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Technical Report No. 6

A SELECTIVE ESSAY KEY FOR THE PHOTOIDENTIFICATION OF COASTAL FEATURES AND ASSOCIATED SETTLEMENT PATTERNS IN A GLACIATED NEW ENGLAND REGION

By

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CHAPTER 1

THE AREAS SELECTED FOR STUDY

Location of the Three Areas

During the summer of 1952 the authors studied three coastal areas in New England. Their objectives were (1) to analyze the associations of coastal features characteristic of a glaciated region of moderate relief embodying both bedrock and unconsolidated subsurface materials, and to devise means for recognizing such associations from their appearance in stereopairs of aerial photos, and (2) to identify types of settlements and specific settlement features in such areas and to recognize significant areal relationships between them and the dominant coastal features. The report, as here presented, not only is a study in aerial photographic identification; it is also a study in the coastal geography of three selected areas of New England. The three areas selected were (1) the western portion of Cape Cod between Hyannis and the Cape Cod Canal, and the adjacent west shore of Cape Cod Bay as far north as Plymouth; (2) the Rockport and Gloucester areas on Cape Ann Peninsula in northeastern Massachusetts together with the nearby mainland coast on both the southwest and the northwest; and (3) the rocky coast of Maine from Rockland northward past Camden.

The areas selected represent several associations of coastal features. Cape Cod consists of rough sandy glacial moraine bordered on the south by pitted outwash plain and on the north by lower rolling moraine of considerable irregularity associated with limited areas of low outwash plain. The south shore of the Cape here is developed on outwash plain and is marked by many small but no major indentations. The north shore, on the contrary, includes large embayments and salt marshes and extensive dune areas associated with spits and beaches. The area between Cape Cod Canal and Plymouth is characterized by high cliffs, rising above bouldery beaches and developed by wave erosion on an area of high glacial moraine and high pitted outwash plain. No bedrock crops out in the Cape Cod and Plymouth areas, which will be called in this report the Cape Cod area.

The Cape Ann peninsula and vicinity will be referred to as the Rockport area in this report. Cape Ann is a rocky promontory which forms part of an irregular embayed coastline. Boulder and sand beaches have developed across small bays and coves and two extensive sand dune areas have been formed along with many beaches and spits.

The area in Maine, referred to in this report as the Camden area, has an irregular embayed coastline controlled by bedrock. Relief inland is greater than in the Rockport area. Relatively thin glacial drift overlies the bedrock and has contributed the materials for extensive beaches of boulders, gravel, and sand. Practically no

sand spits or dunes have been developed within the Camden area.

The three areas present interesting contrasts in physical conditions, access to their interior or hinterland regions, and types of settlement.

The Physiographic Development of Areas Selected for Study and Resulting Landform Types

With respect to its origin and development the New England coastline has counterparts in other regions of the world, particularly northern Europe and Eastern Asia (see map, page 88). An understanding of the present features and development of the New England coastline, therefore, serves to illustrate the development of similar coastlines elsewhere. The underlying materials and surface features of coastal New England were modified first by glacial action, and later by processes of shoreline development, so as to give certain characteristic associations of shoreline features. One purpose of this report is to identify and explain the characteristic associations of such shoreline features in an area of this type.

Physical Development of Coastal New England

The underlying bedrock of the New England coastline consists of various resistant rock types, mainly crystalline. Before the glacial period, stream erosion had probably made this a rough region of ridges, hills and valleys of moderate relief. The continental glaciers advanced across New England from the north and northwest, probably more

than once. The glacier scoured and rounded the resistant bedrock hills, gouged some valleys deeper, and distributed a sheet of glacial drift of varying thickness over the scoured area. At places such drift deposits filled valleys and locally reduced the relief. At other places drift hills were built to moderate heights and locally increased the relief. In many areas the drift was thin or absent and failed to conceal the rugged bedrock below. Thus, even after glaciation the New England area remained relatively rough in many places. In a few areas drift deposits were thick enough to conceal all bedrock and to produce a landscape due solely to glacial action. Such an area was Cape Cod. A high rugged moraine of glacial drift -- the Ellisville moraine[1] -- extends southward along the west side of Cape Cod Bay almost to Cape Cod Canal (see map, page 87). At two places Ellisville moraine is interrupted by areas of high irregular pitted outwash plain almost morainal in appearance but lacking the huge boulders found in true moraine. Just west of Cape Cod Canal begins the Sandwich high rough moraine which extends eastward through southern Cape Cod as a high irregular wooded ridge just north of its center. At the west, another rough high morainal ridge -- the Buzzards Bay

[1]See Mather, Goldthwait and Thiesmayer, Preliminary Report on the Geology of Western Cape Cod, Massachusetts: Mass. Dept. of Pub. Works and U. S. Geological Survey, Cooperative Geologic Project, Bull. No. 2, 1940.

moraine -- diverges from the Sandwich moraine and extends southwestward to form the Falmouth peninsula. Sloping south from the Sandwich moraine and extending into the reentrant between it and the Buzzards Bay moraine is the Mashpee high pitted outwash plain, deposited by meltwaters carrying sand and gravel away from the glacial margin while it was building the two moraines nearby. Although some parts of the Mashpee outwash plain are flat, there are numerous pits containing lakes or bogs that were formed by the melting of buried ice blocks beneath the sand and gravel. Stream channels across this plain add to the complexity of its surface features, and where drowned by the sea at the south, form estuaries. North of the high Sandwich moraine, several tracts of lower rolling moraine -- the Scorton moraine -- descend toward the shores of Cape Cod Bay. Several low flattish areas associated with the Scorton moraine are discontinuous remnants of a glacial outwash plain or plains of washed sand and gravel.

The irregular surface of bedrock, moraine, and outwash plain thus produced in New England was next subjected to partial inundation or drowning due to the rise of the ocean on the land. This submergence amounted to at least 200 feet in the north and was due in part to the final melting of the glacial icecaps and the restoration of their waters to the oceans. Such drowning submerged the irregular margins of the New England area and produced numerous shallow bays and estuaries. Examples of such

estuaries are Barnstable Harbor, Gloucester Harbor, Essex Bay, Rockland Harbor and Lewis Bay at Hyannis. North of the latitude of Boston such submergence has been in part opposed by post-glacial rise of the land itself. Evidence for such uplift consists of elevated marine terraces, deltas, and marine sediments. Such deposits were not sufficient to bury all irregularities on the marginal New England area formerly submerged by the sea, and even where the land has risen rather than sunk with respect to sea level, the coastline remains irregular and embayed.

Since sea level was stabilized near its present position, shore processes have developed the present coastal features on the margins of the glaciated land area. Exposed headlands have been attacked and trimmed back by wave action, a process abetted by wave refraction which tends to concentrate wave energy on projecting points of land. Such erosion has produced lines of bluffs in the weak glacial drift and in a few places, steep cliffs in bedrock. However, the bedrock in this region is mainly of granitic types resistant to the erosive action of the waves. Wave-eroded debris has accumulated in beaches and has been sorted and carried laterally along shore by wave transport. Bedrock cliffs have yielded mainly boulders and coarse gravels which have not moved far from their source. Glacial deposits have been sorted by wave action into their component particle sizes. Large boulders where present have remained on the beach as boulder accumulations

or in some cases have been left in shallow waters offshore as the bluff has receded under further wave erosion. Fine muds and silts have been suspended in the agitated waters of the beach zone and carried out to settle in quieter waters offshore. Sand and gravel have been worked back and forth within the beach zone, thus forming the extensive beaches and sand spits so common on Cape Cod and at certain points within the other areas. Wind action has blown some of the accumulated sand into dunes. Shallow embayments such as Barnstable Harbor and Annisquam River have tended to become filled to sea level or slightly above through the accumulation of swamp vegetation as well as windblown and stream-borne sediment. Such areas now form broad salt marshes, laced in many places by winding tidal rivers.

These are the coastal features which nature has produced and is still modifying. Man has added to their complexity by constructing piers, wharves, sea walls and other shore structures; roadways to gain access to the coast; and buildings for many purposes, particularly as seaside dwellings and for recreational use. Wherever shorelines having these types of natural features occur, man, if present in considerable numbers, has developed the shoreline for his own purposes. Such types of settlements and their distribution in relation to the physical features will be treated in later sections of this report.

Glaciated Landform Types Before Modification by Shore Processes

When the continental glaciers melted from this region they left seven major landform types against which the present shore features have been subsequently developed by such processes as wave work, wind work, inundation through rise of sea level on the land, rain wash, and stream erosion. These seven upland types are:

(1) High rough moraine, treated in Chapter 2.

(2) Low rolling moraine, treated in Chapter 3.

(3) High rough pitted outwash plain, treated in Chapter 4.

(4) Low pitted outwash plain, treated in Chapter 5.

(5) Low non-pitted outwash plain, treated in Chaptor 6.

(6) Rough bedrock upland, treated in Chapter 7.

(7) Flat or gently rolling bedrock upland, treated in Chapter 8.

The appearance of these seven original glaciated landform types in airphoto stereograms and in stereopairs of ground photos will be treated in the following chapters of this report.

A considerable number of coastal landform features have been developed through the modification of these original glaciated landform types of the mainland. The associations of these secondary types among themselves and with the seven primary ones will also be treated in Chapter 9.

Settlement of the Areas Selected for Study and Resulting Settlement Types

History of Settlement

The three coastal areas of New England selected for study in this project are among the first areas of the United States to have been settled by English colonists. The Cape Cod-Plymouth area belonged to the very early Plymouth, or Old Colony, and was settled by the Mayflower people or by their early successors in colonial endeavor. The oldest town on Cape Cod, the town of Sandwich, was established in 1637, just 17 years after the Pilgrims had landed at Plymouth. Barnstable, the county seat of Barnstable County, celebrated its three-hundredth anniversary in 1939. Natural factors account, in great part, for the specific location of these early centers of population. In colonial days, communication was chiefly by water and the early colonists desired a good harbor. Sandwich is located in a valley among low morainic hills. It had a stream for small water power and a sheltered harbor. Barnstable was located on good soil, by the water of an ample bay. To feed their livestock, the early settlers of Cape Cod depended much on the large supplies of salt hay from the nearby Great Marshes.

Like the Cape Cod-Plymouth area, the Gloucester-Rockport area on Cape Ann is one where settlement has been continuous for more than three centuries. Gloucester was established as a fishing station only three years after the Mayflower

landed at Plymouth. It is still among the great fishing ports of the world. Rockport was settled in 1690. It, too, was an early fishing port, but during the nineteenth century it became known for the high-grade granite which everywhere underlies the town. Evidence of this once flourishing occupation now includes piles of faulted blocks and deep pools of abandoned quarries. Today the granite industry is greatly diminished in scope; only a few quarries are operating on a small scale.

The third area, that of Rockland-Camden, Maine, also had an early start, but its real development did not begin until after the Revolutionary War. In its early stages of growth, Rockland was part of Thomaston. It separated from that city in 1848 when it was incorporated as East Thomaston. The city is located on a fine harbor that the Indians called Catawameag (great landing place). Fishing, shipping, shipbuilding, and limestone quarrying have been the chief industries of the city in the past. During the nineteenth century, Rockland became the nation's greatest lime-producing center, although it did not reach the height of its production until about 1900-01. Thereafter, the lime market was impaired, in large measure because of the increasing use of steel and domestic Portland cement in construction work. Of late there has been a revival of the industry. Most of the present activity is devoted to the manufacture of lime for agricultural and chemical purposes.

Camden is located at the base of the famed Camden Hills, some eight miles north of Rockland. It offers one of the best protected and most picturesque anchorages for pleasure craft along the Maine Coast. The city was founded in 1769 and developed as an old woolen milling center and shipbuilding town. The present Camden Shipbuilding Company is a direct descendant of the yard that built six-masted schooners which during the eighteenth century sailed over the world. Woolen mills are still working in Camden, and several smaller industrial plants specializing in high-grade products have been established during the past several decades.

Not only do the three areas included in this report share a long history of development with emphasis on fishing and shipbuilding, they also have a number of other characteristics in common. In all three, most of the inhabitants live close to the shore. Inland the three areas are sparsely settled, with much land entirely without population. On Cape Ann, for example, no road crosses from one side of the peninsula to the other. In order to go from the south side to the north, one must travel a rather circuitous route, outlining the shoreline for much of the way.

Like most of coastal New England, the three areas selected for study do not contain much good farmland. Thus, farming is not an important way of life at the present in any of the areas. The amount of abandoned land, especially

on Cape Cod, does indicate, however, that until the present generation some farming activities were carried on, in particular on the better soils of the low rolling moraines. In addition, cranberry bogs dot the area here and there. These are found for the most part on both the high and low pitted outwash plains.

The three coastal areas studied in this project have yet another economic activity in common. For more than fifty years, each has been the center of a flourishing summer recreational industry. Even before the turn of the twentieth century, many resort settlements were established in all three areas. For the most part these settlements were occupied during the summer months of the year by people living in or around Boston. They reached their summer homes by train and carriage, although many made the journey by regularly scheduled boat passage if such facilities were available.

Since the development of the automobile and hard-surfaced roads, the three areas have attracted tourists from all over the United States. Indeed, the summer tourist industry has become the dominant economic interest on Cape Cod. During the winter there is not much activity, but in the summer, life expands in every town; and in a city like Hyannis, at the head of Lewis Bay on the south side of the Cape, there are displays of an almost metropolitan intensity. The automobile has brought the summer cottage within two hours of easy travel from Boston, and

the well-developed system of highways now crossing the Cape from north to south are alive with automobiles.

In like manner, Gloucester and Rockport are dependent on income from the tourist trade, although Cape Ann is relatively much less so than Cape Cod. Gloucester is an up-to-date industrial city with a fishing industry that is as important today as it was when the city was first founded. Nonetheless the city is fringed by summer resorts including Eastern Point, Bass Rocks, Magnolia, and Annisquam. Modern Rockport, surrounded by water on three sides, has become widely known as the ideal of what an old New England seaport should be. The coves and rocky headlands along the shores of the Cape have become dotted with summer resorts and hotels, rooming houses, and privately owned cottages, some of which are quite large.

The Camden-Rockland area of Maine also attracts an ever-increasing number of people who seek pleasure, adventure, and health along the New England coast. During recent years, Camden has developed rapidly as a small summer resort; and although Rockland is a trading center and shire town for Knox County, its many summer residents and visitors have become an added source of income. In addition, it has maintained its prestige as the leading lobster trading center of Maine.

As changes have taken place in the economy of the three coastal areas during the past century, so, too, have changes taken place in the character and arrangement of

settlements. This does not mean that the old occupations are entirely dead. There will always be fishing and sailing, livestock and crop farming, and industries associated with these activities; but these occupations have and no doubt will become more and more limited, localized, and special. The leading industry since 1900 and particularly since the 1920's in the areas studied has come to be the summer tourist industry. Present types of settlements and their morphology throughout the three areas reflect this dependence on the recreational use of the land.

Settlement Types of the Three Areas

The settlements of the three coastal areas may be classified into seven types: some related almost wholly to the development of the summer recreational industry, and others related to year-round activities.

(1) Dispersed Dwellings:

(1-A) dispersed farmsteads
(1-B) dispersed seasonal dwellings

(2) Agglomerated Seasonal Dwellings, Linearly Arranged.

(2-A) compactly spaced, small dwellings
(2-B) not so compactly spaced, with larger lots and larger dwellings

(3) Agglomerated Seasonal Dwellings, Irregularly Clustered

(3-A) compactly spaced, small dwellings
(3-B) not so compactly spaced with larger lots and larger dwellings

(4) Agglomerated Seasonal Dwellings on Geometrically Platted Properties

(4-A) rectangularly platted
(4-B) non-rectangularly platted

(5) Agglomerated Nucleated Urban Settlements: Villages, Towns, Cities

(5-A) with buildings linearly arranged
(5-B) with buildings irregularly clustered
(5-C) with buildings on geometrically platted properties

(6) Agglomerated Non-nucleated Settlements

(6-A) with buildings linearly arranged
(6-B) with buildings irregularly clustered
(6-C) with buildings on geometrically platted properties

(7) Agglomerated Seasonal Commercial Structures

In addition to the above types of settlements within the coastal areas studied, there are man-made features which are related to one economic activity or another. These include summer hotels, country clubs, private seashore clubs, fishing shacks, warehouses, canning factories, boatyards, docks, fish packing plants, restaurants, motels, and other such phenomena. Insofar as possible these will be indicated on accompanying photographs.

As each of the types of settlement and other man-made features is identified on the accompanying photographs, the reader should be cautioned about changes which are occurring in the three areas under consideration, especially the two along the coast of Massachusetts. One change, although noted in the field, was not studied in sufficient detail to be included in this report. It is deserving, however, of more attention by those interested in settlement geography. Many of the recreational settlements established fifty years ago were developed relatively near the large urban centers in and around the Boston basin. Means of travel limited the accessibility of many sites. With the development of the

automobile and modern all-weather roads, these recreational settlements have become very accessible to urban centers. As a result there has been a movement of people to these former resort settlements to establish year-round homes. This suburbanization of former resort settlements is a trend which will undoubtedly continue as long as our cities keep growing and incomes remain stable. As a result, dwellings which heretofore served only as summer homes for their inhabitants are being winterized; retail centers are beginning to develop; and many new dwellings are being erected. All along the shore, south of Plymouth to Cape Cod Canal there is evidence of active real estate development along these lines. Some of the settlements identified, therefore, in this report as agglomerated seasonal dwellings may in time become agglomerated settlements of year-round residences. Even now, they contain a number of dwellings in which people reside throughout the year.

The density of housing varies within each of the agglomerated settlement types enumerated on the foregoing pages. In some, lots are relatively small and dwellings closely spaced. In others, properties are larger and the residences are not so compactly spaced. The density appears to be a function of (1) the time at which the settlement was first established; (2) the income of property owners; (3) and the values attached to particular sites by property owners. Settlements which were established as long ago as the turn of the twentieth century are quite

different from those which are only now being established. Not only have the architectural styles changes, but older summer settlements tend to be more compactly formed, irregularly developed, and composed of much larger dwellings. The settlements now being developed seem to be more spread out, with properties more geometrically arranged, and composed of much smaller dwellings. The characteristics are a reflection of the times in which we live. The level of income of property owners is, however, as much a factor today as it was fifty years ago. The summer residences of those with large incomes tend to be larger, more isolated, and on more spacious grounds. Those owned by people with lower incomes tend to be smaller in size, more compactly grouped, and on smaller lots.

Study Procedure

In each of the succeeding chapters, attention will be given to one of the seven original glaciated landform types and its associated settlement features. The landform type and settlement characteristics will be identified first on a selected vertical stereopair of airphotos, and then on a stereopair of ground photographs which show the appearance of the landform type and pattern of settlement to the ground observer. It is assumed that the photo interpreter has an understanding of the terminology of glacial and coastal landforms and of their materials and general mode of origin. However, the descriptions will be so written as to review many of these concepts or to

convey their meaning to the person untrained in the subject. Descriptions of settlement types should present no such problem.

Following the identification of the selected original glaciated landform type, the shoreline features associated with this type will be presented. Again, the shoreline features and associated settlement types will be identified first on selected vertical stereopairs of airphotos, and then on stereopairs of ground photographs.

Landform types as well as shoreline features and types of settlement will be pointed out on the left photo of aerial stereograms by use of the following methods: (a) an upper case letter, as A, B, etc. placed on or near the feature referred to; (b) a dashed outline around the area referred to, if its extent is such that a point location by numeral does not meet the needs. All these location symbols are marked in white.

The location of ground photos is indicated on the aerial photographs by a "V" in white, the apex indicating the position of camera and the two diverging lines the field of view. A number within the "V" denotes photo pair, i.e., "1" indicates Ground Photos 1-A and 1-B.

CHAPTER 2

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH HIGH ROUGH MORAINES

General Characteristics of High Rough Moraines

The high rough moraine type of landform is well shown on Airphotos 1-A and 1-B (see page 104). The rough hilly belt extending across the lower part of the photos between dashed lines is the Sandwich Moraine, labeled Qsm (see pages 87 and 89). This is bordered on the south by the Mashpee pitted outwash plain, Qmo, and on the north by pitted outwash, Qou, and by a small area of low rolling Scorton moraine, Qscm.

The Sandwich moraine, Qsm, exhibits the following characteristics of high rough moraines:

(1) A belt-like linear plan or distribution; shown on Airphotos 1-A and 1-B by its east-west trend.

(2) Considerable relief. Note the deep trench with high hill on south at A, and the height of the whole moraine above lake, B, at its northern base.

(3) Steep slopes. Note particularly those at A and C.

(4) Irregular topography with small hills and ridges of unequal height and with many depressions and valleys, some without exterior drainage. Note undrained basin at D, and irregular hills at E. Good examples of short ridges are at C.

(5) Drainage is generally excessive, due to sandy soil and steep slopes. Small streams are, therefore, rare.

(6) Surface boulders are common but are too small to show directly in most airphotos.

Ground Photos 1-A and 1-B (see page 104) show the following features of high rough moraine: considerable relief; steep slopes; irregular topography with ridges; excessive drainage, suggested by steep slopes and stony soil; and surface boulders.

The high rough moraine type of landform is rarely suitable for field crops, but may be in woodland or in pasture. Tree crops often occupy slopes which are not too steep. Settlement Type 1A, the dispersed farmstead, occurs at H, on Airphotos 1-A and 1-B (see page 104). The field at G is in grassy pasture and an apple orchard is at H. Another dispersed farmstead is at I.

None of the fields surrounding the farmsteads at H or I were cultivated at the time of photography. They were in grass. Since the time of photography, the field at G has not been used and is beginning to revert to woodland. The orchard at H is likewise no longer cultivated.

The road pattern on the high rough moraine shown in the airphotos is generally adjusted to its rough topography. This characteristic is indicated by the winding road at F.

The Ground Photos 1-A and 1-B indicate the general absence of settlement. The high rough moraine shown in the foreground is densely covered with scrub forest, indicative of land once cleared for farming, but now permitted to revert to woodland. Indications of idle land appear in the lower left hand corner of the photographs.

Coastal Areas of High Rough Moraine

Two sections of the coastal areas treated in this report have been developed on margins of the high rough Ellisville moraine. These are (a) the coast of Cape Cod Bay from three miles east of Plymouth to the north edge of the shore community of Manomet Bluffs, and (b) the west shore of Cape Cod Bay from Indian Hill southward to Lookout Point (see page 87).

