation by H. L. Cameron, Cartography by Helen Stein. 1956.

dians, and the probable site of the old village are all shown in one photograph.

Fort Anne is shown in Figure 7. This stereo pair gives an idea of the vertical dimensions of these fortifications.

A stereo pair of Fort Beauséjour is shown in Figure 8. The method of attacking a fortress by parallels is illustrated here.

As befitting its importance, Louisburg has received the most attention and has revealed the most detail. Figure 9 illustrates the general area, with main points of interest marked.

From the extensive photography of Louisburg the map (Figure 4) was constructed. A radial plot was first made and then checked against a projector enlarged

OLD LOUISBURG, CAPE BRETON ISLAND
NOVA SCOTIA

CONSTRUCTED BY PHOTOGRAMMETRIC METHODS
FROM SONNÉ PHOTOGRAPHY BY R.C.A.F. 1953

ORIGINAL SCALE $1'' = 250'$
PHOTOGRAMMETRY DIVISION
N.S.R.F.

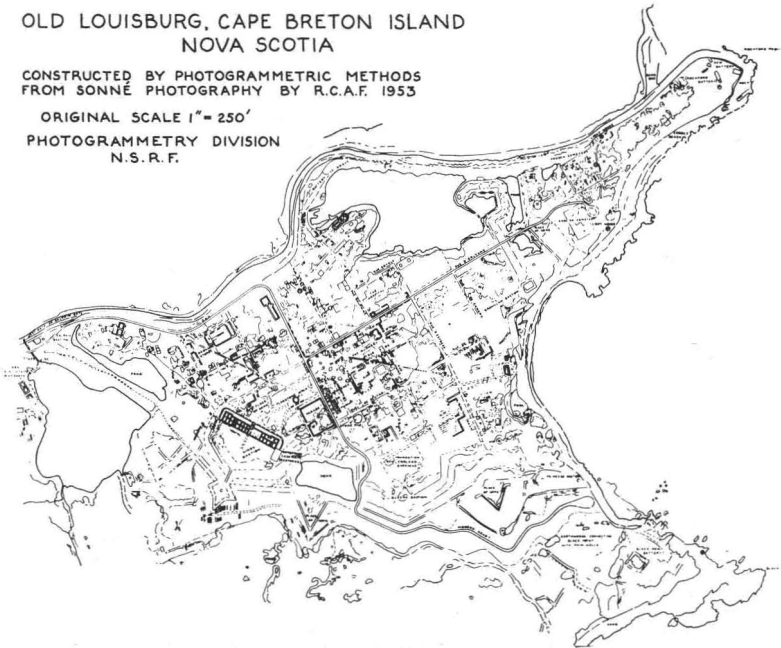


FIG. 4

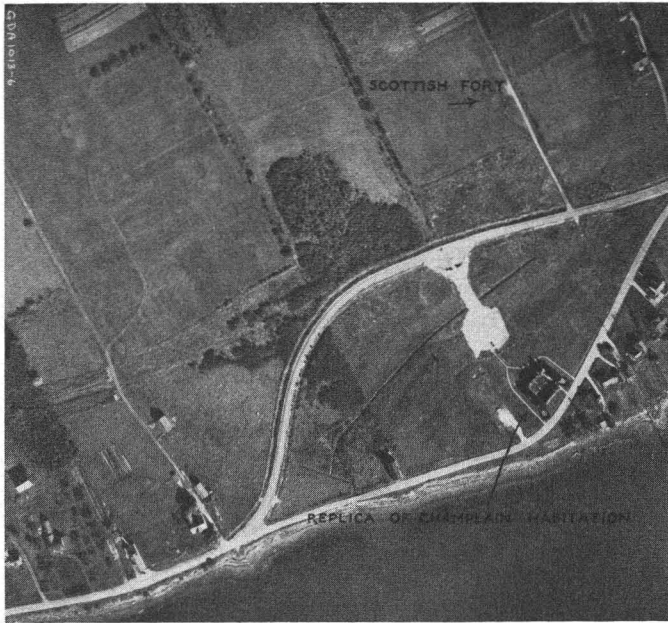


FIG. 5. Airphoto showing full size replica of Champlain Habitation and other features, Lower Granville, Nova Scotia. R.C.A.F. Photo.

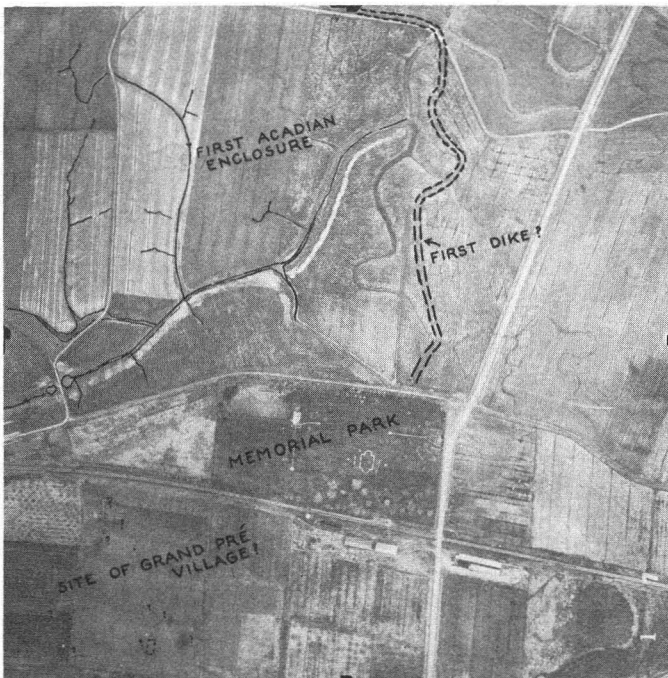


FIG. 6. Grand Pré Area, showing Memorial Park and traces of Acadian French Occupation. Nova Scotia Research Foundation Photo.

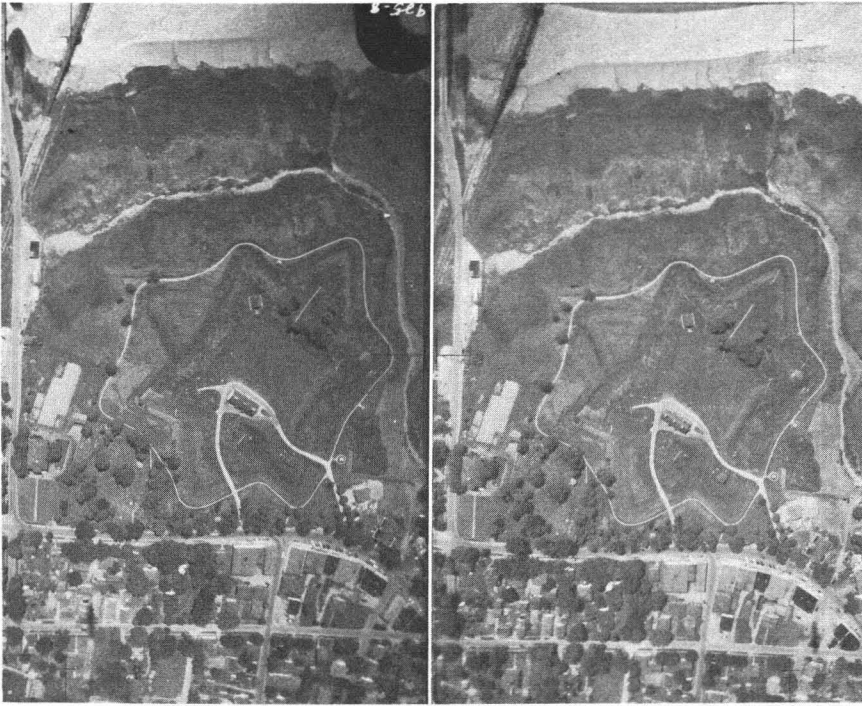


FIG. 7. Stereo photos of Fort Anne, Annapolis Royal, Nova Scotia. R.C.A.F. Photos.