High rough moraine does not form the entire shoreline of these two coastal areas. The first area includes a sand bar with low dunes at White Horse Beach, cutting off Bartlett Pond (see page 91). The second area includes low sand bars that cut off Ship Pond, Center Hill Pond, and Black Pond, and a larger bar with inlet that cuts off the drained salt marsh called Salt Pond (see pages 90 and 92).

The following pages present three examples of shoreline features and settlement types associated with high rough moraine. The airphotos, unfortunately, were taken in 1938. Extensive real estate developments are currently taking place within the areas depicted, and seasonal dwellings are becoming more compactly spaced. Settlement Type 1B (see page 14) is fast disappearing from the areas studied. As new seasonal dwellings are constructed in areas formerly occupied by Settlement Type 1B, agglomerated seasonal settlement types replace dispersed seasonal

dwellings. Many of the former dispersed farmsteads, Settlement Type 1A, since 1938 have been converted to seasonal dwellings and are now occupied only during the summer. In general, farming has declined throughout the Plymouth-Cape Cod coastal area since the time of photography.

Example 1
High Rough Moraine

Airphotos 8-A and 8-B (see page 112)
Ground Photos 8-A and 8-B (see page 112)
Map (see page 90)

Airphotos 8-A and 8-B show the coast of Massachusetts from Lookout Point northward past Salt Pond marsh, B.

Shoreline Features: The following association of shoreline features, characteristic of coastlines developed on high rough moraine may be identified:

(1) High rough moraine, well illustrated at points C and D, is identified by its irregular knolls and basins; undrained depressions, as at E and F; steep slopes as at G; non-accordance in summit levels; and dense forest indicating poor soils and topography for farming. The unconsolidated nature of the subsurface materials is indicated by the large amount of grading done for the highway, as at H and I.

(2) High bluff, at A, due to powerful wave erosion on margin of high morainal upland.

(3) Drained salt marsh, at B, due first, to the development of sand bars, at J and J, which cut off drainage of embayment on their west, and second, to filling and draining of the coastal pond thus formed by the accumulation of stream and wind-blown sediment and swamp vegetation.

(4) Beach of belted sand and gravel, at K, K, and K, is due to wave assortments and longshore transport of sand and gravel fractions which the waves eroded from the morainal bluffs.

(5) Sand spits or bars, at J and J, built by longshore currents across the mouth of the original embayment on their west.

(6) Low sand dunes on spits, at J and J, are due to wind work on the dry sands of the spits, where such sediments were not fixed by vegetation.

(7) Large boulders in water offshore appear at point L in front of high moraine from which they were washed by wave erosion. Such large boulders are too big for longshore transport and hence do not appear on seaward side of sand spits, at J and J.

Ground Photos 8-A and 8-B show the following shoreline features, among those associated here:

(1) High rough moraine, in left foreground.

(2) High bluff, in left foreground.

(3) Drained, salt marsh and small tidal river in left middle distance.

(4) Beach of belted sand and gravel in center foreground and middle distance.

(5) Sand spits, with dredged inlet, between salt marsh on left and ocean on right.

(6) Low sand dunes with trees are present on sand spit beyond inlet. The two mounds at dredged inlet are sand and gravel spoil heaps resulting from dredging.

(7) Boulders in water in foreground have been washed from glacial drift composing high bluffs.

Settlement Types: Settlement in the area depicted in Airphotos 8-A and 8-B is related to farming, fishing, and resort development. General farming, with some specialization in cranberry growing and more recently in the raising of chickens, characterizes the agricultural economy. At the time of photography, 1938, there were only a few seasonal dwellings in the area pictured. Recently the farmland shown at Q has been non-rectangularly platted and developed with summer dwellings compactly arranged, as in Settlement

Type 4B. The site at Q has become attractive for summer homes because of the sandy character of the nearby beach, at J. Fishing is confined to lobstering, and is represented by the settlement features at O.

The following association of settlement features, characteristic of much of the shoreline developed on high rough moraine, may be identified:

(1) In general, a lack of settlement on the high rough moraine. No settlements have developed along the main highway, marked at I and H, once the highway climbs onto the high moraine southward from Ellisville.

(2) Dispersed farmsteads, as at N, Settlement Type 1A, have been established along the secondary road between the main highway and the ocean, where the slopes are less steep and where there are larger stretches of flatter land on top of the knolls. The flat floor of the depression at M is used as a cranberry bog.

(3) Dispersed seasonal dwellings, Settlement Type 1B, are located along the height of land overlooking the shoreline, at A. As stated above, seasonal dwellings have been constructed on this point of land since the time of photography. Today the settlement type can be more appropriately designated as Type 4B, agglomerated settlements with non-rectangularly platted properties. Most of the cottages are built on the former farmland to the west of the shore. Again, the top of this particular knoll is large and flat enough to permit the development of seasonal dwellings. The sandy beach of the adjacent spit is attractive as a bathing beach.

(4) At O, on the west side of the sand spit or bar, J, are buildings associated with lobstering. They consist of a tool shed, boat house, and living quarters for a single lobsterman.

(5) The dwelling at P is a dispersed farmstead, Type 1A. Although the name Ellisville appears on maps designating this location, no agglomerated settlement now exists, although at one time it may have been an unincorporated settlement of less than hamlet size. The name was derived from the family name of an early settler in the area.

Ground Photos 8-A and 8-B show the following settlement features and types:

(1) On the sand spit between the salt marsh on the left and the ocean on the right are the buildings associated with lobstering. The boat moored on the west side of the spit belongs to the lobsterman.

(2) On the high moraine to the north of Salt Pond stand several seasonal dwellings. These are examples of Settlement Type 1B. Note that the homes are large and of high quality. The one to the left was formerly a dispersed farmstead.

The sandy character of the shore in the center foreground can be noted. It is the beach used by the residents of the seasonal dwellings recently constructed along the height of land immediately to the west.

Example 2
High Rough Moraine

Airphotos 9-A and 9-B (see page 113)
Ground Photos 9-A and 9-B; 9-C and 9-D (see page 114)
Airphotos 9-C and 9-D (see page 115)
Ground Photos 9-E and 9-F (see page 115)
Map (see page 91)

Airphotos 9-A and 9-B show Manomet Point at the northeast, Stage Point at the southeast, and White Horse Beach on the north. The two points are moraine promontories eroded by wave action, whereas White Horse Beach is a sand bar surmounted by low dunes built across the former embayment now occupied by Bartlett Pond.

Shoreline Features: The following features of this shoreline association may be identified on Airphotos 9-A and 9-B:

(1) High rough moraine, identified by irregular knolls and ridges, as at A; basins, as at B and B; closed depressions containing lakes or swamps, as at C; steep slopes, as at D; forest vegetation, as at D; largely non-agricultural use; adjustment of roads to topography, as at E; and considerable relief, as shown by difference in elevation between hill at A and lake, at C.

(2) High bluff, due to wave erosion, at F.

(3) Low bluff, at G.

(4) Sand bar, at H and H, cutting off coastal pond, at I.

(5) Low dunes on sand bar, at H and H.

(6) Beach, sandy and clean, at J.

(7) Beach, belted sand and gravel, at K and L.

(8) Boulders in water offshore, at M, N, O, and P.

Ground Photos 9-A and 9-B show the view to the west of Manomet Point, to White Horse Beach. The following features among those associated here may be seen in the photos:

(1) High rough moraine, in immediate foreground.

(2) High bluff, beneath edge of grass in immediate foreground.

(3) Low bluff, strewn with boulders, near boat on shore in left foreground.

(4) Sand bar, forming ridge just inland from broad sand beach.

(5) Low grassed sand dunes surmount sand bar near center of photos, on right of large beach clubhouse with flags.

(6) Sandy clean beach is present in center and right parts of view.

(7) Belted sand and gravel beach, with a few large boulders, is seen in lower left center.

Ground Photos 9-C and 9-D show the view southward toward Stage Point from Manomet Point. The following shoreline features among those associated here may be seen:

(1) High rough moraine forming the upland. The bouldery glacial drift composing this moraine is evident from the character of the shore materials revealed by wave erosion.

(2) High wave-eroded bluff is seen in foreground, at right, and at Stage Point in distance at left.

(3) Low bluff is seen near center of view, where a low basin in the moraine has been intercepted by shore erosion.

(4) Belted sand and gravel beach of limited extent is seen at extreme right and in front of low bluff in center distance.

(5) Boulders in water offshore are present along almost the entire shoreline in the view.

Settlement Types: Airphotos 9-C and 9-D (page 115) show a number of settlement types commonly associated with high rough morainal landforms. The following may be identified on the photographs:

(1) Dispersed farmstead at Q, Settlement Type 1A, is located along the highway leading to Manomet Point. This road is known as Point Road and was an early improved road leading to the Coast Guard station on the Point. The farm is still operating today. It is a dairy farm, and the fields are, for the most part, kept in grass. The large farmstead, with its huge barn, at R, is connected with the summer hotel at S. The farm residence is today used as an annex to the hotel, but the land continues to supply dairy and poultry products.

(2) Dispersed seasonal dwellings, T, Settlement Type 1B, may be found along the shoreline from Manomet Point to Stage Point, and from Stage Point to Manomet Bluffs. It will be noted that this type of settlement is closely associated with high rough moraines bordered by high bluffs and beaches which are sand and gravel with boulders in water offshore.

(3) Agglomerated seasonal dwellings, linearly arranged, but not compactly spaced, Settlement Type 2B, are at U. The architecture is representative of the early 20th century. The highway leading to the Coast Guard station at Manomet Point made this area accessible at an early period, and it was one of the first parts of the shore to be developed for seasonal use. Resort settlements which developed as early as this tended to be agglomerated rather than dispersed.

(4) Agglomerated seasonal dwellings with habitations arranged in two or more rows and very compactly spaced, Settlement Type 2A, may be seen at V. It will be noted that this type of settlement is associated with the sand bar at H and with the sandy and clean beach at J. The individual dwellings are small and rather shabby in appearance. The beach attracts many people, regardless of the compactness of the settlement. This type of settlement is characteristic of many which

have been developed on sand bars along sandy and clean beaches. This particular settlement is known as White Horse Beach and has been utilized for a number of years. It was wiped out by high seas a number of times, but has always been rebuilt.

(5) Certain special settlement features connected with resort development occur at W and S. At W is a large, privately owned beach club. Guests at the large summer hotel at S are permitted the privilege of using the beach and other clubhouse facilities.

Since the photographs have been taken, land has been cleared at Y, and several attractive widely spaced homes have been built along the road running westward from the ocean. They command an excellent view of the water. Immediately to the north of White Horse Beach is an agglomerated settlement, Type 4A, known as Priscilla Beach. This, too, is a development of more than sixty years ago. The individual dwellings, although compactly arranged, are larger than those which have been built at White Horse Beach. The beach is more gravelly than that at White Horse and contains large boulders as a result of erosion of the morainic materials which compose the immediate landforms.

Ground Photos 9-A and 9-B (page 114) show the following settlement features:

(1) In the left foreground is the Mayflower Shore Club, a private club which permits guests at the Mayflower Hotel to have bathing and other clubhouse facilities.

(2) To the right of the club is White Horse Beach with its agglomeration of compactly arranged seasonal dwellings built along the top of the sand dune on the sand bar. Note the small size of the individual dwellings and the compactness of their arrangement. Four, and in some cases, five parallel rows of cottages extend between the ocean front and the road to the west. The single two-story dwelling is conspicuous at the east end of the agglomeration because of its unique size.

(3) In the distance there can be seen some of the larger dwellings of Priscilla Beach, an agglomerated settlement which has been developed on the low moraines immediately to the northwest of White Horse Beach.

Ground Photos 9-C and 9-D (page 114) illustrate Settlement Types 2B and 1B. In the immediate foreground, the dwellings are aligned in a single row, but are not compactly spaced. Stretching away in the distance the dwellings become more dispersed. These latter are not a part of the agglomerated settlement at Manomet Point. They are reached by different roads than the dwellings in the foreground. The settlement is more characteristic of 1B, dispersed seasonal dwellings. The agglomeration in the foreground will undoubtedly become more compactly arranged as new residences are built. The two houses shown in the immediate foreground have been constructed only recently. Note the difference in their style of architecture from those built at an earlier date. The beach is not attractive to those who like to swim; hence the site has not been considered attractive for summer dwellings except by those who like the view.

Ground Photos 9-E and 9-F (page 115) picture agglomerated seasonal dwellings, Type 2B with houses arranged linearly but more or less widely spaced. The individual dwellings are large and well constructed.

One row has been built along the highway serving the Coast Guard station; another row stands at the crest of the knoll above them. Each face northwestward and command good views of the ocean. They are not far from the sandy beach at White Horse, and the settlement has long been an attractive one for seasonal development. The large lot sizes have prevented it from becoming too built-up, however. It will be noted that most of the dwellings have an architectural style characteristic of dwellings built about fifty years ago.

Example 3
High Rough Moraine

Airphotos 10-A and 10-B (see page 116)
Ground Photos 10-A and 10-B (see page 116)
Map (see page 92)

Airphotos 10-A and 10-B show Ship Pond, with a part of the promontory of Center Hill Point at south and the south part of Indian Hill at north. These are parts of the Ellisville high rough moraine, labeled Qem on the airphotos. However, the northwestern part of the area shown, labeled Qou, is high rough pitted outwash plain. Ship Pond is a former cove or bay cut off by the development of a sand bar by wave action and the accumulation of longshore drift.

Shoreline Features: The following associated shoreline features may be identified on Airphotos 10-A and 10-B:

(1) High rough moraine, identified by irregular topography of knolls, as at A, and basins, as at B; closed depressions containing lakes or bogs, as at C and D; steep slopes as at E; non-accordance of summit levels of knolls; strong relief as indicated by difference in level of hill, A, and basin, B; the obviously unconsolidated nature of subsurface materials, as shown by deep road cut at F; and the absence of streams, due to immaturity of water erosion and porous character of subsoil. Both of these last features are characteristic of high rough moraine.

(2) High bluff developed by wave erosion along shore, as at G and H.

(3) Salt marsh, due to partial filling of Ship Pond by vegetation, as at I.

(4) Coastal pond -- Ship Pond, as at J.

(5) Beach, belted sand and gravel, as at L.

(6) Beach, bouldery as at M.

(7) Sand spit or bar, as at K.

(8) Boulders in water offshore, as at N and O.

Ground Photos 10-A and 10-B show a view to the south with Ship Pond at right and the sand bar and distant shore bluff in center and left. The following features among those associated here may be identified:

(1) High rough moraine, in immediate foreground and in distance, forming high bluff and upland.

(2) High bluff, extending to left from center distance.

(3) Salt marsh, narrow, adjacent to Ship Pond on right.

(4) Coastal pond at right -- Ship Pond.

(5) Beach, belted sand and coarse gravel, on seaward side of spit, near center of view.

(6) Bouldery beach, dark area below and on left of sand beach.

(7) Sand spit or bar between shore and Ship Pond.

(8) Boulders in water offshore, now exposed at low tide in left middle distance.

Settlement Types: The Airphotos 10-A and 10-B show a settlement pattern characteristic of shoreline features associated with high rough moraines. These are as follows:

(1) Settlement Type 1B, at P, dispersed seasonal dwellings. The dwellings are not modern in architectural style, but represent a type of construction that dates back to the turn of the century. No further development has taken place in this area since the time of photography. The beach is a belted sand and coarse gravel beach with boulders exposed at low tide. The high bluff from the top of the moraine to the water's edge necessitates a steep descent. For these reasons the site has not as yet proved sufficiently attractive to cause further development.

(2) Settlement Type 1A is shown at Q. This is an old farmstead which was very early established on the summit of this particular knoll where a small expanse of flat land could be cleared.

(3) Buildings associated with lobstering are near M. They include a dwelling, and other buildings used to house equipment and fishing gear.

(4) The depression at C is used for growing cranberries.

(5) The subdivision at R was platted more than 15 years before the time of photography, but development is only now taking place. It is going forward very slowly, however, for the shoreline is not attractive for reasons explained above.

Ground Photos 10-A and 10-B show the lobsterman's dwelling and associated buildings in the immediate foreground. In the distance, at the edge of the bluff fronting the ocean, can be seen a row of summer dwellings, more or less widely separated. The dwellings are large and well cared for. They are typical of Settlement Type 1B.

In general, the shorelines of high rough moraines are not attractive sites for those who enjoy swimming. High bluffs overlook the beach, which in most cases is composed of sand and gravel and strewn with huge boulders. In consequence, a dispersed type of seasonal dwelling, Type 1B,

is the rule. Only where the bluffs are lower and a sandy beach is readily available does the settlement become more agglomerated.

Associated with high bluffs are coastal ponds, salt marshes, and sand spits or bars. On the sand spits or bars, if the beach is clean and sandy, agglomerations of seasonal dwellings, arranged in rows and compactly spaced have developed. Where the spits or bars are not so clean or are low-lying and too near salt marshes, no seasonal dwellings have been built. Within the coastal areas studied, such bars or spits are generally occupied by a single lobsterman's dwelling.

Dispersed farmsteads, Settlement Type 1A, customarily occur on top of knolls which have an expanse of flat land large enough for the farmstead and a few small fields. Elsewhere dispersed farmsteads may be found in valleys, or on slopes that are not too steep for cultivation. Dairy farming is the rule, although general farms and chicken farms are scattered throughout the high rough moraine area. For the most part, however, the land is not used for agriculture due to the steep slopes and stony sandy soil. Instead, much of the land is in forest.

CHAPTER 3

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH LOW ROLLING MORAINE

In the coastal areas treated in this report, low rolling moraine occurs only on the north side of the high rough Sandwich Moraine (see page 87) and is called the Scorton moraine. The latter appears to have been formed either as a sheet of drift deposited as ground moraine beneath the Sandwich glacier, when the Sandwich moraine was being formed at its margin, or as a lower marginal moraine during retreat of the glacier after the Sandwich moraine was built.

The areas of low rolling Scorton moraine are shown on page 87 and on the sectional maps, pages 89, 93, and 103, bearing the symbol Qscm. These areas of low rolling moraine are separated at several points by lower pitted outwash plain, which makes most of the dry ground marginal to Barnstable Harbor, and the marshlands extending west as far as nearly to Cape Cod Canal (see page 87). Outside of these marshlands is a belt of dunes and sandspit that forms the south shore of Cape Cod Bay.

General Characteristics of Low Rolling Moraines

The low rolling moraine landform type is well illustrated by the Scorton moraine shown in Airphotos 2-A and 2-B (see page 105). The dashed line separates the low rolling Scorton moraine, Qscm, in the south part of the

area from a lower area of outwash, Qou, at the northwest, extending to the shore of Barnstable Harbor. The following characteristic features of this landform type may be observed on Airphotos 2-A and 2-B:

(1) Relatively low relief, as shown by slight difference in level between low hill at A and basin at B.

(2) Irregular rolling topography with many low rounded swells, as at A, and basins, as at B.

(3) Gentle slopes.

(4) Undrained depressions as at C. Drainage may be poor.

(5) Only moderate or slight adjustment of road pattern to topography. Note course of roads at D and E.

(6) Heavier, better soils than most areas of high rough moraine.

(7) Many areas have relatively few surface boulders.

Three types of settlement characteristic of low rolling moraine in the coastal areas treated in this report may be observed on Airphotos 2-A and 2-B. These are:

(1) Along the east-west highway near the lower border of the photograph, is a good example of Settlement Type 6A, a non-nucleated agglomerated settlement with buildings linearly arranged. The settlement is known as Cummaquid. Its residences and other buildings align the highway on either side. Some of the dwellings today are occupied only seasonally, but a majority are residences which are occupied the year-round. It will be noted that highway and dwellings follow a rather circuitous route on top of a low ridge.

(2) As indicated by the large number of cleared fields, a portion of the low moraine has been, or is now, cultivated. It will be noted that a large number of fields have been permitted to revert to brush and trees. One such field

is indicated at F. The fields that are of uniformly light gray tone are in grass. Only a few of the fields are now in field crops. One such is indicated at G. The settlement over the area is composed of Type 1A, dispersed farm dwellings, some of which are now used as summer homes rather than as active farmsteads.

(3) It will be noted that there is an absence of seasonal dwellings along the shoreline. Since the time of photography a number of the farmhouses have been converted to summer residences, as noted above, but no seasonal dwellings have been constructed. The shore is not an attractive one, being composed of muck and salt grass with only small patches of sand which are likely to contain rocks and boulders from the morainic deposits nearby.

Two types of settlement shown on Airphotos 2-A and 2-B stand in marked contrast to those described above. On the outwash plain, indicated by Qou, Settlement Type 4-A, agglomerated seasonal dwellings on rectangularly platted properties, has developed at H. The dwellings are arranged in rows at right angles to the shoreline. Cross streets have also been constructed. Most of the dwellings are occupied only seasonally, but a few are used as year-round residences. The beach adjacent to the outwash plain is sandy and free from boulders, muck, and grass. This was undoubtedly the site condition which attracted the development of the platted subdivision with cottages compactly arranged.

The second settlement type, Type 2A, agglomerated seasonal dwellings, linearly arranged and compactly spaced, is represented at I. The larger building is a lighthouse. The remaining are small seasonal dwellings. They can be reached only by boat from Barnstable Harbor, or on foot

by way of Sandy Neck.

In brief, Airpnotos 2-A and 2-B show that at one time Settlement Type 1A was common on low rolling moraine areas on Cape Cod. The slopes were not too steep for farming, and the soils were relatively fertile. Farms tended to develop at an early date. Seasonal dwellings are few even today for the beach conditions are not attractive.

Ground Photos 2-A and 2-B (see page 105) show the following features characteristic of low rolling moraines: relatively low relief; irregular rolling topography with low rounded swells, undrained depression in left foreground; gentle slopes; and few surface boulders, though some may be seen. It will be noted that no settlement features can be identified on this ground photograph. The fields were once cultivated but are now beginning to revert to woodland. Hedgerows can be seen at left and on the more distant skyline.

Two further examples of landform and settlement features associated with low rolling moraines follow.

Example 1
Low Rolling Moraines

Airphotos 11-A and 11-B (see page 117)
Ground Photos 11-A and 11-B (see page 117)
Map (see page 89)

Airphotos 11-A and 11-B show Calves Pasture Point, a peninsula extending into Barnstable Harbor. It overlooks Great Marshes on the west.

Low rolling moraine (Scorton moraine, Qscm) forms the higher ground southward past the main east-west road lined by houses. To the south of this is the wooded Sandwich high rough moraine, Qsm. Note the characteristic absence of settlements on this high rough moraine. Near the shore of Barnstable Harbor, to the northeast, is a small area of low pitted outwash, Qou.

Shoreline Features: The shoreline features associated in this area may be identified on Airphotos 11-A and 11-B as follows:

(1) Low rolling moraine, recognized by its rolling surface of rounded knolls, as at A, and basins, as at B; relatively small relief; lack of accordance in summit levels of knolls; depressions without drainage, as pond at C; moderate degree of adjustment of road pattern to topography, as at D; relatively good, heavy soils. Surface boulders cannot be seen on the airphotos, but have probably been piled into stone walls along the hedgerows.

(2) High bluff, due to wave erosion on moraine, at F.

(3) Low bluff, due to wave erosion on lower parts of moraine, as at G.

(4) Beach, belted sand and grass, at F, G, and H.

(5) Boulders on beach, at I and elsewhere.

Ground Photos 11-A and 11-B show a view toward the west along north shore of Calves Pasture Point. The following shoreline features among those associated here may be seen on the ground photos:

(1) Moraine, forming upland at left. Moderate height of bluff suggests low rolling moraine rather than high rough moraine.

(2) Moderately high bluff at left.

(3) Beach, sandy with a lower area of muck and salt grass, dry at low tide.

(4) Boulders on beach, derived from erosion of glacial drift.

Settlement Types: Airphotos 11-A and 11-B indicate that at one time most of the low rolling moraine on Calves Pasture Point was cleared for agricultural land use. By the time of photography, however, many of the fields, marked by hedgerows, were reverting to woodland. Since then most of the fields on Calves Pasture Point have been abandoned and are rapidly reverting to brush and small trees. The photographs show the following settlement types:

(1) Settlement Type 1A, dispersed farmsteads. This settlement type was dominant when the land was being cultivated. Today the farmsteads along the road leading to the north shore of Calves Pasture Point have been converted to seasonal dwellings.

(2) Settlement Type 1B, dispersed seasonal dwellings. This type has now become the dominant settlement type on Calves Pasture Point. An additional dwelling or two has been built since the time of photography, but the residences are still widely dispersed. The dwellings are of high quality and have been constructed on large lots.

(3) Settlement Type 5A, the Village of Barnstable, is a linear agglomeration of structures along the main highway. The small business core of the village is at J. Barnstable is one of the older settlements on Cape Cod.

In addition to the features associated with the low rolling moraine landform type, attention should be called to the features at K. The buildings, pier, and other facilities belong to the Barnstable Yacht Club. The buildings, including a clubhouse and bath houses, have been built on the flat outwash plain. The beach, at this point is sandier than the beach adjacent to the low rolling moraine to the west.

Unfortunately, the dispersed seasonal dwellings on top of the low rolling moraine cannot be seen in Ground Photos 11-A and 11-B.

Example 2
Low Rolling Moraine

Airphotos 12-A and 12-B (see page 118)
Ground Photos 12-A and 12-B (see page 118)
Map (see page 93)

Airphotos 12-A and 12-B show an excellent example of shoreline features associated with low rolling moraine, on the south shore of Barnstable Harbor about one mile east of Cobbs Village. Here the Scorton moraine, Qscm, approaches very close to Barnstable Harbor, though separated from it by a narrow belt of marsh. Farther to the west, the low pitted outwash plain, Qou, forms the shoreline.

Shoreline Features: The following shoreline features are associated here and may be identified on Airphotos 12-A and 12-B:

(1) Low rolling moraine. This landform type was identified in this area on pages 37-41 of this report. Airphotos 2-A and 2-B and Ground Photos 2-A and 2-B (see page 105) were used to illustrate the characteristics of this landform type.

(2) Low bluff, due to wave erosion, at A.

(3) Salt marsh, outside of beach at B, and in filled inlet at C.

(4) Beach, presumably of sand, mud, muck and grass, inasmuch as it is on a shore bordered by salt marsh, as at D.

Ground Photos 12-A and 12-B show a view of this coastline looking west toward Cobbs Village. The following features of the shoreline association described above may be seen in these ground photos:

(1) Low rolling moraine forms the higher ground at left.

(2) Low bluff shows poorly behind bushes at left.

(3) Salt marsh inundated at high tide, in middle ground and extending to water's edge at right.

(4) Beach of sand, mud, muck in immediate foreground and at left of salt marsh. The beach is partly grassed. Areas of sand beach are discontinuous.

Settlement Types: The settlement types shown on Airphotos 12-A and 12-B have been described on pages 38-40 of this chapter. The only active farms today are shown at E and F. Two small buildings, used as bath houses are at G.

Ground Photos 12-A and 12-B show the general absence of seasonal dwellings along the shoreline. The beach is unattractive, and there has been no recent construction of seasonal homes in the area.

CHAPTER 4

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH HIGH ROUGH PITTED OUTWASH PLAINS

High rough pitted outwash plains form the shore in two areas within the regions treated in this report. The first of these extends from Manomet Bluffs south to a point just north of Indian Hill (see page 87). The second area runs southward from near Lookout Point to Sagamore Beach. In both of these areas, this landform type is high and rough, densely wooded, and superficially resembles high rough moraine. High bluffs are characteristic of much of the shore of these areas.

General Characteristics of High Rough Pitted Outwash Plains

The high rough pitted outwash plain type of landform is well shown in Airphotos 3-A and 3-B (see page 106). Superficial resemblances to high rough moraine can be noted. Where thick glacial outwash was deposited among and on top of a large number of melting stagnant ice masses, an excessively irregular surface topography may result when the ice masses melt away. However, such pitted outwash areas differ from high rough moraine in that they are composed primarily of washed gravel and sand; contain few surface boulders of large size; and seen in a broad view, show an accordance of level among those points which represent the original surface of the outwash plain, undisturbed by settling and slumping. The following characteristic features of high rough pitted

outwash are well shown on Airphotos 3-A and 3-B:

(1) A general accordance in level among flat-topped remnants of the original outwash plain as deposited. See A, A, A.

(2) Numerous undrained depressions and basins, as at B, C, and D.

(3) Steep slopes, as at E.

(4) Gravel and sand are underlying materials. Their presence is suggested by pits, presumably for sand and gravel at F; and by apparent sandy character of steep bluff extending from G to H, and sandy beach at base of this bluff.

(5) Absence of surface boulders of large size.

(6) Relief may be moderate to considerable. Note how rough upland at J rises above large pit lake at I.

The settlement features and their arrangement on Airphotos 3-A and 3-B are representative of those which may be found elsewhere on areas of high rough pitted outwash:

(1) Roads may show considerable adjustment to the more irregular areas in this landform type. Note how road at K, built on higher ground, circles pit lake.

(2) The sandy soils, steep slopes, and rather strong relief are not favorable for farming. Such areas generally are used mainly for woodland or pasture. Note the dense forest over much of the area. The pattern of fields in the area near J suggests that some farming is carried on. At L, a former orchard may be recognized. Cranberries are raised in drained bogs, as at B.

(3) The areas which have been cleared for farming are marked by a dispersion of farmsteads, Settlement Type 1A, as at M. A majority of these farmsteads are no longer operating as farm dwellings. They have been converted to summer homes. Those which still persist provide only a low level of income.

(4) Settlement Type 6B, agglomerated non-nucleated settlement with buildings irregularly clustered, is shown at N. Here at the junction of roads are several commercial establishments including eating places, automobile repair services and the like. It is an unincorporated hamlet. Another such settlement type was at one time located at O, and was known as Cedarville. The name suggests the type of vegetation that may have been common on this type of landform during the early period of settlement. Cedarville has now disappeared as a functioning hamlet. Farming has not persisted on these high rough pitted outwash plains even where land is flat enough for cultivation. The poor quality of the soils has not made farming a productive use of the land.

(5) Two types of seasonal agglomerations may be found around the pit lake in the upper left hand corner of the airphotos. Along the north and east side of the lake the cottages are dispersed. Each is reached by a separate road built to the lake from the highway. This is representative of Settlement Type 1B. On the west side of the lake, south of the river crossing, there is a platted subdivision representative of Settlement Type 4, in part rectangularly, and in part, non-rectangularly platted, with cottages rather compactly spaced. This is an old resort area reached at one time by interurban trains.

Paradoxically the area adjacent to the coast was not compactly developed at the time of photography, but the site was occupied by a few dispersed seasonal dwellings. A high bluff stands above the beach, although the beach is sandy and attractive. Since the time of photography, a rectangularly platted resort, Settlement Type 4A, has been developed along the top of the bluff at P. The cottages are modern in architectural style and of high quality. A beachhouse has been built for those who own cottages in the agglomeration.

Ground Photos 3-A and 3-B show the following features:

(1) Rather uniform level of higher parts, as shown by level top of forest in distance.

(2) Artificially drained depression in center of photo.

(3) Rather steep slope between photographer and edge of basin in foreground.

(4) A small old sand pit is beyond bushes in immediate foreground and suggests sandy underlying material.

(5) An absence of surface boulders.

(6) Moderate relief.

(7) Flat bottom of basin is used for cranberry bog.

Another example of shoreline features and settlement types associated with high rough pitted outwash plains follows.

Example 1
High Rough Pitted Outwash Plains

Airphotos 13-A and 13-B (see page 119)
Ground Photos 13-A and 13-B (see page 119)
Map (see page 91)

Airphotos 13-A and 13-B show the area of high rough pitted outwash plain from Manomet Bluffs south to Churchill Landing.

Shoreline Features: The following features are associated in this shoreline, and may be identified on the airphotos:

(1) High rough pitted outwash plain, recognized by its flat summit level, as at A, B; numerous pits, filled with bog, as at C, or lakes, as at D; steep slopes on sides of pits, as at E; general absence of large boulders in waters offshore, showing absence of these in glacial materials composing eroded bluffs; gravel pits, as at F and G.

(2) High bluff due to wave erosion, at J.

(3) Low bluff due to wave erosion in pitted area of plain, at K.

(4) Beach of belted sand and gravel, suggested by faintly striped beach pattern as at L.

(5) Small boulders offshore in limited accumulations are suggested by dark patches such as at M. Such boulder accumulations tend to be below level of higher sand beaches and are exposed only at low tide.

Ground Photos 13-A and 13-B show a view looking southward from Manomet Bluffs. The following shoreline features of the association just described may be seen in these photos:

(1) High rough pitted outwash plain, at right, with houses. The relatively flat surface of this landform type is very characteristic.

(2) High bluff, at right, and extending into distance.

(3) Low bluff shows faintly in distance at left center.

(4) Beach of belted sand (light tone) and coarse gravel (dark bands).

(5) Limited numbers of rather small boulders in edge of water which is shown at low tide in the picture.

Settlement Types: The development of resort settlements on high rough pitted outwash plain areas is well shown on Airphotos 13-A and 13-B:

(1) Rather limited agricultural use is made of the extensive flat upland areas, indicating sandy and gravelly soils that are too dry for best farming (see fields at A and H.) Note extensive forest areas at I. Settlement Type 1A is representative of the farm areas. Note use of drained bogs for cranberry cultivation, as at C.

(2) Stretching along the shoreline at the top of the bluff and east of the main highway indicated on the airphotos, are agglomerated settlements of various types. These settlements were developed, for the most part, as early as the turn of the century. The view from the top of the bluff plus the sandy character of the beach give the area shown in the photograph a quality which early attracted seasonal development. In the early days, the seasonal settlements were served by both interurban and boat traffic from Boston. Note the significance of the names Fisherman's Landing and Churchill Landing. Boats often stopped at these places to load on ice cut from Fresh Pond a short distance inland. The structure of each of the communities differs:

(a) Manomet Bluffs, at M, is for the most part, a complex agglomerated settlement. It consists of a row of dwellings along the edge of the bluff overlooking the coast. Inland the properties are rectangularly platted as the settlement grew inland from the coast. The cottages are all of high quality, although not modern in construction. At one time the center of resort settlement was platted in a circular fashion. Lot lines still show the result of this ground plan, and the circular road is evident on the airphotos. A large summer hotel stands at N.

(2) Southward along the shore is Fisherman's Landing, Settlement Type 2B, an agglomeration of dwellings more or less widely spaced, at O. This settlement stands on a lower bluff than that of Manomet Bluffs and consists mostly of two rows of cottages, one fronting on the ocean; the other on the west side of the road. The cottages are of high-grade quality and well cared for. The settlement is attractive, although somewhat compact. It resembles the type of settlement found at Manomet Point. The beach, however, is sandy and much more inviting.

(3) Settlement Type 7, agglomeration of Seasonal Commercial Structures occurs at P. Since the time of photography, additional commercial buildings have been constructed. A modern store and post office now serve the summer residences of Manomet Bluffs. Other commercial buildings, including a snack bar and a laundromat have been built on the west wide of the highway. These operate only seasonally.

There is evidence today that a few of the dwellings included in Manomet Bluffs and Fisherman's Landing have been winterized and are being used as year-round residences. The nearness of these settlements to Plymouth and Boston makes it possible for commuters to live here and work in these nearby cities.

Ground Photos 13-A and 13-B show the seasonal dwellings at the edge of the bluffs looking southward from Manomet Bluffs. Note the linear arrangement of the dwellings. Note, also, that they are large and well-cared for although not modern in their architectural style. The settlement is of high quality and has served as a quiet, rather exclusive resort settlement for more than fifty years. The fine character of the beach and the delightful ocean view have long been valued by summer residents.

CHAPTER 5

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH LOW PITTED OUTWASH PLAINS

Within the regions treated in this report, low pitted outwash plains occur in two general areas. The Mashpee pitted plain, Qmo, extends eastward from the Buzzards Bay moraine and southward from the Sandwich moraine, to Nantucket Sound, thus forming the southern part of Cape Cod (see page 87) Parts of the Mashpee "pitted" plain are non-pitted and form good examples of the latter landform type. Discontinuous areas of low pitted outwash lie north of the Sandwich moraine and extend eastward from Cape Cod Canal to Barnstable Harbor (see page 87). These bodies of outwash, labeled Qou, are interspersed with areas of Scorton moraine but generally are lower than the latter and lie between many areas of Scorton moraine and marsh or water on the north.

General Characteristics of Low Pitted Outwash Plains

Low pitted outwash plains are well illustrated by the Mashpee pitted plain, shown in the central and southern parts of Airphotos 4-A and 4-B (see page 107). At the north, this plain slopes up to the foot of the higher Sandwich moraine, Qsm. The following characteristic features may be seen on the airphotos:

(1) Higher parts of plain are flat and show an accordance of level, as at A, B, and C.

(2) Deep pits and depressions, with either lakes or bogs, are present, as at D and E.

(3) Side slopes of depressions are steep, as at F.

(4) Underlying sand and gravel may be indicated by gravel pits as at G.

(5) Surface boulders are generally absent.

(6) Sandy soils are porous and higher ground is excessively drained. Surface streams are few, save in low areas.

The distribution of settlements on low pitted outwash plains shows an accordance with slope and soil conditions. Sandy soils are infertile, but flatter areas may be farmed to some extent. Rougher areas are commonly in woodland or pasture. Drained bogs may be used for cranberries. Note rectangular field at J; wooded plain at K; and small orchard at L. Cranberry bogs are seen at E and M.

Because the area is sandy, soils are apt to suffer from excessive dryness. If dry periods exist, the ground becomes quite dry. For this reason, the farmer operating the farm at O irrigates his land when necessary. There is a pump house at P which pumps water up the steep slope of the pit and onto his fields. Sprinkler system of irrigation is used.

Settlement Type 1A, dispersed farmsteads, is characteristic of the area. Along the pit lake, but not shown on Airphotos 4-A and 4-B, are summer cottages. The development is representative of Settlement Type 2B, agglomerated seasonal dwellings, linearly arranged, parallel to the shoreline.

The large field located on the non-pitted portion within the area circled is today used as an airfield for small planes.

The road pattern may be adjusted to rougher pitted areas, as at H, but for the most part shows no adjustment on flatter areas, as at I.

Ground Photos 4-A and 4-B (see page 108) show the following characteristic features of low pitted outwash plains:

(1) Higher parts of plain in center distance and right distance are flat and accordant in level.

(2) A deep, large pit -- now a cranberry bog -- occupies most of view.

(3) Slopes are steep, as on farther side of pit, at right.

(4) No surface boulders are to be seen.

(5) The drained bog in pit is used for raising cranberries.

An example of a low pitted outwash plain forming a portion of the shoreline of Barnstable Harbor follows.

Example 1
Low Pitted Outwash Plain

Airphotos 14-A and 14-B (see page 120)
Ground Photos 14-A and 14-B (see page 120)
Map (see page 95)

Airphotos 14-A and 14-B show the south coast of Cape Cod about four miles west of Hyannis. At the south is a long sandspit, Craigville Beach, parallel to the bluff margin of the low pitted outwash plain on the north. This sand spit now protects the bluffs on the north from further wave attack. An embayment, actually the drowned lower course of Bumps River, is also shown.

Shoreline Features: The following physical features are associated in this shoreline, and may be identified on Airphotos 14-A and 14-B:

(1) Low pitted outwash plain, recognized by its flat summit areas of accordant level, as at A and B; the numerous pits with bogs or lakes, as at C and D; the absence of short parallel ridges marking positions of the receding glacial margin, which are commonly present in moraines; gravel pit, at E; absence of evidence of large boulders at base of eroded bluff, F; limited agricultural use of flat upland areas, suggesting sandy infertile and excessively drained soils.

(2) Low bluff, F, eroded by wave action.

(3) Sand spit, built to west by longshore drift, G.

(4) Sandy beaches, H and I.

(5) Tidal river, J, bordered by salt marsh, K.

(6) Lagoon behind sand spit, at L and L.

Ground Photos 14-A and 14-B show the view looking westward from a point on Craigville Beach sandspit. The

following features of the association described above may be observed:

(1) Low pitted outwash plain forming upland in right distance.

(2) Low bluff, at and below large houses in right distance.

(3) Sand and gravel spit, in immediate foreground and at left.

(4) Tidal river enters view at right.

(5) Lagoon between spit and mainland, in center of picture.

Settlement Types: Settlement types associated with shorelines developed along low pitted outwash plains are well illustrated in Airphotos 14-A and 14-B.

(1) The general absence of farm settlements has been mentioned. Only a few samples, as at M, exist in the area pictured.

(2) Settlement Type 2B, agglomerated seasonal dwellings, linearly arranged, not so compactly spaced, with larger lots and larger dwellings, has developed on the Craigville Beach sandspit at N. The seasonal dwellings are large, well-kept with neatly landscaped properties. The beach is sandy. The water on the south side of Cape Cod is warmer than on the north. For this reason, the site is inviting, both to those who can afford large, highly-valued seasonal dwellings, and to lower economic groups. Whereas on the north side of the Cape, Settlement Type 2A is commonly found on sandbars and spits, here Settlement Type 2B occurs.

(3) Settlement Type 1B, dispersed seasonal dwellings, is represented at O. These seasonal dwellings are very large and may be classified as mansions. Separate driveways lead through the large estates to the dwellings overlooking the tidal river and Nantucket Sound.

(4) A rather complex type of settlement exists at P. This may be classified in part as Types 2B and 4A. Were the outwash plain at this point flat and free from pits and embayments, the settlement undoubtedly would be entirely of Type 4A with the streets rectangularly platted. Because there are only small islands of flat outwash plain, separated by poorly drained areas, rectangularly platted streets are not possible throughout the settlement. Roads meet each other, therefore, at angles and give the settlement the appearance of being somewhat irregularly designed. Along the street which follows the higher pieces of land, at Q, dwellings have developed in a linear arrangement.

(5) Along the river's edge leading to Scudder Bay the dwellings are of Type 1B, dispersed seasonal dwellings.

Ground Photos 14-A and 14-B show a dispersion of large, mansion-type dwellings along the bluff overlooking Centerville River. These represent Type 1B, although not so widely dispersed as found along the high bluffs of the high rough moraine southward from Plymouth. Some may want to classify this as Type 2B. The author has not done so, for each dwelling is reached from the main highway by its own driveway.

CHAPTER 6

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH LOW NON-PITTED OUTWASH PLAINS

There are no extensive areas of non-pitted outwash plains within the regions studied, but many small portions of the Mashpee pitted outwash plain are locally without pits (see page 87). The pits due to melting buried ice blocks are not present.

General Characteristics of Non-Pitted Outwash Plains

Airphotos 4-A and 4-B (see page 107) show an excellent example of a non-pitted outwash plain within the dashed boundary in the southeast. The following features are characteristic of this landform type:

(1) Flat, horizontal or gently sloping surface.

(2) Stream channels may cross this surface, but none is present within the area outlined here.

(3) Underlying sand and gravel give excessive soil drainage.

(4) Small streams are rare, and none appears within the area outlined.

(5) No large surface boulders are present. None can be seen within the outlined area.

Excessive soil drainage and sandy soil make many such areas poor for farming, even though the flat ground surface is favorable for cultivation. Hay is a common crop. In places, however, a surficial deposit of silt overlies the sand and gravel and makes a productive soil. In Airphotos 4-A and 4-B, the area outlined has been under cultivation

but now appears to be unused save as a small non-surfaced airfield, and possibly for pasture. Roads show no adjustment to topography. Note roads at I and N.

Ground Photos 4-C and 4-D (see page 108) show the non-pitted Mashpee outwash plain in the foreground. In the distance the Sandwich moraine with a gravel pit in a gravelly morainal ridge can be seen. The following characteristic features of low non-pitted outwash plain are shown:

(1) Very flat surface, without pits.

(2) A broad, shallow depression or former stream channel appears to cross area in middle of view.

(3) Sandy, gravelly soil appears in foreground.

(4) No small streams are present.

(5) No surface boulders are present.

The area appears to be an abandoned hay field, now idle. Poor agricultural productivity is indicated.

The following is an example of shoreline features which have become associated with non-pitted outwash plains in the area studied.