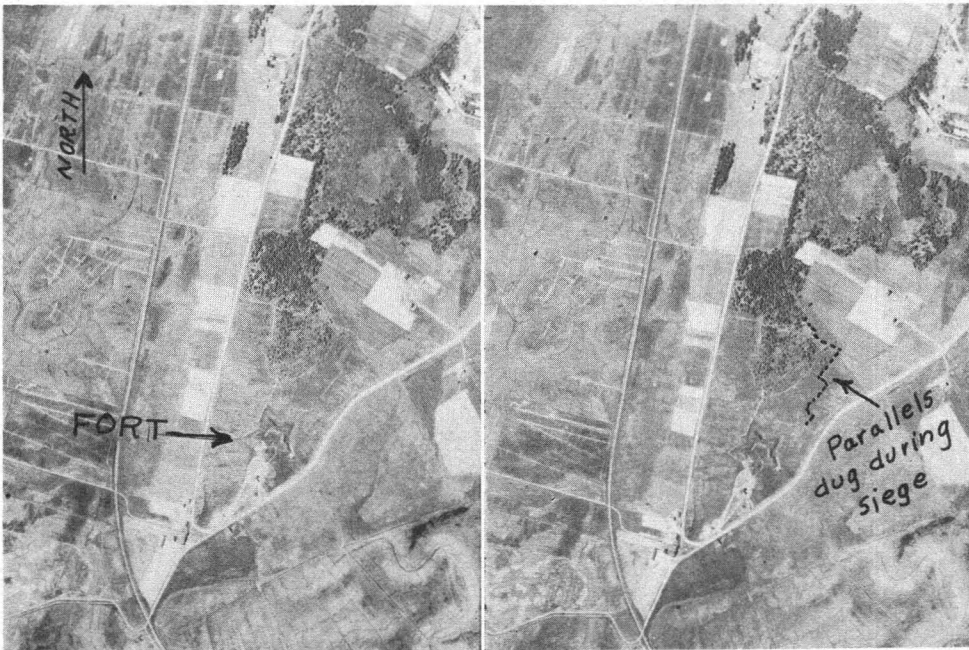


FIG. 8. Fort Beauséjour, New Brunswick. Note laterals and parallels dug during siege of 1755 by Colonel Monceton. R.C.A.F. Photos.

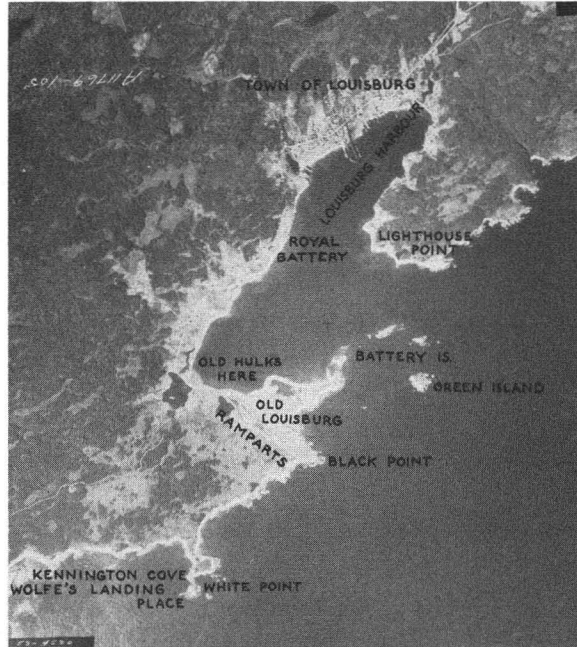


FIG. 9. General area of Louisburg, showing harbour and old and new towns. Gov. of Nova Scotia Photos.

tracing of one photo which covered the main area of the old city. Because of the relative flatness of the terrain, it was found that the two plots checked very closely, so to simplify plotting detail from the Sonne strips, a detailed tracing of the $1"=500'$ photo was made at a scale of $1"=250'$. On this plot the Sonne stereo pairs were superimposed by Multiscope and any correc-

tions for altitude terrain, or tilt, were made. In order to use the Sonne photos with conventional mirror stereoscopes and the Multiscope, they were printed in 10" length on 9" wide paper and cut apart for viewing.¹ Two stereo pairs of the central

¹ "The Use of Aerial Photography in Seaweed Surveys," H. L. Cameron, PHOTOGRAMMETRIC ENGINEERING, Vol. XVI, No. 4, Sept. 1950.