Example 1
Low Non-Pitted Outwash Plains

Airphotos 15-A and 15-B (see page 121)
Ground Photos 15-A and 15-B (see page 121)
Map (see page 96)

Airphotos 15-A and 15-B show the south coast of Cape Cod and a part of the city of Hyannis. The large body of water at southeast is Lewis Bay.

Shoreline Features: The following features are associated in this shoreline area, and may be identified on Airphotos 15-A and 15-B:

(1) The area marked by A and B on west side of Lewis Bay is a low non-pitted outwash plain, as indicated by the following: flat summit areas at about same level, see A and B; general absence of pits within this limited area; steep slopes on borders of flat remnants, as at C; sandy beaches, as at D, evidently derived from erosion of sandy materials in bluffs; absence of large boulders in water offshore; and sand or gravel pit at E.

(2) Low bluff, due to wave erosion, at H and I.

(3) Bays, J and K, due to drowning of stream valleys on pitted outwash plain.

(4) Beach, gravelly, is suggested by dark area below upper beach at L.

(5) Beach, sandy and clean, shows as white belt at M.

Ground Photos 15-A and 15-B show the view westward from Harbor Bluff, a low peninsula in western part of Lewis Bay. The following features among those listed in the association above may be seen in Ground Photos 15-A and 15-B.

(1) Non-pitted low outwash plain, beneath houses in right distance.

(2) Low wave-eroded bluff back of beach in right and center.

(3) Bay at left.

(4) Gravelly beach in foreground.

(5) Clean sand beach in right center.

Settlement Types: The extensive use of this area for urban development and seasonal dwellings makes it difficult to judge the character of landforms from nature of agricultural use, which is very slight. However, the unused fields at F and forest at G suggest that soils are sandy and unproductive. A great part of the area pictured in Airphotos 15-A and 15-B is occupied by the city of Hyannis, Settlement Type 5C, agglomerated nucleated urban settlement with buildings on geometrically platted properties.

Hyannis serves as a shopping center for the summer visitors on Cape Cod and is the wholesale and trading center for permanent residents as well, although a portion of the city's stores do not operate during the off-season. A detailed geographic study of the city would contribute to a better understanding of the character of such a trading center.

From the aerial photographs one can see how closely the morphology of the city is associated with the character of its site. The main shopping street, indicated at N, follows the flat surface of the outwash plain between two pits. Because the main street is adjusted to the topography,

side streets constructed at right angles to the main street, do not follow a rectangular grid pattern. Only in Hyannis Park, indicated at O, are the streets rectangularly platted. The seasonal development conforms to Settlement Type 4A. The dwellings along Ocean Road, at P, which extends from the heart of the business section of Hyannis southward, are both year-round and seasonal. The development along this road may be classified as Settlement Type 2B.

Ground Photos 15-A and 15-B show two settlement types. The two larger dwellings represent dispersed summer habitations, Settlement Type 1B. The small cottages aligned in two rows, Settlement Type 2A, is a unique development. The cottages are owned by the Massachusetts State Teachers College at Hyannis and the development is known as Camp Howes.

CHAPTER 7

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH ROUGH BEDROCK UPLAND WITH THIN DRIFT

Rough bedrock uplands with thin drift occur only where relief is in excess of 75 to 100 feet, and where the bedrock basement is but thinly and incompletely covered by glacial drift. Cape Cod has no bedrock exposures, and the Rockport area, though rocky, has relatively low relief. However, the coastal region of Maine from Rockland north to Camden, the so-called Camden Area of this report, forms a good example of rough bedrock upland (see map, page 87)

General Characteristics of Rough Bedrock Upland with Thin Drift

The form of bedrock surface is dominant in the present topography of rough bedrock uplands with thin drift. Where drift is thin or absent, bedrock exposures are numerous. The following features characteristic of this landform type are shown on Airphotos 5-A and 5-B (see page 109).

(1) Strong to moderate relief. Note height of hill A above valley at B.

(2) Steep slopes, as east side of ridge at C.

(3) Bedrock outcrops, particularly on steep slopes and crests of hills. Note outcrops on ridges at D.

(4) Rock quarries may be present. Note those at E and F.

(5) Unless bedrock is in horizontal layers, the hills, valleys and stone quarries often show a parallel alignment reflecting a folded or tilted bedrock structure below. Note how the quarries E and F, the low ridge, D, the high ridge, A, and the valley, B, all show a parallel alignment trending northeast.

Airphotos 5-A and 5-B show several interesting settlement types characteristic of rough bedrock uplands with thin drift.

(1) Road pattern may show considerable adjustment to topography. Note how roads at G and H ascend slope at favorable positions.

(2) Higher, rougher, and more steeply sloping parts of such areas are poorer for farming than lower valleys. Note the field pattern at I indicating present farm use, but the evident abandonment of farm fields on higher rougher ground at A. The latter area is reverting to a brush vegetation but is probably used for pasture.

(3) Two examples of Settlement Type 6A are shown on these airphotos. One is at J; the other at K. The development at J is at the edge of the hill overlooking the steep descent to the valley below. The other also stretches along a highway known as Old County Road.

(4) In the valley at L, there are a few dispersed farmsteads, Settlement Type 1A.

(5) Rockland is representative of Settlement Type 5C, with the street pattern adjusted to the outline of the harbor. The business section of town stretches along Main Street, indicated at M. Crockett Point, at N, extends out from about the center of Rockland Harbor. On the extreme eastern tip of the Point is a coast guard unit. The rest of the Point, shown on the airphoto is used, for the most part, for industrial structures. The Elgin Kelp and Moss Co., manufacturers of bases for paint, candy, and perfume is at O. A small boat building company is at P. On the north side of the harbor are other industrial structures including the Rockport Lime Company at Q, and a fertilizer plant at R. The wharf at S is no longer usable for docking.

Ground Photos 5-A and 5-B (see page 109) show the following characteristic features of this landform type:

(1) Strong relief, as shown by high wooded ridge in left background.

(2) Steep slopes in part, particularly on distant wooded knoll in center of view.

(3) Bedrock outcrops in foreground.

(4) Rock quarry, now unused and filled with water, in foreground.

(5) The elongation of the rock quarry is parallel to that of broad valley in center of view and that of high ridge at left.

(6) Higher, steeper ground at left is wooded, whereas lower flatter land in valley in center of view appears to be farmed.

(7) Other dispersed farmsteads are indicated in the valley to the left.

Example 1
Rough Bedrock Upland With Thin Drift

Airphotos 16-A and 16-B (see page 122)
Ground Photos 16-A and 16-B (see page 122)
Map (see page 98)

Airphotos 16-A and 16-B show the Maine coast just north of Camden, part of which city may be seen in the pattern of houses along the main street about half a mile inland from the shore on the south side of photos.

Shoreline Features: The following features associated in this shoreline area may be identified on Airphotos 16-A and 16-B:

(1) Rough bedrock upland, recognized by strong relief, - note height of mountain A above lower areas near coast, as at B; steep to vertical side slopes, as at C and D; irregular, rocky cliffed coastline, indicating bedrock structure resistant to wave attack, as at D; absence of knolls, kettles, ridges, or other minor landform features characteristic of glacial moraines; densely wooded character of all higher and rougher ground, as at E, indicating thin stony soils. Evidence of agriculture is mainly confined to lower, flatter areas, as at B, but even here is limited; road pattern follows lower ground, as at F, and no roads penetrate higher rougher sections; rocky reefs show in water offshore, as at G.

(2) Rocky shore with steep slope, as at D, due to wave erosion.

(3) Rocky reefs in water near shore, as at G.

(4) Gravelly or bouldery beach in shallow cove at H.

The following features among those in the association listed are visible in Ground Photos 16-A and 16-B:

(1) Rocky shore with steep cliff, in foreground.

(2) Rocky reef in water near shore, in middle distance.

(3) Small gravel beach in cove, above rocks at water line, in right middle distance.

Settlement Features:

The settlement features shown on Airphotos 16-A and 16-B are closely related to the nearby urban center of Camden, Maine. The line of houses, at J, represents relatively new homes built among former farmhouses on streets leading out from the city. Farther out along the road, at K, is an old farmstead now occupied by a rural non-farm family. The owner works in the city and the land is now not cultivated.

An interesting feature exists at I. This is an old CCC camp, erected during the 1930's, and composed of long, low buildings. Since the 1930's some of the buildings have been torn down. Those remaining, for a time, were used as overnight dwellings for summer tourists. In recent years, they, too, have been dismantled.

The lack of seasonal dwellings along the coast is noteworthy. As can be seen from Ground Photos 16-A and 16-B, the shoreline is rocky. Few sandy areas are to be found. The seasonal dwellings of the area are located inland from the coast and are closely tied to the main highway.

CHAPTER 8

SHORELINE FEATURES AND SETTLEMENT TYPES ASSOCIATED WITH FLAT OR GENTLY ROLLING BEDROCK UPLANDS

Flat or gently rolling bedrock uplands occur in areas of thin glacial drift cover where the underlying bedrock surface has slight to moderate relief. Therefore, only in the matter of relief does this landform differ significantly from rough bedrock upland.

Within the areas treated in this report, flat or gently rolling bedrock uplands are well illustrated by the Rockport, Massachusetts area. The Rockport area is characterized by thin drift, crystalline bedrock widely exposed along the coast and also inland in ledges, and moderate relief generally not more than a few tens of feet.

General Characteristics of Flat or Gently Rolling Bedrock Uplands

Airphotos 6-A and 6-B (see page 110) show the following characteristics of flat or gently rolling bedrock uplands:

(1) Moderate relief. Higher hills, as A, appear to be only a few tens of feet higher than lower parts, as at B.

(2) Some slopes may be steep, even though relief is small. Note steep slope at C.

(3) Bedrock may crop out on hills, as at D, or on steep slopes and cliffs, as E.

(4) Rock quarries may be present. No rock quarry can be definitely identified on Airphotos 6-A and 6-B. The pit at F appears to be a gravel pile in a low terrace.

(5) A parallel alignment of ridges and valleys may reflect such parallelism in underlying bedrock structure. Note that narrow valley from G to H is parallel to ridge from A to I.

(6) Road pattern may show considerable or small adjustment of topography, depending on amount of relief. Note location of roads at J and K, with respect to hills and valleys.

(7) Such areas if rough are poor for farming, due to thin stony soils and steep slopes. Most cultivation is likely to be in lower areas. Note low hills at A, I and C are in forest and appear to be idle land. Some cultivated fields are present in flatter land near L.

For the most part the settlement features pictured on Airphotos 6-A and 6-B are seasonal dwellings. Several types may be identified:

(1) Settlement Type 4A is illustrated by the development on Magnolia Point. The streets are laid out in a rectangular grid-pattern, for the most part, and dwellings front on north-south and east-west streets. The road following the irregular rocky shoreline shows adjustment to the topography. The dwellings are large and well-kept. Magnolia has long been an exclusive seasonal summer resort. The large building at M is a wooden hotel, of the type common to New England during the early part of the 20th century. A unique feature among New England seasonal settlements, but common to seasonal settlements in other well-to-do areas of the United States, is the business street at N. These shops cater only to the summer people. Most of them are closed during the off-season.

(2) Settlement Type 5B is represented at O. Although this is a part of the whole complex, known as Magnolia, it is the part of the settlement which functions throughout the year. Here are located the personal and retail services of the community. The small village grew up when farming was more widespread in the vicinity and served as a small trading center.

(3) Settlement Type 1B is represented at P. This type extends along the shore to the northeast to Gloucester. The seasonal dwellings are large, well-kept and represent summer homes of families with high income. Other dispersed seasonal dwellings are represented at Q.

(4) Settlement Type 5A is shown along the highway at R. A few of these are occupied by farmers; some work in nearby cities and towns. Some of the dwellings are seasonal homes and the type could be listed as 2B depending on their number.

(5) Settlement Type 2B is to be seen at S on the sandspit. The larger buildings on this spit are beach houses; one private, the other for use by hotel guests.

Ground Photos 6-A and 6-B (see page 110) show the following features characteristic of gently rolling bedrock uplands:

(1) Moderate relief. Highest points within field of view appear to be only a few tens of feet higher than lowest ones.

(2) Fairly steep slopes are present in foreground.

(3) Bedrock is widely exposed, and drift cover is evidently thin.

(4) No evidence of farming is present. The area is too rough and rocky.

The ground photos show dispersed seasonal dwellings, Settlement Type 1B, which exist just to the east of Magnolia. The residences are large and very well-kept. The dwellings are representative of those which dot the rocky coast from Magnolia to Gloucester.

Following are three examples of flat or gently rolling bedrock uplands.

Example 1
Flat or Gently Rolling Bedrock Uplands

Airphotos 7-A and 7-B (see page 111)
Ground Photos 7-A and 7-B (see page 111)
Map (see page 100)

A good example of flat to gently rolling bedrock upland is shown in Airphotos 7-A and 7-B. In this case, relief is even smaller than in areas of Airphotos 6-A and 6-B (see page 110).

Shoreline Features: The following characteristics of the landform type may be seen in Airphotos 7-A and 7-B:

(1) Relief is small. Hill A appears to be not more than 30 or 40 feet higher than plain, B.

(2) Some slopes are steep, as sides of low hill, A.

(3) Bedrock may crop out, as on hill, C, and shore cliff, D.

(4) Rock quarries may be present. None, however, can be positively identified on Airphotos 7-A and 7-B.

(5) A parallel alignment of topographic features, namely, ridge A-E and valley F-G, reflects the underlying bedrock structure.

(6) Because of small relief, winding road pattern shows adjustment to topography. Note course of road, H.

(7) Rougher parts of area, as A and E, are wooded, but flatter areas are cultivated, as B.

(7) Surface boulders may be numerous, but do not show on Airphotos.

Ground Photos 7-A and 7-B show the following features characteristic of flat or gently rolling bedrock uplands:

(1) Relief is small. Hill at left is not more than 20 feet high.

(2) Hill at left has moderately steep side slopes, though area is mainly flat.

(3) Bedrock crops out in low rocky knoll at right and small rocky hill at left.

(4) Rougher higher part of area in distance is wooded, but flat field in foreground is under cultivation as a hay field. Large barn is shown in background.

(5) Surface boulders have been collected and built into the stone wall on distant side of hay field.

Settlement Features: Airphotos 7-A and 7-B includes the area west of Rockport, Massachusetts, around Gap Head and to the south past Land's End (see map, page 100). In the northern part of the area shown the dwellings form a part of the city of Rockport, Settlement Type 5C. The residences are, in part, year-round dwellings, and in part, seasonal. There are, however, certain recognizable adjustments to land and sea features on the airphotos both within the city limits and southward to Land's End. These are as follows:

(1) On Gap Head and the small peninsula directly west of it, at I, the dwellings are dispersed and representative of Settlement Type 1B. They are large seasonal homes and very well-kept. They command an excellent view of the ocean and Sandy Bay. Other examples of Settlement Type 1B are at Flat Point, see J, and on Emerson Point, see K.

(2) A large number of summer dwellings are grouped in a linear fashion along roads, or at the top of small bluffs overlooking the rocky shoreline. These may be noted at L. Other agglomerations, typical of Settlement Type 2B in this area are found at tops of ridges inland a short distance from the shoreline. They command excellent views of the ocean because of the height of the land. Their locations have long been considered desirable sites for summer homes. Examples of these occur at M and N.

Selected settlement features shown on Airphotos, include the hotel at Land's End, at O. It overlooks a sandbar beach extending southward which is prized for swimming. Another summer hotel is at P.

Example 2
Flat or Gently Rolling Bedrock Uplands

Airphotos 17-A and 17-B (see page 123)
Ground Photos 17-A and 17-B (see page 123)
Map (see page 101)

Airphotos 17-A and 17-B show the settlement of Annisquam on peninsula in south center, Ipswich Bay at north, and Annisquam River at south. The area is on the northwest side of Cape Ann (see map, page 87).

Shoreline Features: The following features are associated in this shoreline area, and may be identified on Airphotos 17-A and 17-B.

(1) Gently rolling bedrock upland, recognized by rough topography of moderate relief -- compare height of hill, A with ocean level; parallel pattern of ridges A-B, and C-D, and adjacent bay, E-E. This indicates parallel structures in underlying bedrock. Irregular rocky coast line, with bedrock exposed, as F, G; steep or vertical slopes on hillsides, as at H; lack of evidence of present or past agricultural land use, indicating thin stony soil; close adjustment of roads and settlement pattern to irregularities of land surface; old stone quarry at I.

(2) Rocky shore, with gentle slope at some places, as at J, and steep slopes at others, as at K.

(3) Bays, as Lobster Cove, E-E, and Ipswich River, L, which has been drowned.

(4) Sandy clean beaches, as at M and N.

(5) Rocky peninsulas, as at F.

Ground Photos 17-A and 17-B show the view southwestward along the coast of Annisquam Village. Ipswich Bay is on the right. The following features among those in the association described above may be recognized in the Ground Photos:

(1) Gently rolling bedrock upland, wooded, at left.

(2) Gently rocky slope from edge of rocky upland to sea, in foreground and at left.

(3) Bays: Ipswich at right, and small cove in foreground.

(4) Sandy, clean beach, in cove in foreground.

(5) Rocky peninsulas, as in center beyond cove.

Settlement Types: Annisquam Village, shown on Airphotos 17-A and 17-B, is an agglomeration of seasonal dwellings, irregularly arranged. It may be classified as Settlement Type 3B. The location of dwellings within the agglomeration shows a close adjustment to the topography. Some are aligned along the ocean front as at O; others have been built at the top of ridges, as at A and B, and command an excellent view of the ocean. Still others are aligned along the main road which serves the agglomeration. A few commercial outlets, including a post office, exist at P. These function, however, only during the summer season, and may be classified as Type 7. Small piers extend into Lobster Cove at Q, and there is a Yacht Club and boat service station at R.

Across the mouth of the Annisquam River, at S, is Wingaersheek Beach, used by residents of Gloucester. A small agglomeration of seasonal dwellings is at T. This is another example of Settlement Type 3B, but the dwellings are much smaller in size than those to be found in Annisquam.

Ground Photos 17-A and 17-B show two of the seasonal dwellings at Annisquam. They are located along the coastline and are of high quality. In the distance may be seen Wingaersheek Beach and the end of Farm Point on which there is the small cluster of summer homes, referred to above.

Example 3
Flat or Gently Rolling Bedrock Uplands

Airphotos 18-A and 18-B (see page 124)
Ground Photos 18-A and 18-B (see page 124)
Map (see page 99)

The area included in Airphotos 18-A and 18-B is on the mainland shore of Massachusetts Bay about four miles southwest of Gloucester (see map, page 87). The general characteristics of this area of gently rolling bedrock upland have been described under Airphotos 6-A and 6-B of this report (see pages 69-71).

Shoreline Features: The following features are associated in the shoreline of this area and may be identified on Airphotos 18-A and 18-B:

(1) See pages 69-70 for evidences that mark this as gently rolling bedrock upland.

(2) Rocky shore with gentle slope, as at A.

(3) Sandy clean beach, white band at B.

(4) Bouldery beach, inferred to be associated with irregular rocky shoreline at such places as C.

(5) Spit or bar closing off coastal lake, at D.

(6) Sea wall, vertical features below roadway, at E.

(7) Piers, as at F.

Ground Photos 18-A and 18-B show the view north along the west side of Magnolia Harbor from the seawall at the southwest corner of the Village of Magnolia. The following features among those listed in the association enumerated above may be seen in Ground Photos 18-A and 18-B.

(1) Gently rolling bedrock upland on distant skyline.

(2) Sandy clean beach, in left distance.

(3) Bouldery beach, in foreground.

(4) Spit or bar closing off coastal lake, beyond sandy beach in left distance.

(5) Seawall of masonry at right.

(6) Piers, supported on driven piles, in water in foreground.

Settlement Types: Types of settlement which are illustrated on Airphotos 18-A and 18-B have been described on pages 70-71 of this report.

Ground Photos 18-A and 18-B show the development of settlement on the spit or bar at the end of Magnolia Harbor. Settlement Type 2B has developed on this landform. The dwellings are interspersed with private beach clubs, one of which is shown in the ground photographs. Note the smaller, more closely spaced homes on the north side of the main highway. They are new and occupy a less desirable site than those which front on the beach. Although the dwellings are normally closer than average for Settlement Type 2B, they are large and are of a higher grade than those normally associated with 2A.

CHAPTER 9

LANDFORMS OCCURRING IN THE RESEARCH AREAS BUT NOT DIRECTLY ASSOCIATED WITH THE FORMER GLACIATION

Two types of landforms occur in the research areas treated in this report which are not directly associated with former glaciation. These include: high sand dunes and tidal river basins.

High Sand Dunes

High sand dunes occur in two areas among those treated in this report: (1) the long peninsula known as Sandy Neck lying between Cape Cod Bay and Barnstable Harbor-Great Marshes lowland on the north side of Cape Cod, and (2) three peninsulas on the west side of Ipswich Bay, northwest of Cape Ann in the Rockport area.

Sandy Neck is well shown on the Hyannis quadrangle map of the U. S. Geological Survey (see maps, pages 93 and 102. It i a sandspit seven or eight miles long by half a mile wide, built eastward by longshore currents on the north side of Barnstable Harbor. Great Marshes represents a partial filling of the embayment thus cut off. The sands of the growing sandspit have been swept up by winds and built into dunes, many of which show, by their scalloped ground plan with concavities to the west, that westerly winds were dominant in their formation.

The three peninsulas of the second area are adjacent to Ipswich Bay. Plum Island at the norwest is a long narrow

sandspit built southward and surmounted by high dunes. There is salt marsh on its landward side adjacent to the bay called Plum Island River. Castle Neck, farther south, was built eastward as a sandspit from Castle and Steep Hills, enclosing Castle Neck River and associated salt marsh area on the south. High dunes surmount the sandspit. Coffin Beach, a little farther east, is a sand bar and beach connecting rocky ledges at its west and east ends. High dunes have been built by wind action at both the west and east ends of Coffin Beach. Airphotos 19-A and 19-B picture an example of high sand dunes.

Example 1
High Sand Dunes

Airphotos 19-A and 19-B (see page 125)
Ground Photos 19-A and 19-B (see page 126)
19-C and 19-D (see page 126)
Map (see page 102)

Airphotos 19-A and 19-B show Cape Cod Bay at north, Sandy Neck (Qbs) with its high dunes, Great Marshes (Qal) with Scorton Creek and other tidal rivers, and at the south, low pitted outwash plain (Qou) (see map, page 87).