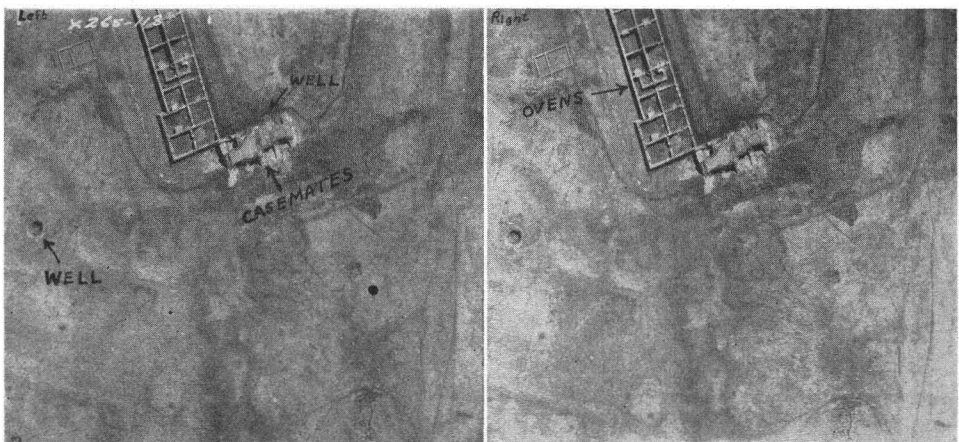


FIG. 10. Sonné stereo pair, Louisburg, showing ruined casemates and partially restored foundations of Citadel. Note ovens with rounded tops and grating over well near casemates. R.C.A.F. Photos.

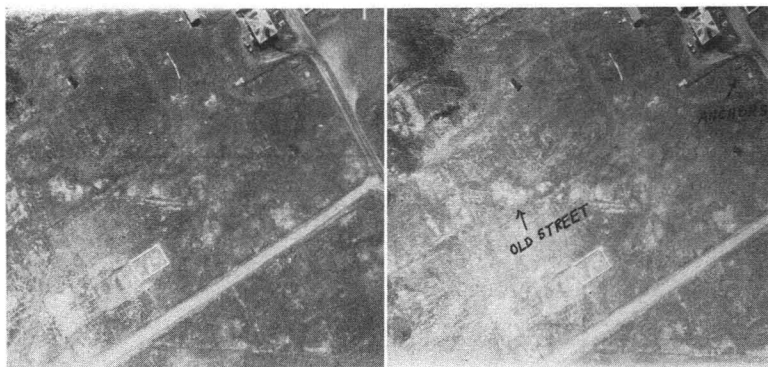


FIG. 11. Sonné Stereo pair, Louisburg, showing general topography of old city. Note anchors beside Museum residence, old street lines and unrestored foundations. R.C.A.F. Photos.

section of Louisburg are given in Figures 10 and 11. Even in the printed reproduction there can be clearly seen such details as the anchors outside the museum and the ovens in the central section of the Citadel, whose foundation has been partially restored. The ruined casemates are conspicuous with their well for water supply. In the original Sonne prints the modern barred grating can be seen to have nine bars.

The infra-red photos proved excellent for mapping subsurface detail, such as buried foundation walls and other objects under the turf. One particularly interesting detail is shown in Figure 12. It is the ring, or annulus, just northwest of the parade ground. Study of the Sonne photos of the same area revealed no trace of this mark, so a small "dig" was made to check it. At depths ranging from 12 to 16 inches hammer-trimmed flat stones were found which

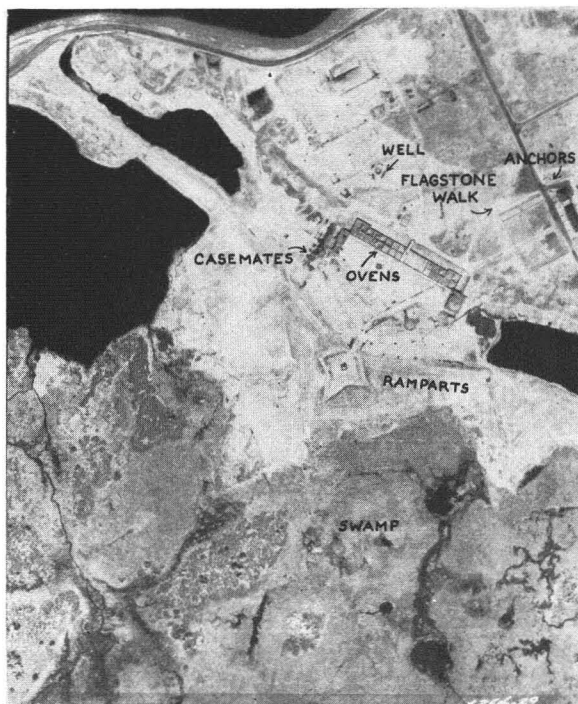


FIG. 12. Infra-red photo of Louisburg. Subsurface detail revealed by this photo have been checked and flat hammer trimmed paving stones were found at the ring site. R.C.A.F. Photo.



FIG. 13. Old Field Walls or Stone Fences first seen in air photos and later identified on the ground. Nova Scotia Research Foundation Photo.

are believed to be part of a circular garden walk in the Governor's garden. The infrared was unkind to modern restorers when it revealed that the wall rebuilt around the Parade Ground is not in its former location. This, and many other details are shown in the map of Louisburg.