Shoreline Features: The following features are associated in this shoreline area, and may be identified on Airphotos 19-A and 19-B:

(1) High sand dunes, recognized by extensive area of sand (light tone) with sparse vegetation (note dark patches, as at A); crescent plan of many of the dunes with concave side toward northwest and west, from which dune-building winds came, as at B; festooned plan of such crescent ridges where joined at ends, as at C; association with extensive beach at north, a source for the sand; lack of roads, which are difficult to build and maintain in sand dunes. The only road shown skirts edge of Great Marsh at D; lack of houses; lack of evidences of agricultural land use.

(2) Low sand dunes, similar in other respects than height to high dunes.

(3) Sandy clean beach, at E.

(4) Sand spit or bar.

(5) Low bluff in edge of dunes above beach, at F and F.

Ground Photos 19-A and 19-B show the view northwestward toward Cape Cod Bay from the top of a high dune known as White Hill. The following features among the shoreline association enumerated above may be recognized in these photos:

(1) High sand dunes, in right foreground.

(2) Low sand dunes, in center middle distance.

(3) The sand spit or bar on which the dunes are built, underlies area shown.

Ground Photos 19-C and 19-D show the view westward along the shore of Cape Cod Bay, from a point somewhat west of White Hill. The following features among the association enumerated above may be seen in Ground Photos 19-C and 19-D:

(1) Low sand dunes, at left.

(2) Sandy clean beach at right.

(3) Sand spit, elongated and curved, on which dunes and beach are developed.

(4) Low bluff in edge of dunes above beach, in center of view extending into distance.

Settlement Features: Although Airphotos 19-A and 19-B show no dwellings, both east and west of the area pictured in these photographs there are small, dispersed seasonal cottages, Settlement Type 1B, very small in size and difficult to reach over a sandy roadway. An interesting settlement feature of the Great Marshes is shown at G. These are hunting shacks used by duck hunters during the hunting season, and unoccupied during the rest of the year.

On the outwash plain in the southern part of the area pictured the land has been cleared for farming, as at H, and Settlement Type 5A has developed along the highway in the lower left hand corner of the photograph.

No settlements can be seen in Ground Photos 19-A and 19-B, or 19-C and 19-D.

Tidal River Basins

Within the areas treated in this report, tidal rivers occur (1) on both the north and south sides of Cape Cod and (2) on the south side of Cape Ann near Gloucester and on the north side adjacent to Ipswich Bay (see map, page 87). No good examples are present in those parts of the Camden area studied for this report, inasmuch as the extensive areas of coastal marsh associated with this landform type do not occur in the rugged Camden area.

In areas studied, tidal streams are associated with extensive salt marsh areas at or near high tide level. Such salt marsh is commonly seen on aerial photos to be lined and crossed with connecting shallow ditches, dug in recent years as part of a mosquito abatement program in eastern Massachusetts. An example of a tidal river basin follows:

Example 1
Tidal River Basins

Airphotos 20-A and 20-B (see page 127)
Ground Photos 20-A and 20-B (see page 127)
Map (see page 103)

Airphotos 20-A and 20-B show Sandwich Harbor (inlet between jotties at A); Mill Creek, B; Dock Creek, C, and Old Harbor Creek, D; the village of Sandwich, E; areas of Scorton low rolling moraine (Qscm) at northwest and west; sandspit and beach with low dunes along shore of Cape Cod Bay; and areas of low outwash (Qou) adjacent to salt marsh (Qal).

Shoreline Features: The following features are associated with tidal rivers in this area, and may be identified on Airphotos 20-A and 20-B:

(1) Tidal rivers as Mill Creek, B, recognized by the great width of stream channel in comparison to length of stream and size of drainage basin; its association with salt marsh, F-F; meanders as at B and G.

(2) Sandspit or bar, as at H.

(3) Sand dunes, low, surmounting sandspit, as low hills, at I.

(4) Salt marsh, F and F, recognized by its flat surface near sea level; its dark vegetation of low marsh plants; drainage ditches, as at J and K; low bridge or causeway at L, leading across marshy ground from Sandwich Village to beach.

Ground Photos 20-A and 20-B show a view looking across marshes toward northeast, from end of road from Sandwich, at M. The following associated features among those enumerated above may be recognized:

(1) Tidal river, Mill Creek, at right and beneath bridge.

(2) Sandspit or bar; ridge in distance.

(3) Sand dunes, low; bare and partly grassed hillocks on sandspit in distance.

(4) Salt marsh bog, flat plain in middle of view, which is at low tide. One of the straight drainage ditches for mosquito abatement enters Mill Creek from rear, just right of center of view. At left is the plank causeway which provides dry footing across the salt marsh from Sandwich to the distant dunes and beach.

Settlement Features: Airphotos 20-A and 20-B show a portion of the agglomerated urban settlement of Sandwich, Settlement Type 5C. It will be noted how closely the edges of the settlement conform to the boundaries of the outwash plain, Qou.

Rural dispersed dwellings occur where slopes are not too steep on the Scorton low rolling moraine, as at N. Throughout the Cape Cod area this particular landform type was cultivated by early settlers. Since the time of photography, the Scorton low rolling moraine at O has been platted and dwellings have been built. The residences are occupied the year-round, for the most part, and the settlement may be classified as 6C. It is, in fact, an extension of Sandwich.

It is also interesting to note the lack of seasonal dwellings along the sand dunes at the water's edge. On many similar sites in the three areas treated in this report, Settlement Type 2A is not uncommon. This stretch of beach has been kept, however, as a town beach for the town of Sandwich. It is reached by a plank causeway across the salt marsh, shown in Ground Photos 20-A and 20-B.

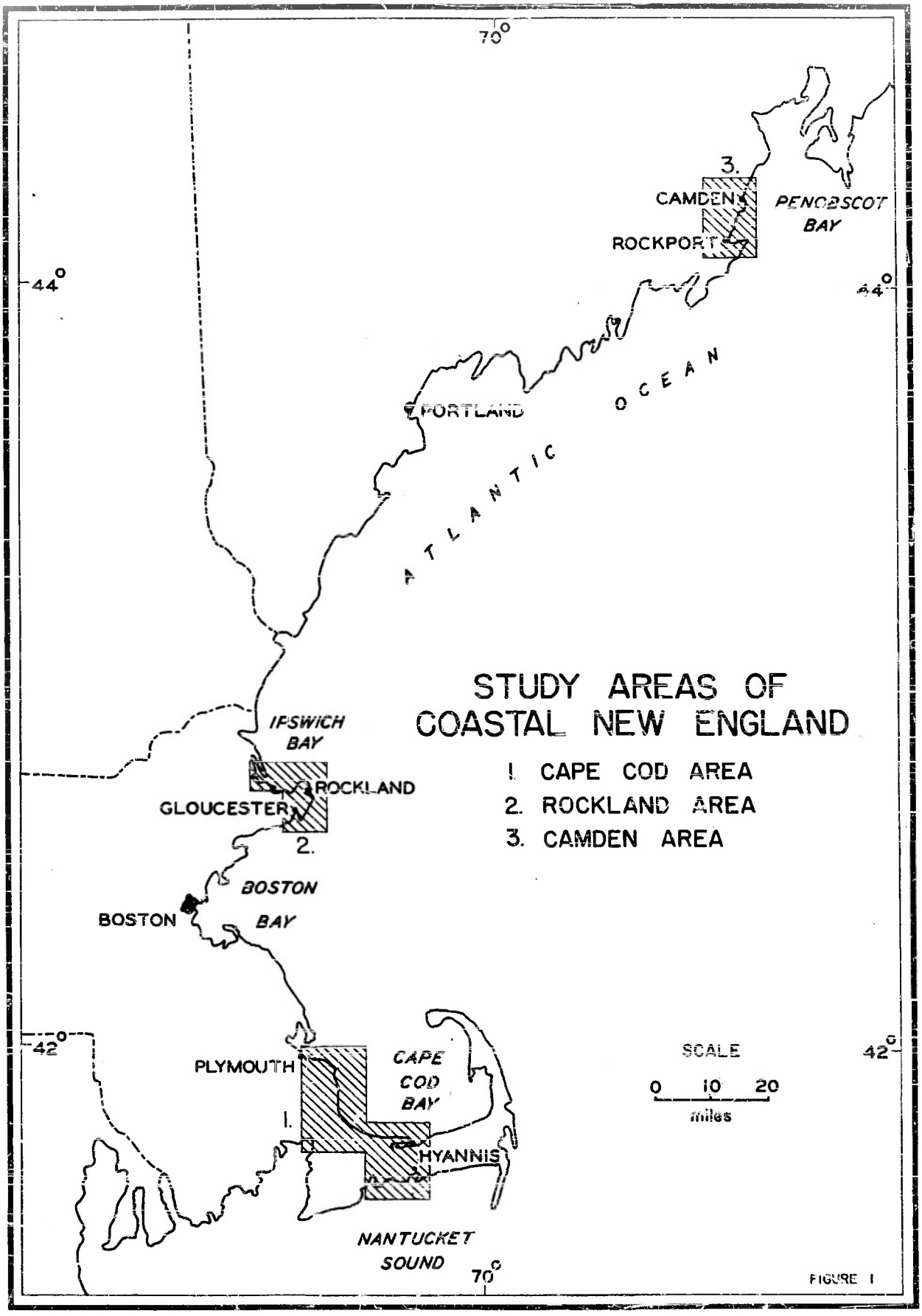
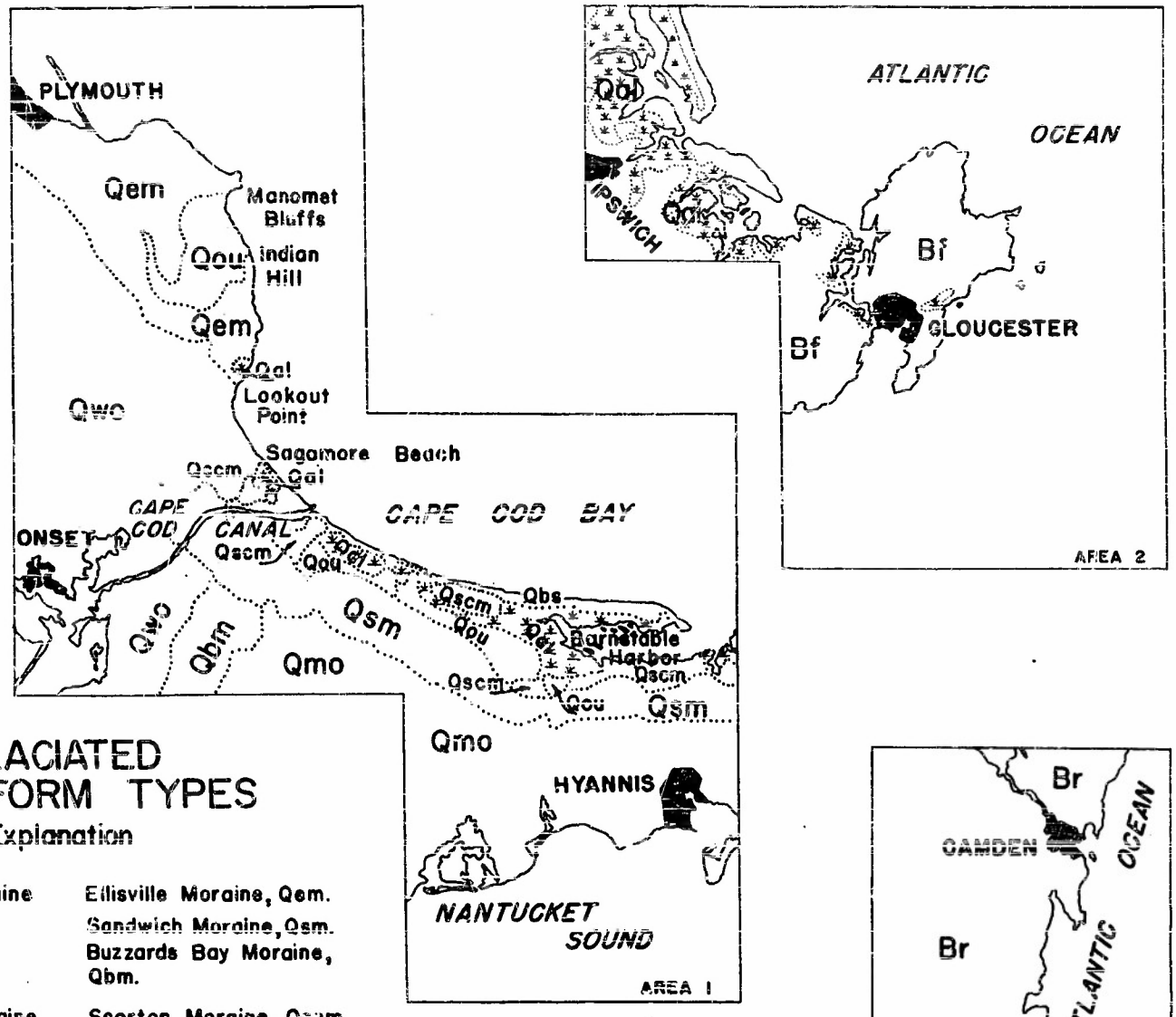

70°
44°
44°
42°
42°
70°
3.
CAMDEN
ROCKPORT
PENOBSCOT BAY
PORTLAND
ATLANTIC OCEAN
IPSWICH BAY
ROCKLAND
GLOUCESTER
2.
BOSTON
BOSTON BAY
PLYMOUTH
CAPE COD BAY
1.
HYANNIS
NANTUCKET SOUND
STUDY AREAS OF COASTAL NEW ENGLAND
1. CAPE COD AREA
2. ROCKLAND AREA
3. CAMDEN AREA
SCALE
0 10 20
miles

FIGURE 1



GLACIATED LANDFORM TYPES

Explanation

High Rough Moraine	Ellisville Moraine, Qem. Sandwich Moraine, Qsm. Buzzards Bay Moraine, Qbm.
Low Rolling Moraine	Scorton Moraine, Qscm.
High Rough Pitted Outwash Plain	Wareham Pitted Plain, Qwo. Uncorrelated Outwash Deposits, Qou.
Low Pitted Outwash Plain	Mashpee Pitted Plain, Qmo, Uncorrelated Outwash Deposits, Qou.
Low Non-Pitted Outwash Plain	No large mappable units, forms parts of Low Pitted Outwash; Qmo and Qou.
Rough Bedrock Upland	Br
Flat or Gently Rolling Bedrock Upland	Bf
Salt Marsh	Qal
Sand Beach	Qbs

AREA KEY

1. CAPE COD AREA
2. ROCKPORT AREA
3. CAMDEN AREA

SCALE

0 5 10 miles

FIGURE 2

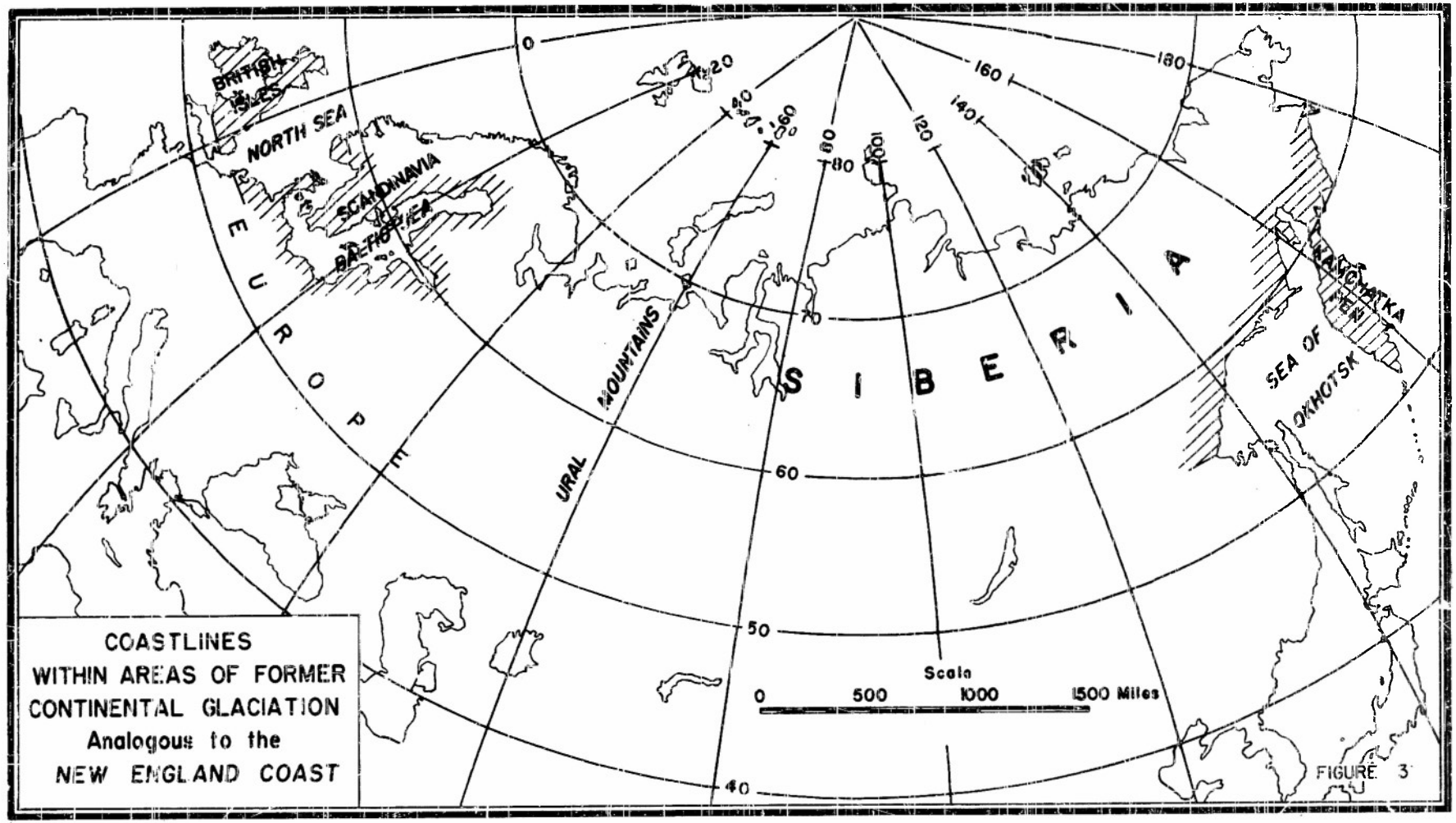

BRITISH ISLES
NORTH SEA
SCANDINAVIA
BALTIC SEA
EUROPE
URAL MOUNTAINS
SIBERIA
KAMCHATKA PEN.
SEA OF OKHOTSK
0
20
40
60
80
100
120
140
160
180
70
60
50
40
Scale
0 500 1000 1500 Miles
COASTLINES
WITHIN AREAS OF FORMER
CONTINENTAL GLACIATION
Analogous to the
NEW ENGLAND COAST

FIGURE 3

Figure 4. Portion of U.S.G.S. Hyannis, Mass., quadrangle showing Air and Ground Photos 1-A and 1-B at left, and Air and Ground Photos 11-A and 11-B at right. Physical features include: Qal-salt marsh, Qmo-low pitted outwash plain, Qou-uncorrelated outwash deposits, Qscm-low rolling moraine, and Qsm-high rough moraine. Scale: 1 inch equals 1/2 mile.

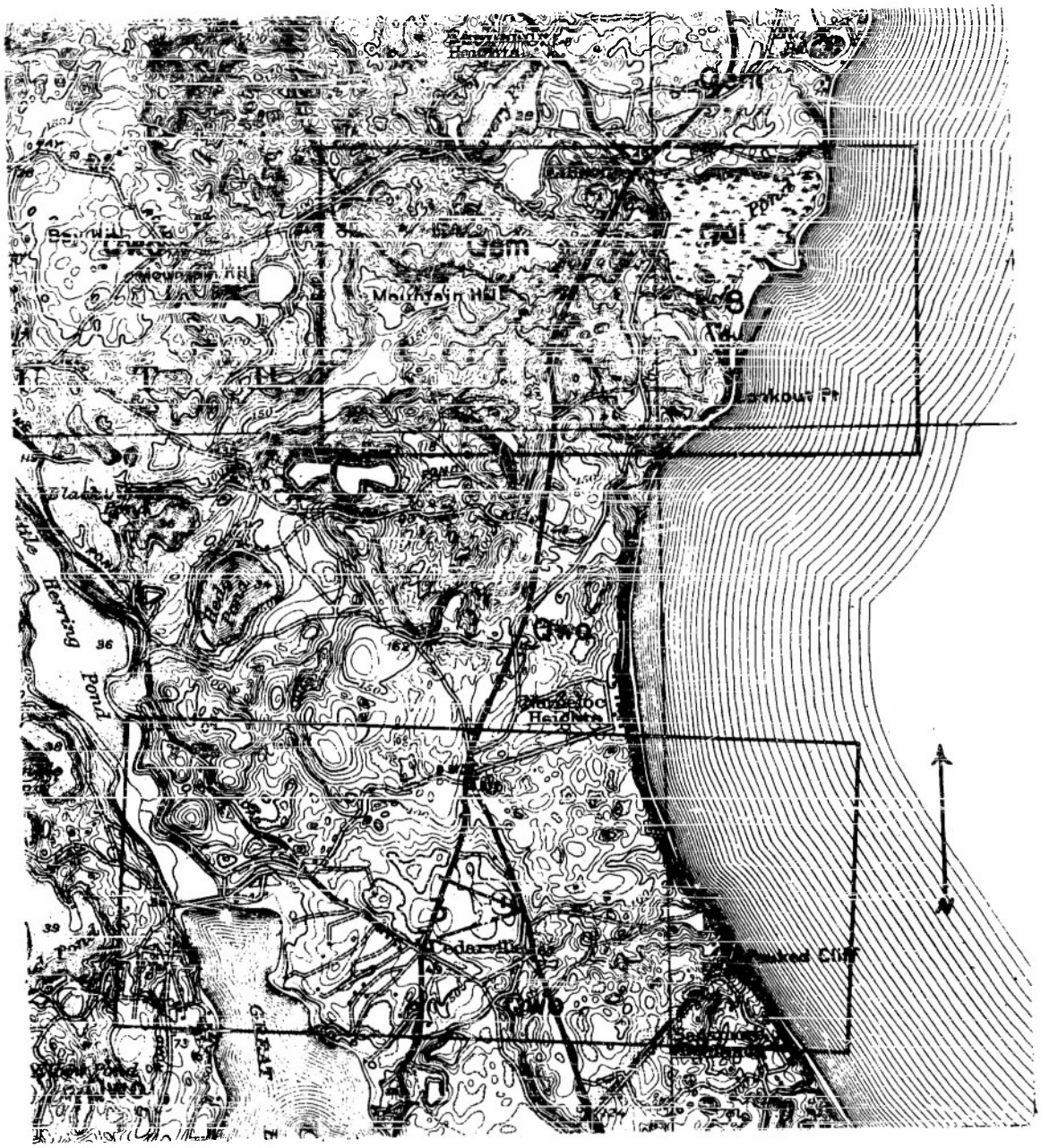


Figure 5. Portion of U.S.G.S. Sagamore, Mass., quadrangle showing Air and Ground Photos 8-A and 8-B at top, and Air and Ground Photos 3-A and 3-B at bottom. Physical features include: Qem-high rough moraine, and Qwo-high rough pitted outwash plain. Scale: 1 inch equals 1/2 mile.

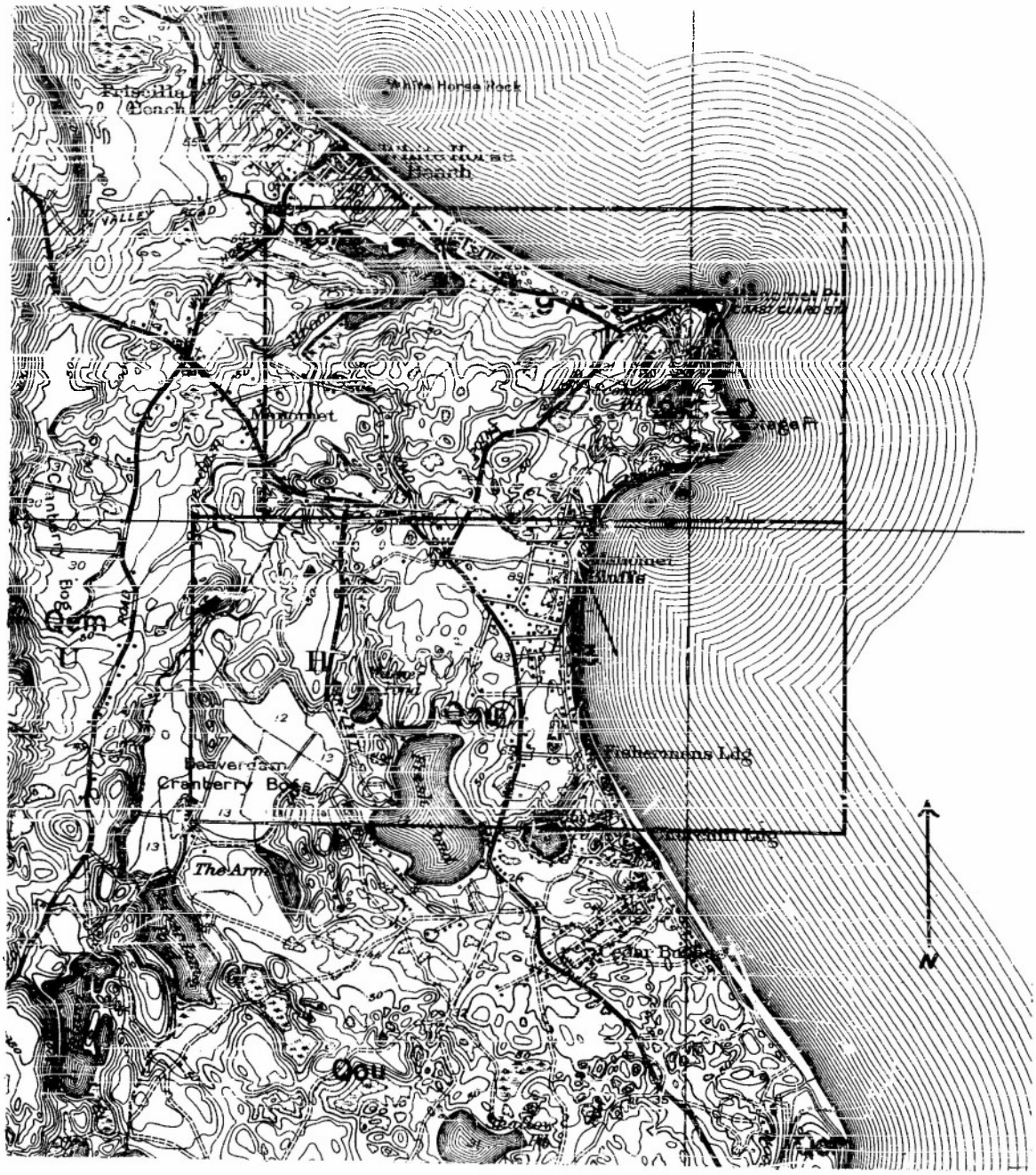
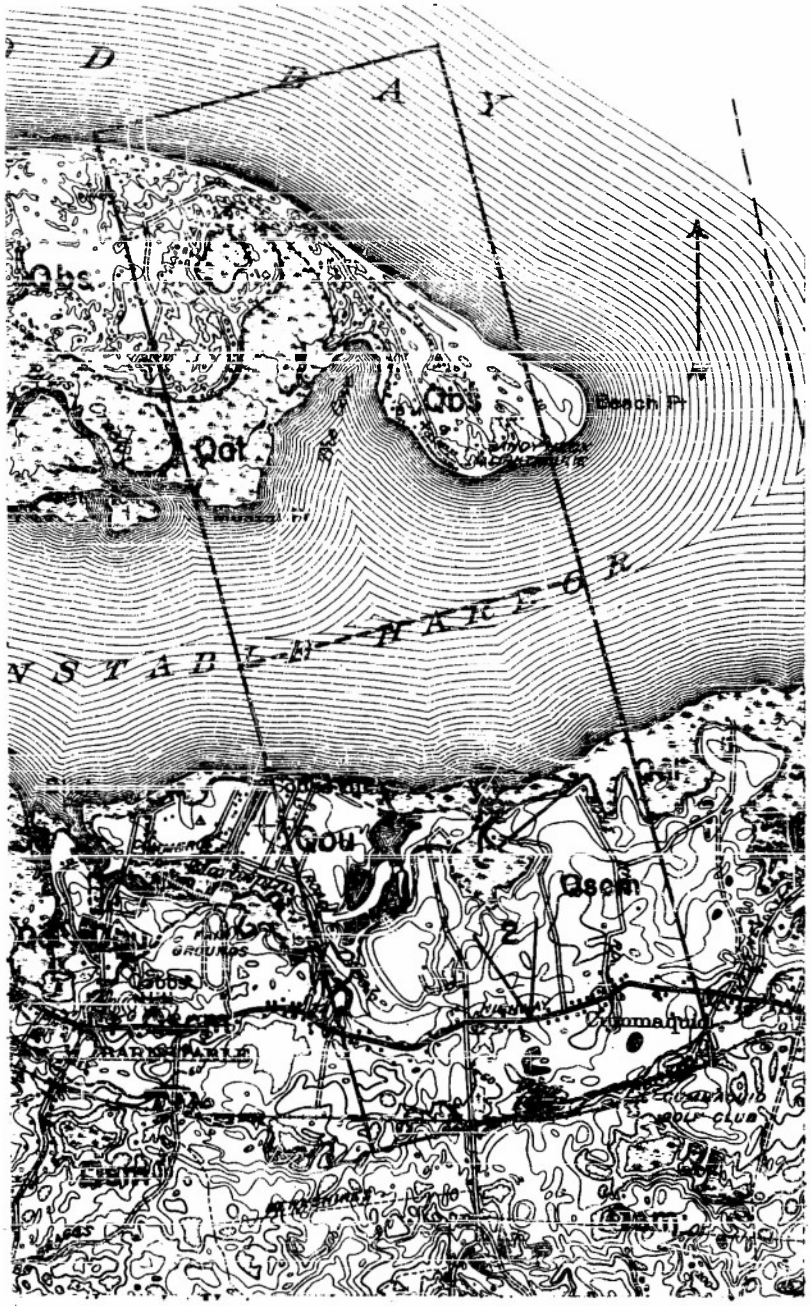


Figure 6. Portion of U.S.G.S. Manomet, Mass., quadrangle showing Air Photos 9-A and 9-B and Ground Photos 9-A and 9-B, 9-C and 9-D at top, and Air and Ground Photos 13-A and 13-B below. Physical features include: Qem-high rough moraine, and Qou-uncorrelated outwash deposits. Scale: 1 inch equals 1/2 mile.

Figure 7. Portions of U.S.G.S. Manomet and Sagamore, Mass., quadrangles showing Air and Ground Photos 10-A and 10-B. Physical features include: Qou-uncorrelated outwash deposits, Qom-high rough moraine, and Quo-high rough pitted outwash plain. Scale: 1 inch equals 1/2 mile.


Qbs
Qbs
Beach Pt
Qal
Qou
Qscm
Qscm
Qscm

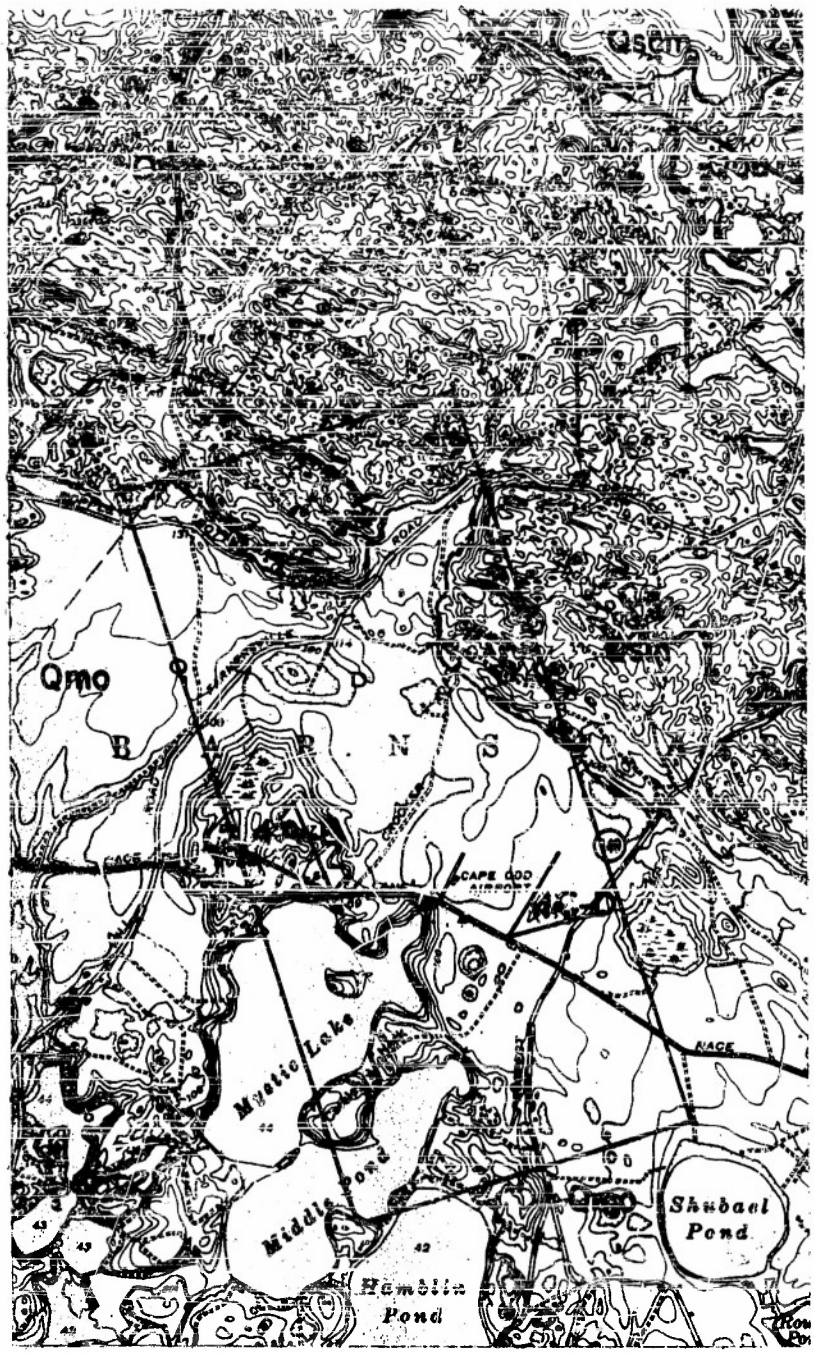


Figure 9. Portion of U.S.G.S. Sandwich, Mass., quadrangle showing Air Photos 4-A and 4-B, and Ground Photos 4-A and 4-B, 4-C and 4-D. Physical features include: Qou-uncorrelated outwash deposits, Qmo-low pitted outwash plain, Qmm-high rough moraine, and Qscm-low rolling moraine. Scale: 1 inch equals 1/2 mile.

Figure 10. Portion of U.S.G.S. Hyannis, Mass., quadrangle showing Air and Ground Photos 14-A and 14-B. Physical feature: Qmo-low pitted outwash plain. Scale: 1 inch equals 1/2 mile.

Figure 11. Portion of U.S.G.S. Hyannis, Mass., quadrangle showing Air and Ground Photos 15-A and 15-B. Physical feature: Qmo-low pitted outwash plain. Scale: 1 inch equals 1/2 mile.

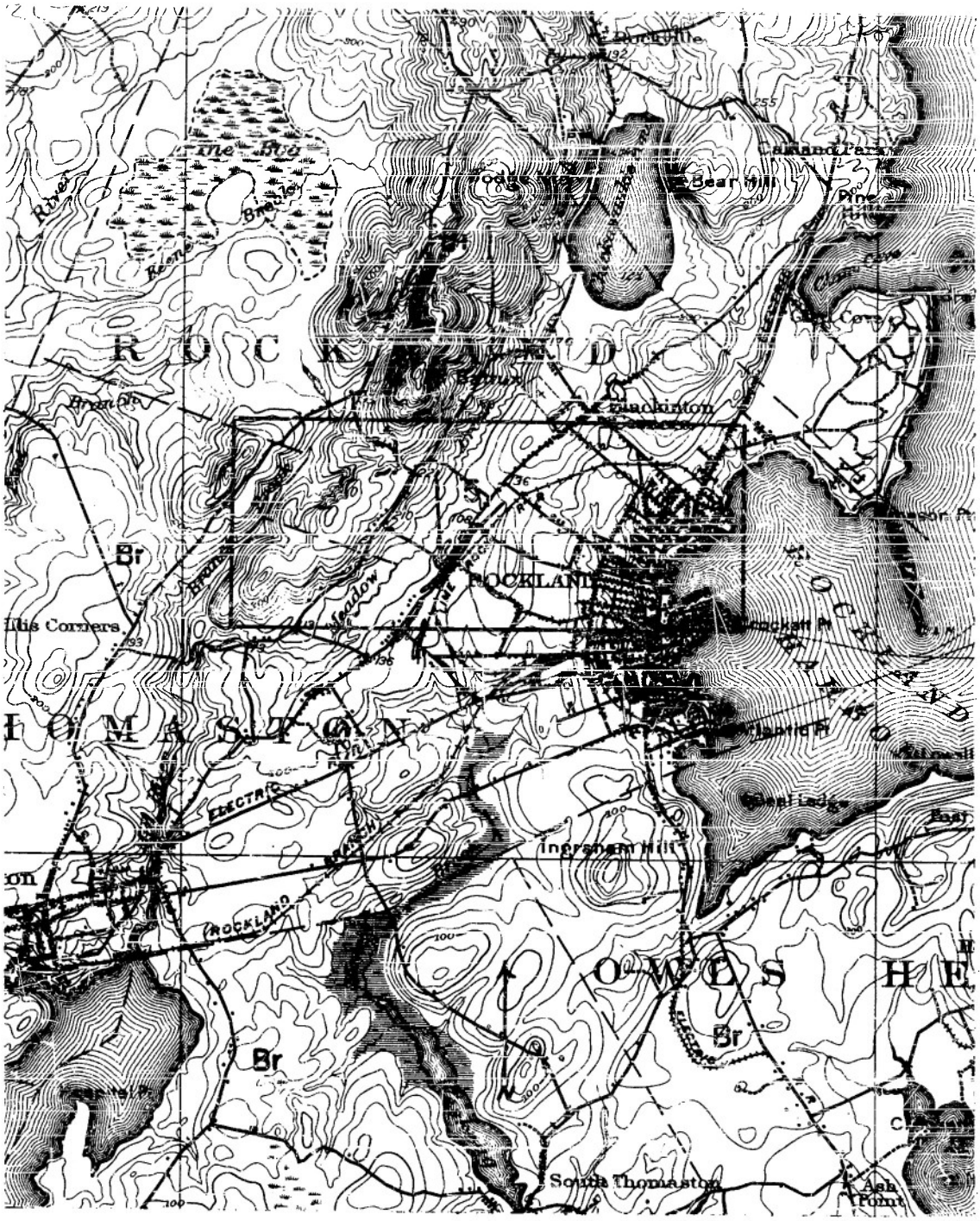


Figure 12. Portion of U.S.G.S. Rockland, Maine, quadrangle showing Air and Ground Photos 5-A and 5-B. Physical feature: Br-rough bedrock upland. Scale: 1 inch equals 1 mile.

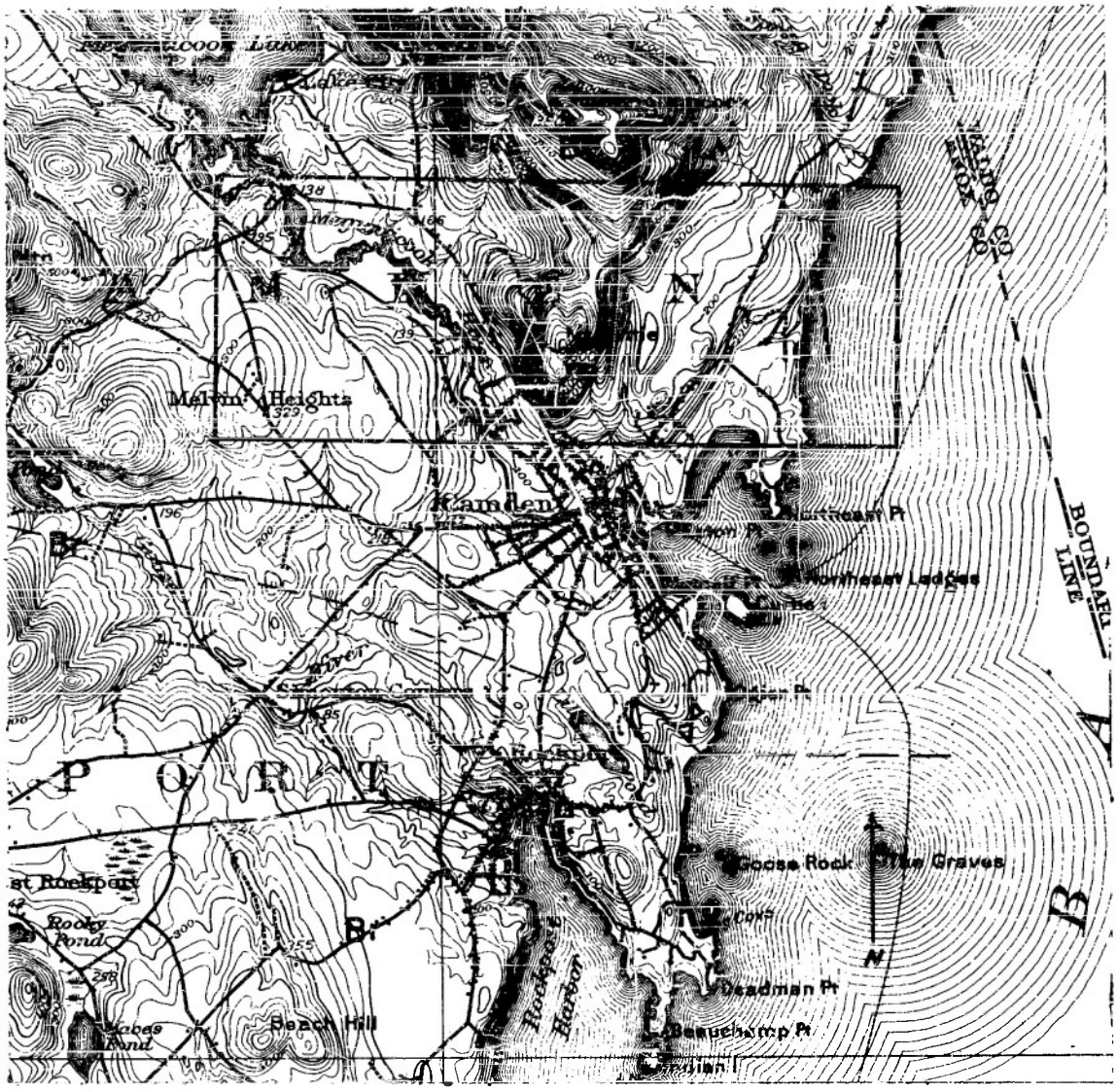


Figure 13. Portion of U.S.G.S: Rockland, Maine, quadrangle showing Air and Ground Photos 16-A and 16-B. Physical feature: Br-rough bedrock upland. Scale: 1 inch equals 1 mile.