Ground details outside the old fortress are shown in Figures 13 and 14. In Figure 13 old stone field walls are shown. These are the low stone fences built by the French fishermen—farmers in the process of clearing their garden plots. These were first seen in the air photos and were identified and photographed on the ground. The foundations of the Royal Battery are shown in Figure 14. These had lain masked by beach debris for decades, when Hurricane Edna blew through in 1954. This big

wind eventually blew some good by creating a heavy surf which cleared away the beach rubble, revealing the massiveness and extent of this work.

Stereoscopic examination of the harbour gave bottom features which did not appear to be either rock or seaweed. Two areas in particular in the southwest corner were noted and were later explored by skin diving. The second attempt yielded the old wrought iron chain shown in Figure 15. It was heavily encrusted with *lithothamnion*, a lime-secreting algae. It was first thought to be a small anchor chain, but it is now considered more likely that it is a piece of the standing rigging from one of the three ships known to have been captured and burned in this section of the harbour. They were taken by an English cutting out



FIG. 14. Foundations of Royal Battery, Louisburg, revealed by heavy surf scour created by Hurricane Edna, 1954. Nova Scotia Research Foundation Photo.

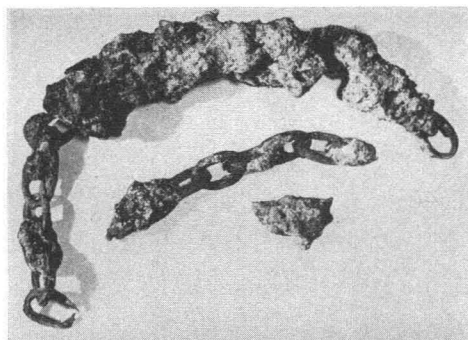


FIG. 15. Wrought iron chain recovered from Louisburg Harbour. Believed to be part of standing rigging of ship sunk during second siege. Nova Scotia Research Foundation Photo.

party, but were burned when they were found to be aground owing to delay in the attack. The open link on the left in Figure 15 was submitted to a variety of tests by the Department of Engineering and Metallurgy of the Ontario Research Foundation. The results are very striking and are briefly tabulated.

1. From the rate of corrosion of wrought iron in salt water, the chain has been underwater for over one hundred years. (If it is part of a ship sunk during the siege, it had been underwater for 196 years before being recovered.)
2. The chain is a good grade of wrought iron and the links were hand welded. Photomicrographs reveal the grain and slag.
3. Chemical analysis gave: carbon .12 per cent, phosphorus .21 per cent, manganese .04 per cent. The high phosphorus indicates an European origin rather than Canadian or Scandinavian.
4. X-ray spectroscopic analysis of residual alloys gave a very small trace of chromium and no titanium. This

eliminates Canada as a source of the metal between 1750-1800.

5. X-ray spectroscopic analysis showed no vanadium. This eliminates Scandinavia as a source.
6. Comparison of slag inclusions with European wrought iron slags makes it appear that the iron ore came from Lorraine or the Saar. The slag minerals under sensitive tint lighting appear more likely to have originated from ores in this region than from ores being worked in England, France or Germany at the end of the 18th century.

These scientific tests offer practically complete confirmation of the age and origin of the chain. We need only quote a remark by a European metallurgist, who sourly commented that considering the excessive slag content, the chain was probably made in France!

This research work is being continued by the Nova Scotia Research Foundation. It is hoped that new infra-red and Sonne coverage of all the historic sites in Nova Scotia will be obtained and the map series on them completed.

It is suggested that similar work should be carried out on all known historic sites before they are further disturbed by diggers, amateur or professional.

REFERENCES

- Cameron, H. L. 1954. "New Maps of Historic Sites in Nova Scotia." *Trans. Roy. Soc. Can.*, Series III, Vol. XLVIII, Section 11, pp. 59-64.
- Cameron, H. L. 1956. "Nova Scotia Historic Sites." *Trans. Roy. Soc. Can.*, Series III, Vol. L, Section 11, pp. 1-7.
- Cameron, H. L. 1950. "The Use of Aerial Photography in Seaweed Surveys," *PHOTOGRAMMETRIC ENGINEERING*, Sept. 1950.
- Bradford, John. 1957. *Ancient Landscapes*, G. Bell and Sons Ltd., London.