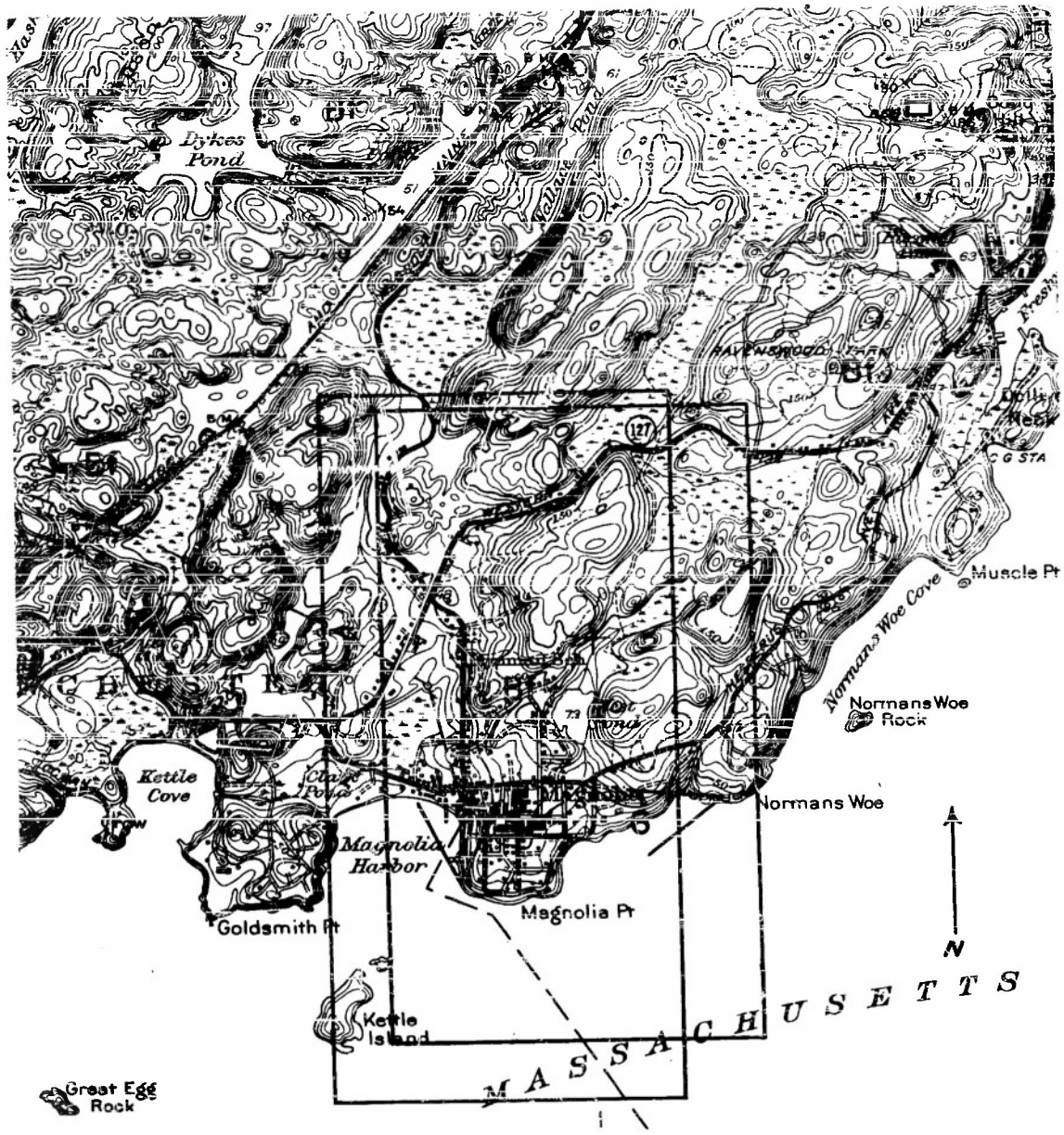


Figure 14. Portion of U.S.G.S. Gloucester, Mass., quadrangle showing Air and Ground Photos 6-A and 6-B (right strip) and Air and Ground Photos 18-A and 18-B (left strip). Physical features: Bf-bedrock upland. Scale: 1 inch equals 1/2 mile.

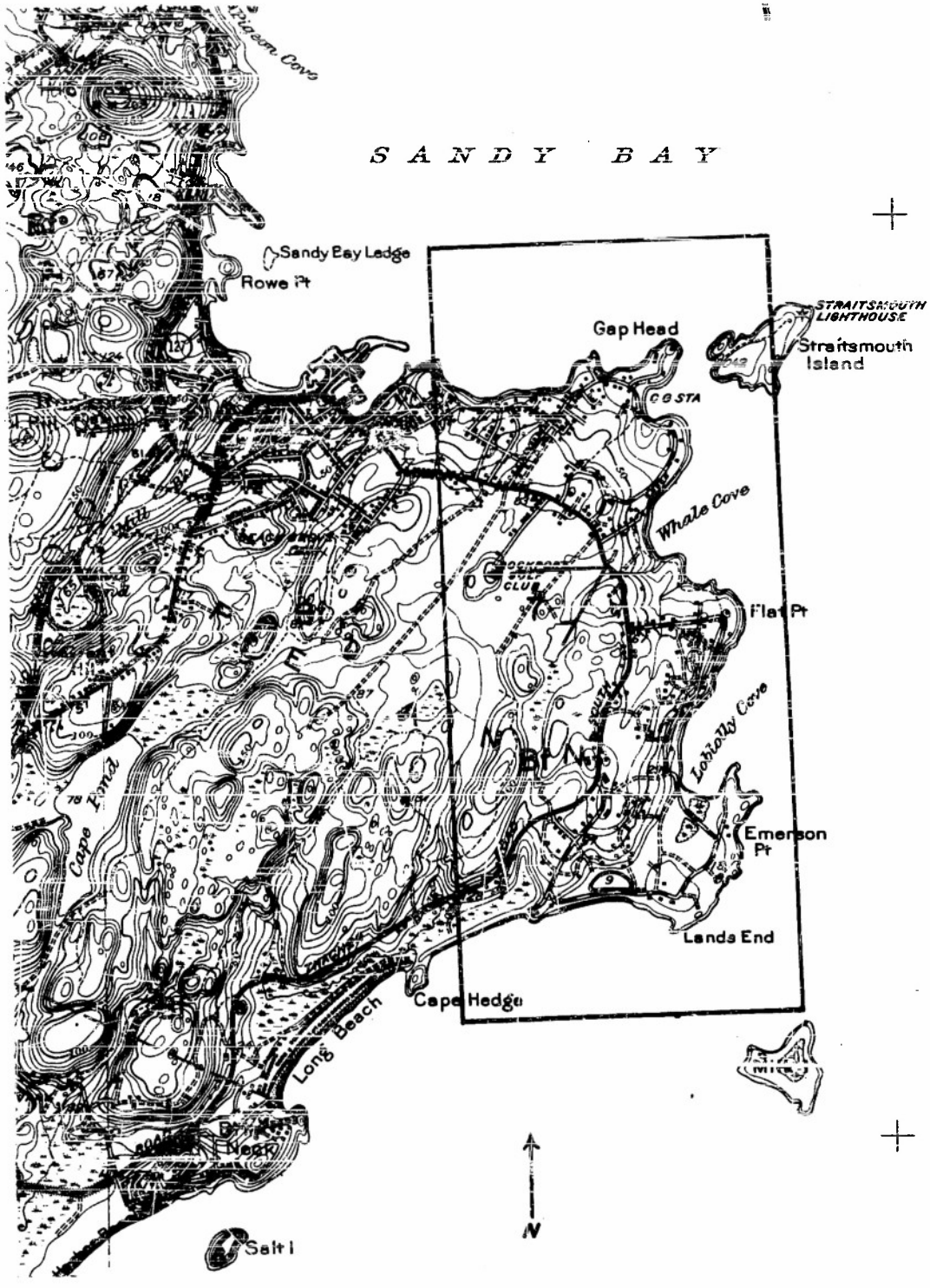


Figure 15. Portion of U.S.G.S. Rockport, Mass., quadrangle showing Air and Ground Photos 7-A and 7-B. Physical feature: Bf-bedrock upland. Scale: 1 inch equals 1/2 mile.

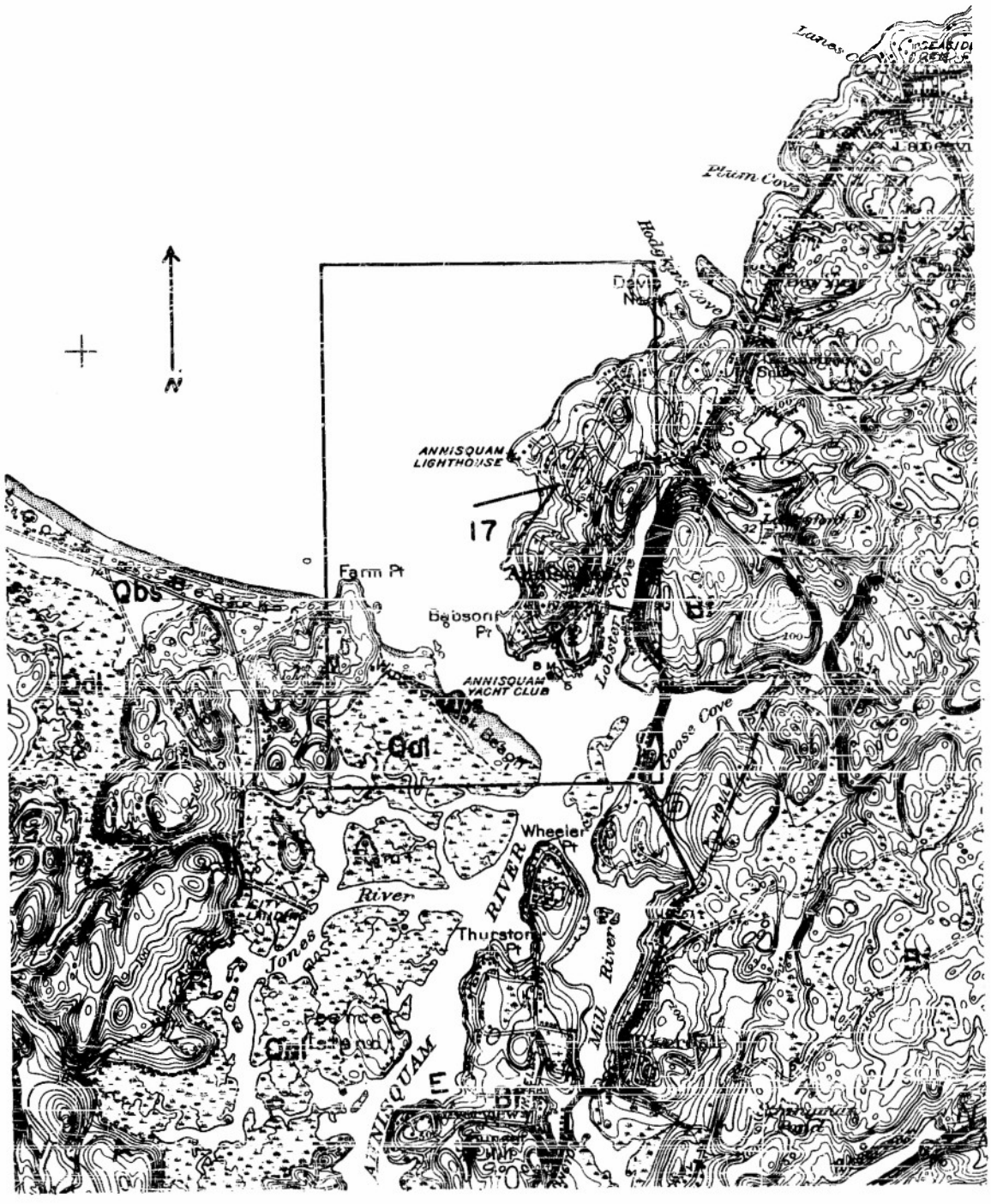


Figure 16. Portion of U.S.G.S. Gloucester, Mass., quadrangle showing Air and Ground Photos 17-A and 17-B. Physical features: Bf-bedrock upland, Qal-salt marsh, and Qbs-sand beach. Scale: 1 inch equals 1/2 mile.

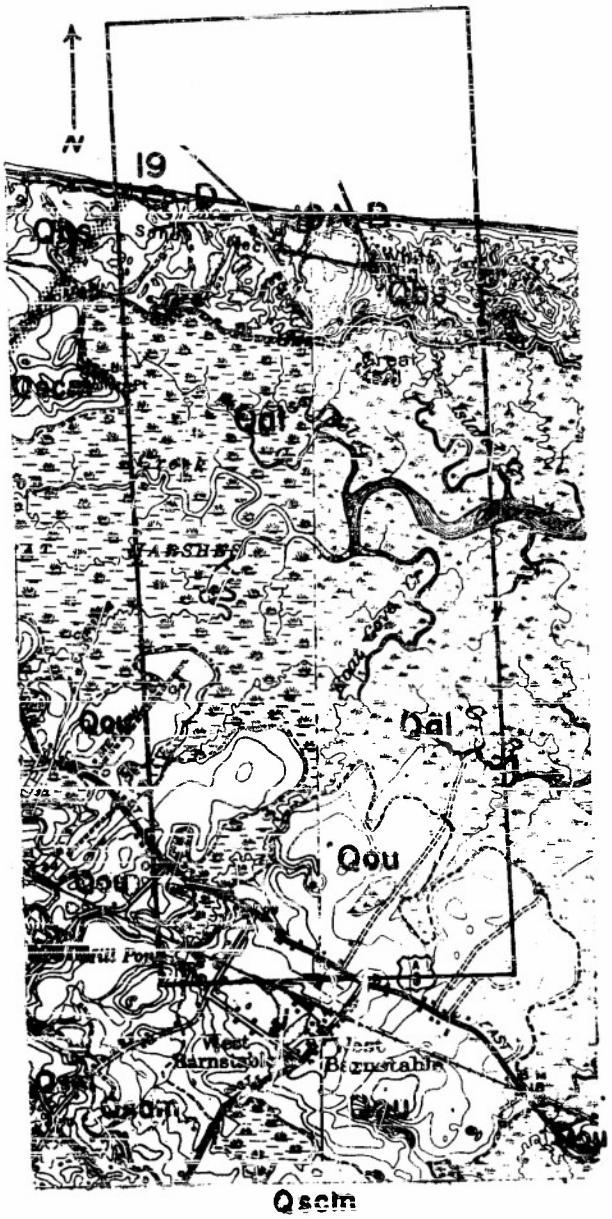


Figure 17. Portions of U.S.G.S. Sandwich and Hyannis, Mass., quadrangles showing Air Photos 19-A and 19-B and Ground Photos 19-A and 19-B, 19-C and 19-D. Physical features: Qbs-sand beach, Qal-salt marsh, Qou-uncorrelated outwash deposits, Qsm-high rough moraine, and Qsom-low rolling moraine. Scale: 1 inch equals 1/2 mile.

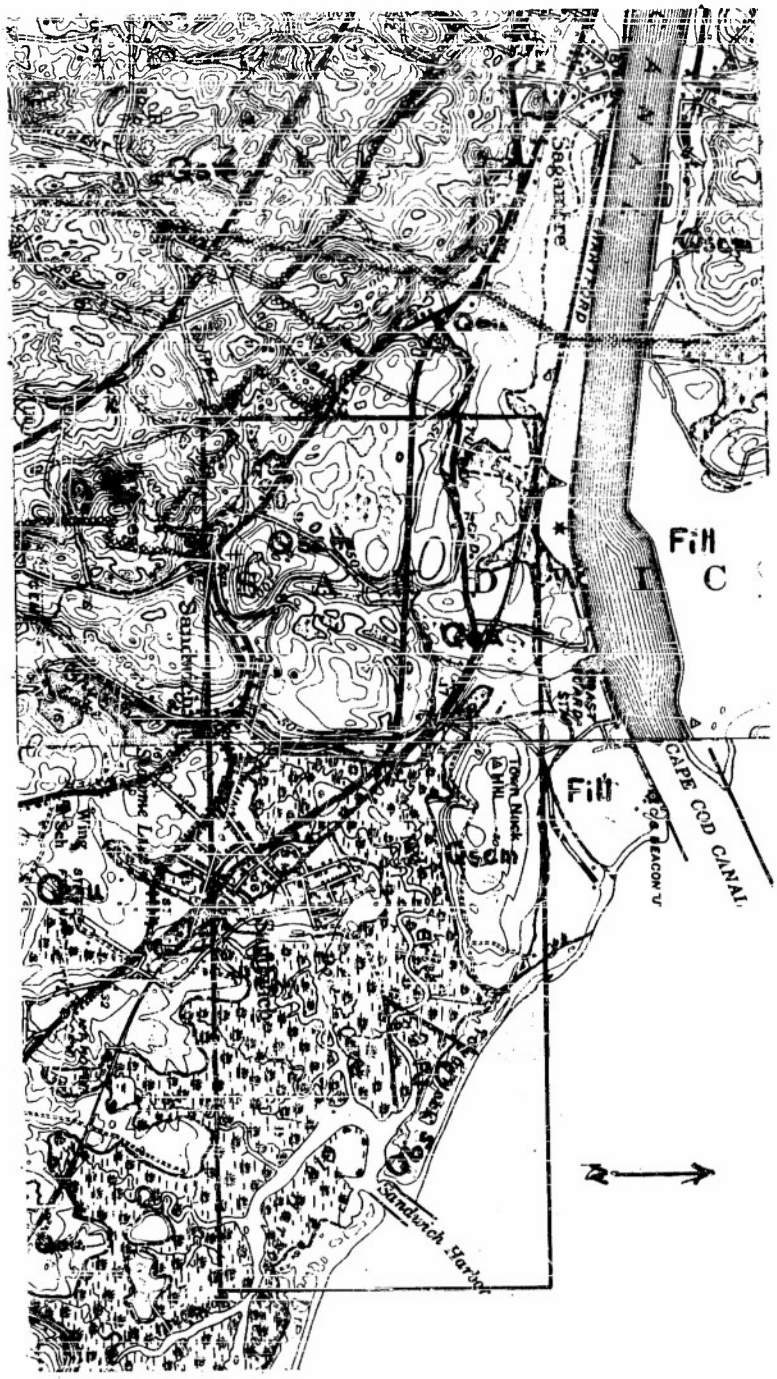
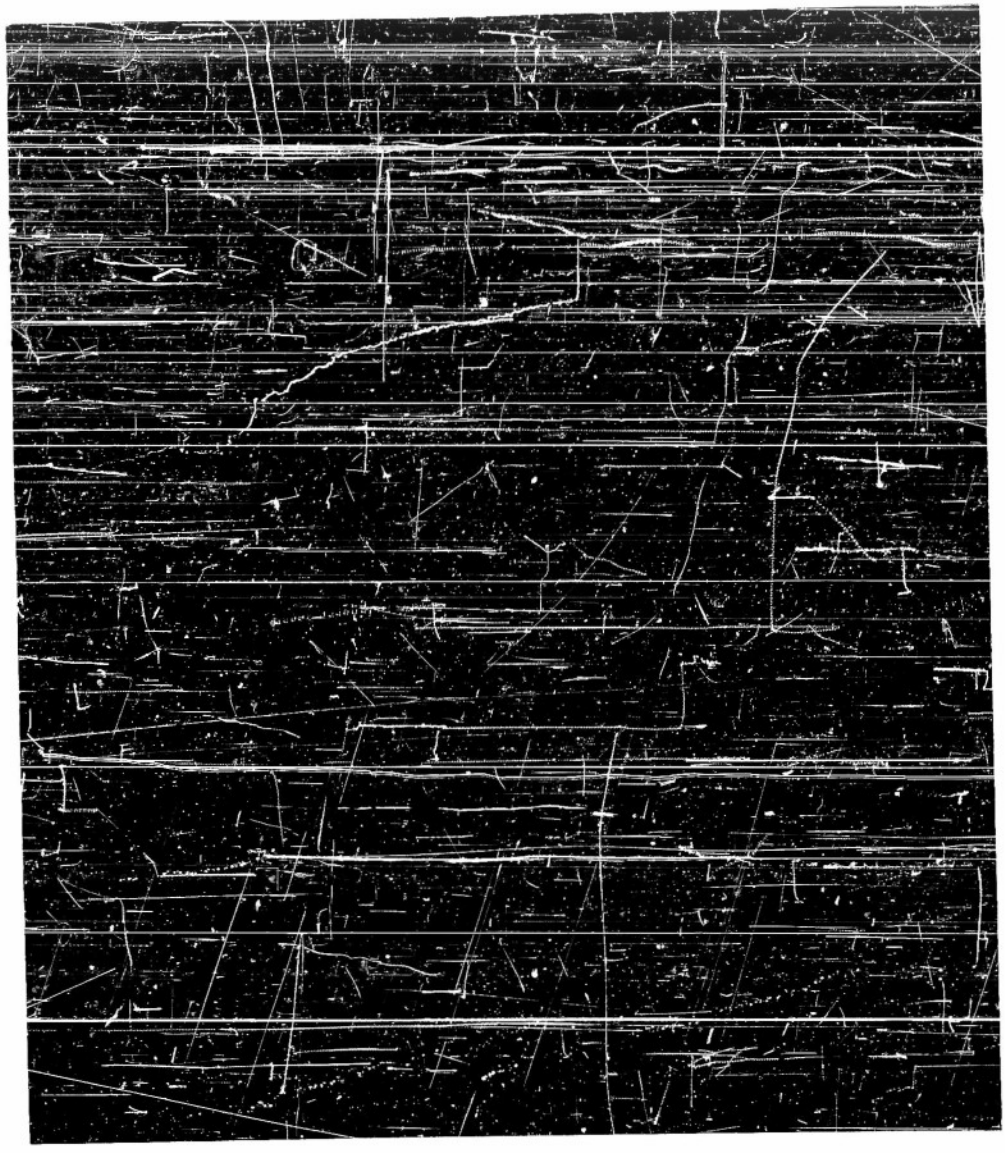


Figure 18. Portions of U.S.G.S. Sandwich and Sagamore, Mass., quadrangles showing Air and Ground Photos 20-A and 20-B. Physical features: Qscm-low rolling moraine, Qou-uncorrelated outwash deposits, Qsm-high rough moraine, and Qbs-sand beach. Scale: 1 inch equals 1/2 mile.



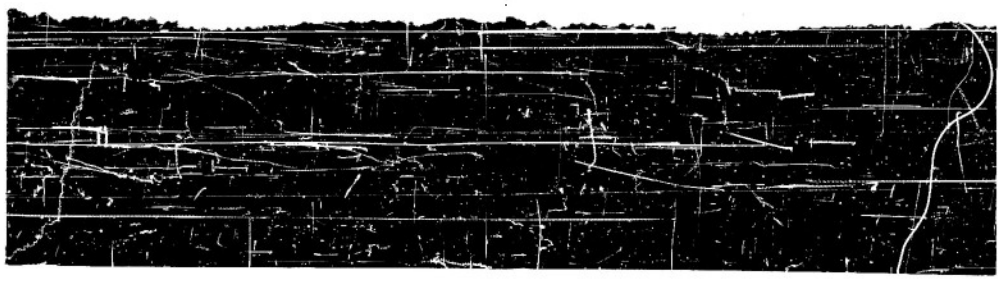
Airphotos 1-A and 1-B. Stereogram of area between Wequaquet Lake and Great Marshes, east of West Barnstable, in northwest part of Hyannis quadrangle. (See map, page 89; see text, pages 19-20).

Ground Photos 1-A and 1-B. Stereopair of view of high rough moraine, looking northwest from Shootflying Hill. (See map, page 89; see text, pages 19-20; and Airphotos 1-A and 1-B, above).

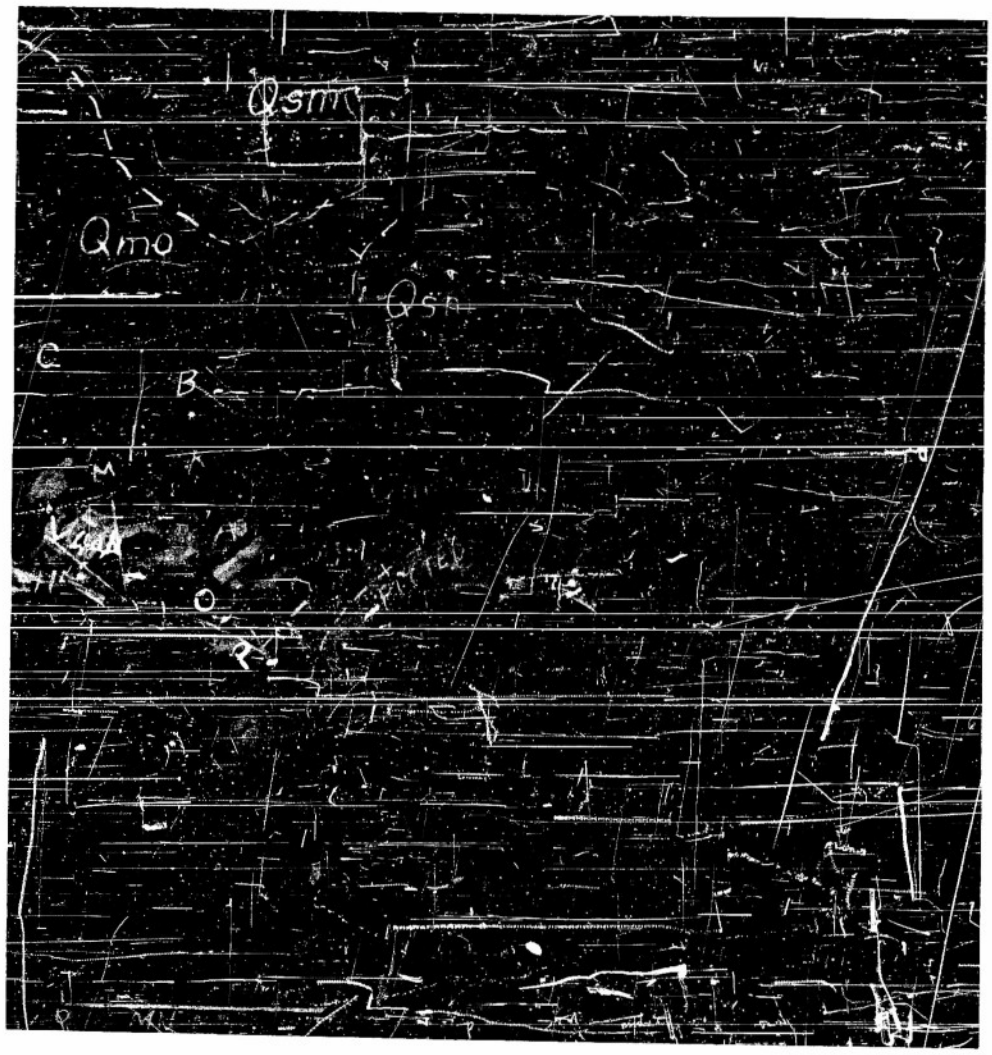
Airphotos 2-A and 2-B. Stereogram of area including Cummaquid, Cobbs Village, and eastern Sandy Neck, Hyannis quadrangle. (See map, page 93; see text, pages 37-40).

Ground Photos 2-A and 2-B. Stereopair of view of low rolling moraine, looking north from road west of Cummaquid, Hyannis quadrangle. (See map, page 93; see text, pages 37-40; and Airphotos 2-A and 2-B, above).

Airphotos 3-A and 3-B. Stereogram of area including Cedarville and part of Sagamore Highlands, Sagamore quadrangle. (See map, page 90; see text, pages 46-49).



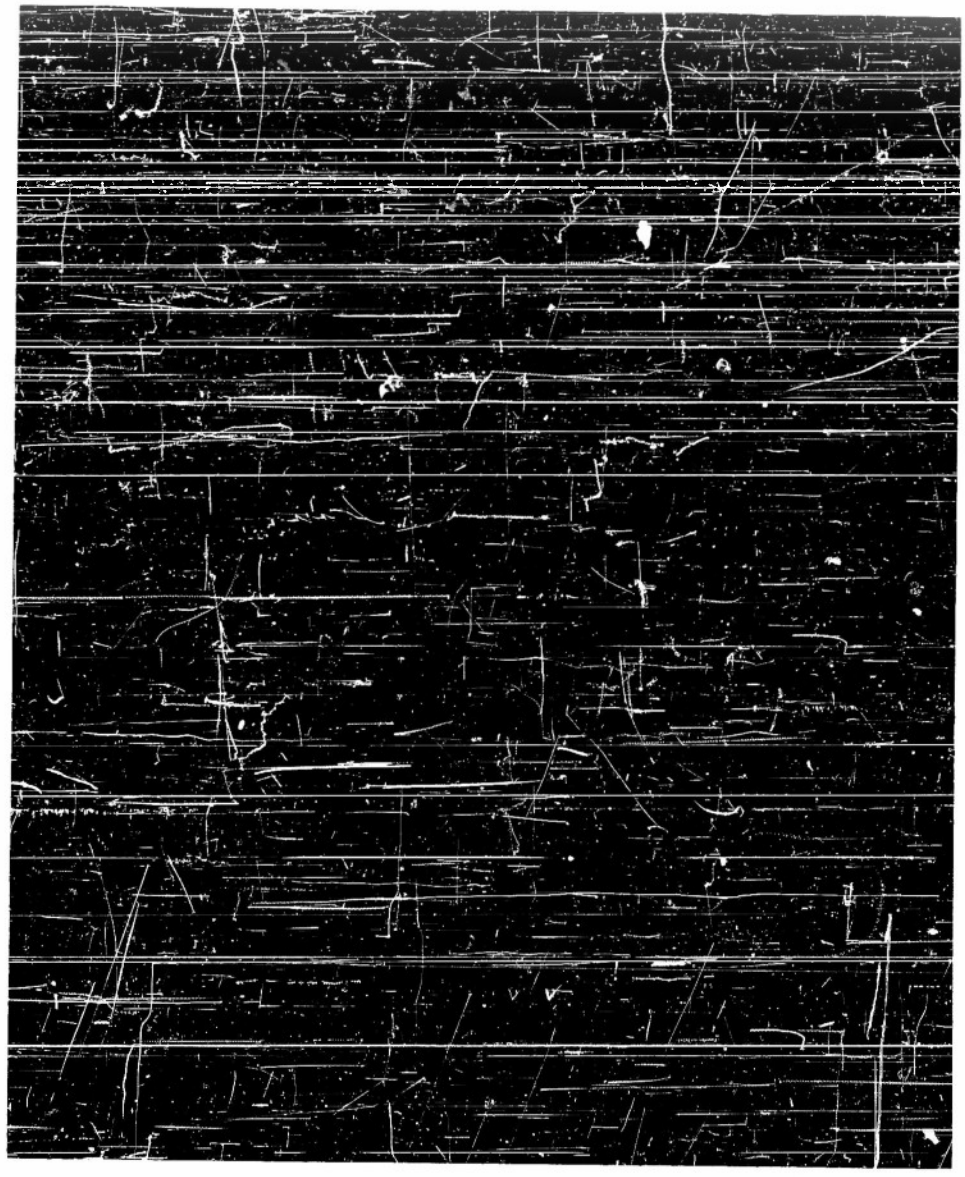
Ground Photos 3-A and 3-B. Stereopair of view to west showing cranberry bog in high rough pitted outwash east of Cedarville. (See map, page 90; see text, pages 46-49; and Airphotos 3-A and 3-B, above).



Airphotos 4-A and 4-B. Stereogram of area lying east and north of Middle Pond and Mystic Lake, Sandwich quadrangle. (See map, page 94; see text, pages 53-55).

Ground Photos 4-A and 4-B. Stereopair of view of low pitted outwash plain, looking northwest from road near north shore of Mystic Lake, Sandwich quadrangle. (See map, page 94; see text, pages 53-55; and Airphotos 4-A and 4-B, page 107).

Ground Photos 4-C and 4-C. Stereopair of view of non-pitted low outwash plain, looking northeast from Cape Cod airport, Sandwich quadrangle. (See map, page 94; see text, pages 53-55; and Airphotos 4-A and 4-B, page 107).



Airphotos 5-A and 5-B. Stereogram of area extending inland from Rockland, Rockland quadrangle. (See map, page 97; see text, pages 64-66).

Ground Photos 5-A and 5-B. Stereopair of view to north across old quarry in rough bedrock upland west of Rockland, Maine. (See map, page 97; see text, pages 64-66; and Airphotos 5-A and 5-B, above).

Airphotos 6-A and 6-B. Stereogram of area including Magnolia, Gloucester quadrangle. (See map, page 99; see text, pages 69-71).

Ground Photos 6-A and 6-B. Stereopair of view to west to Magnolia Point, from coast 1/2 mile east. (See map, page 99; see text, pages 69-71; and Airphotos 6-A and 6-B, above).

Airphotos 7-A and 7-B. Stereogram of area between Gap Head and Lands End in eastern Rockport area, Rockport quadrangle. (See map, page 100; see text, pages 72-74).

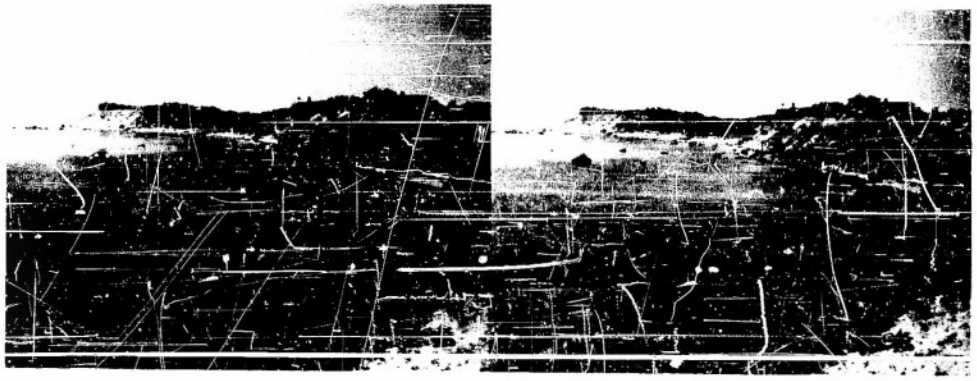
Ground Photos 7-A and 7-B. Stereopair of view to southwest from road near Whale Cove, showing gently rolling bedrock upland. (See map, page 100; see text, pages 72-74; and Airphotos 7-A and 7-B, above).

Airphotos 8-A and 8-B. Stereogram of area on Sagamore quadrangle including Ellisville, Salt Pond and Lookout Point. (See map, page 90; see text, pages 23-26).

Ground Photos 8-A and 8-B. Stereopair of view of shore features developed on high rough moraine, looking north from Lookout Point. (See map, page 90; see text, pages 23-26; and Airphotos 8-A and 8-B, above).

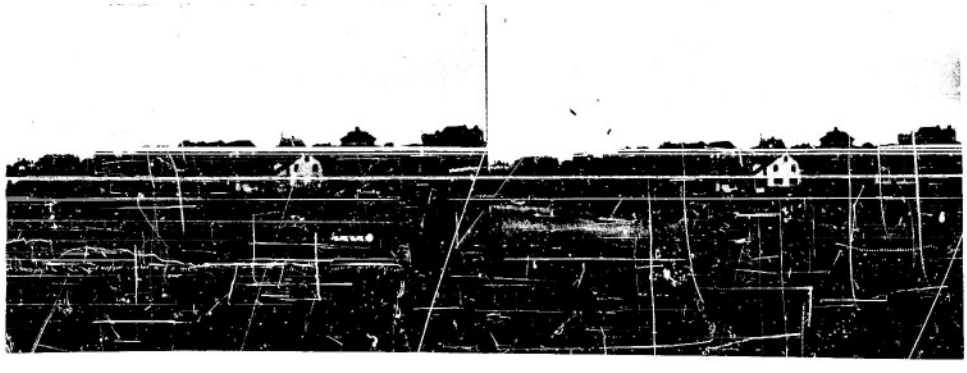
Airphotos 9-A and 9-B. Stereogram of area including Manomet Point, Stage Point, and White Horse Beach, Manomet quadrangle. (See map, page 91; see text, pages 27-32).

Ground Photos 9-A and 9-B. Stereopair of view of White Horse Beach, looking west from Manomet Point, Manomet quadrangle. (See map, page 91; see text, pages 27-32; and Airphotos 9-A and 9-B, page 113).



Ground Photos 9-C and 9-D. Stereopair of view to Stage Point, looking south from Manomet Point, Manomet quadrangle. (See map, page 91; see text, pages 27-32; and Airphotos 9-A and 9-B, page 113).

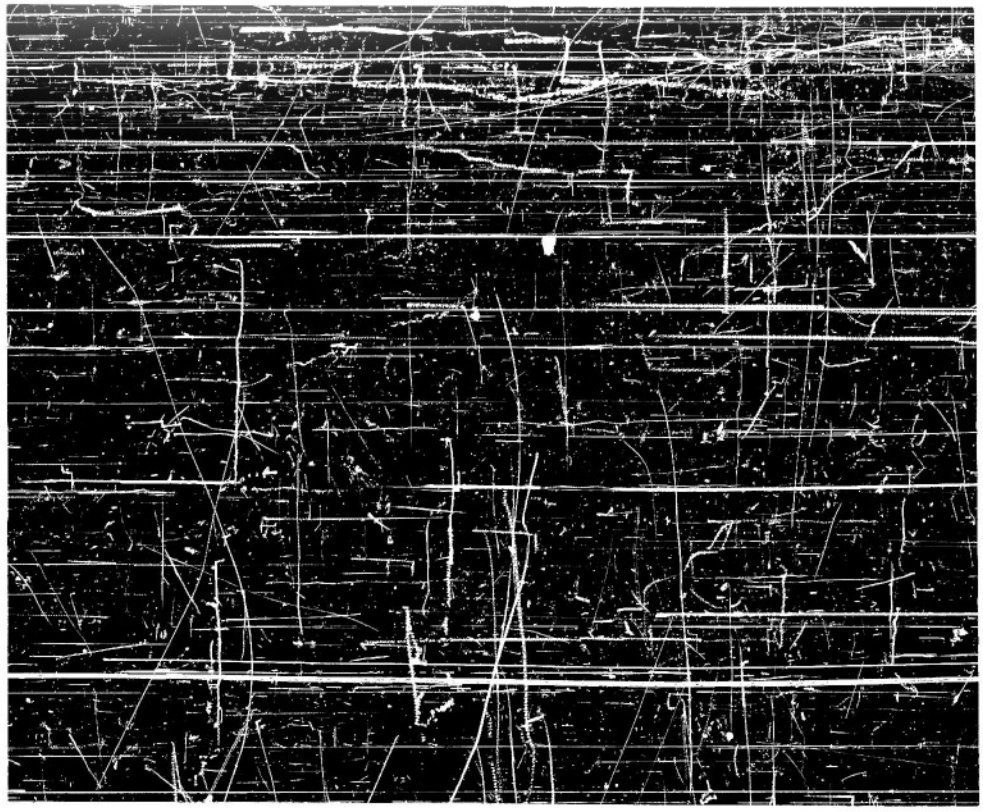
Airphotos 9-C and 9-D. Stereogram of area including Manomet Point, Stage Point, and White Horse Beach, Manomet quadrangle. (See map, page 91; see text, pages 27-32).



Ground Photos 9-E and 9-F. Stereopair of view to northeast to residential development on northwest side of Manomet Point, Manomet quadrangle. (See map, page 91; see text, pages 27-32; and Airphotos 9-C and 9-D, above).

Airphotos 10-A and 10-B. Stereogram of area including Vallersville and Ship Pond, in northeast part Sagamore quadrangle. (See map, page 92; see text, pages 33-36).

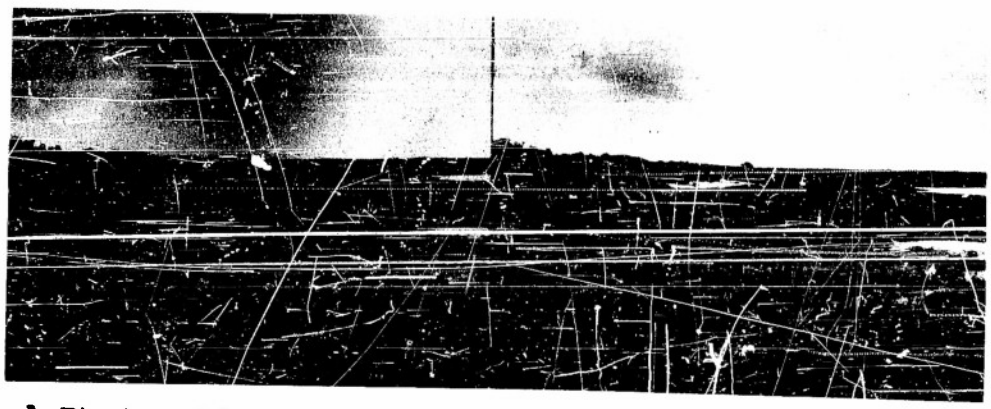
Ground Photos 10-A and 10-B. Stereopair of view south to Ship Pond (at right) and coastal bluffs in distance, from point east of Vallersville, Sagamore quadrangle. (See map, page 92; see text, pages 33-36; and Airphotos 10-A and 10-B, above).



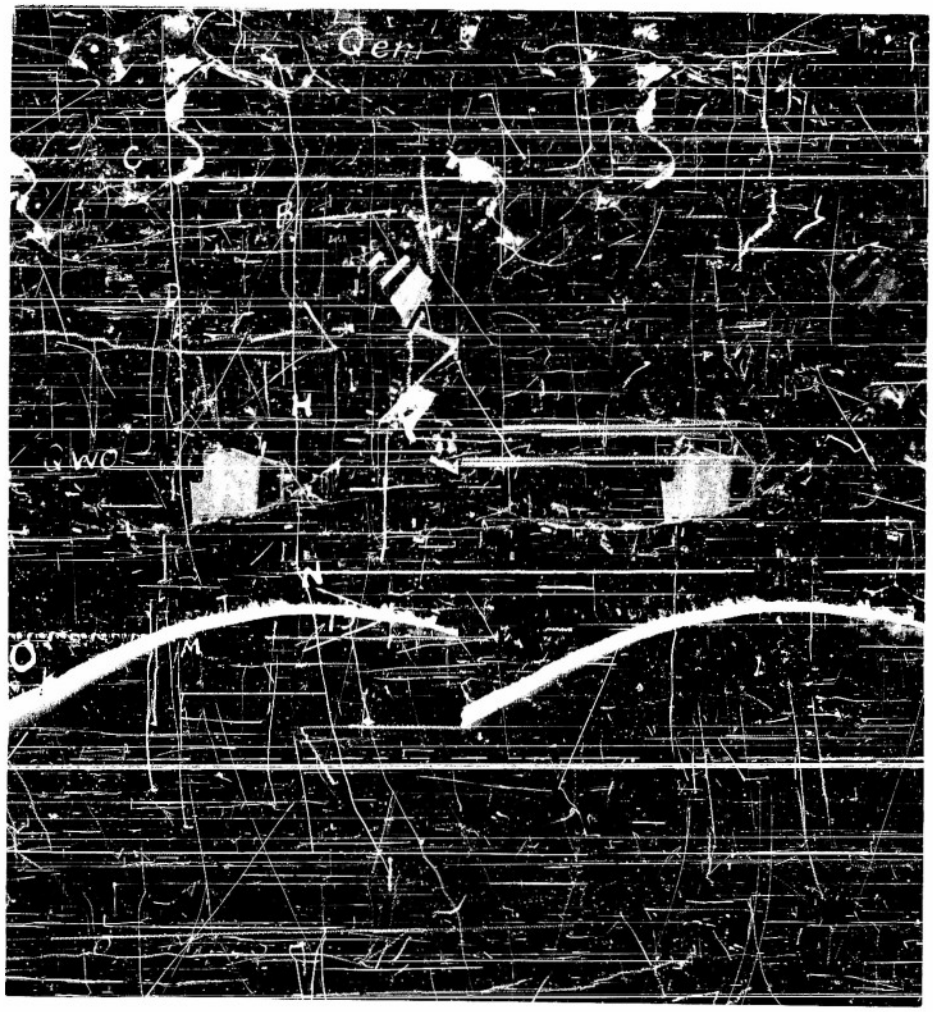
Airphotos 11-A and 11-B. Stereogram of area including Calves Pasture Point and Pond Village, Hyannis quadrangle. (See map, page 89; see text, pages 41-42).

Ground Photos 11-A and 11-B. Stereopair of view to west showing wave-eroded bluff in low morainic upland, at Calves Pasture Point. (See map, page 89; see text, pages 41-42; and Airphotos 11-A and 11-B, above).

Airphotos 12-A and 12-B. Stereogram of area including Cummaquid and Cobbs Village, Hyannis quadrangle. (See map, page 93; see text, pages 44-45).

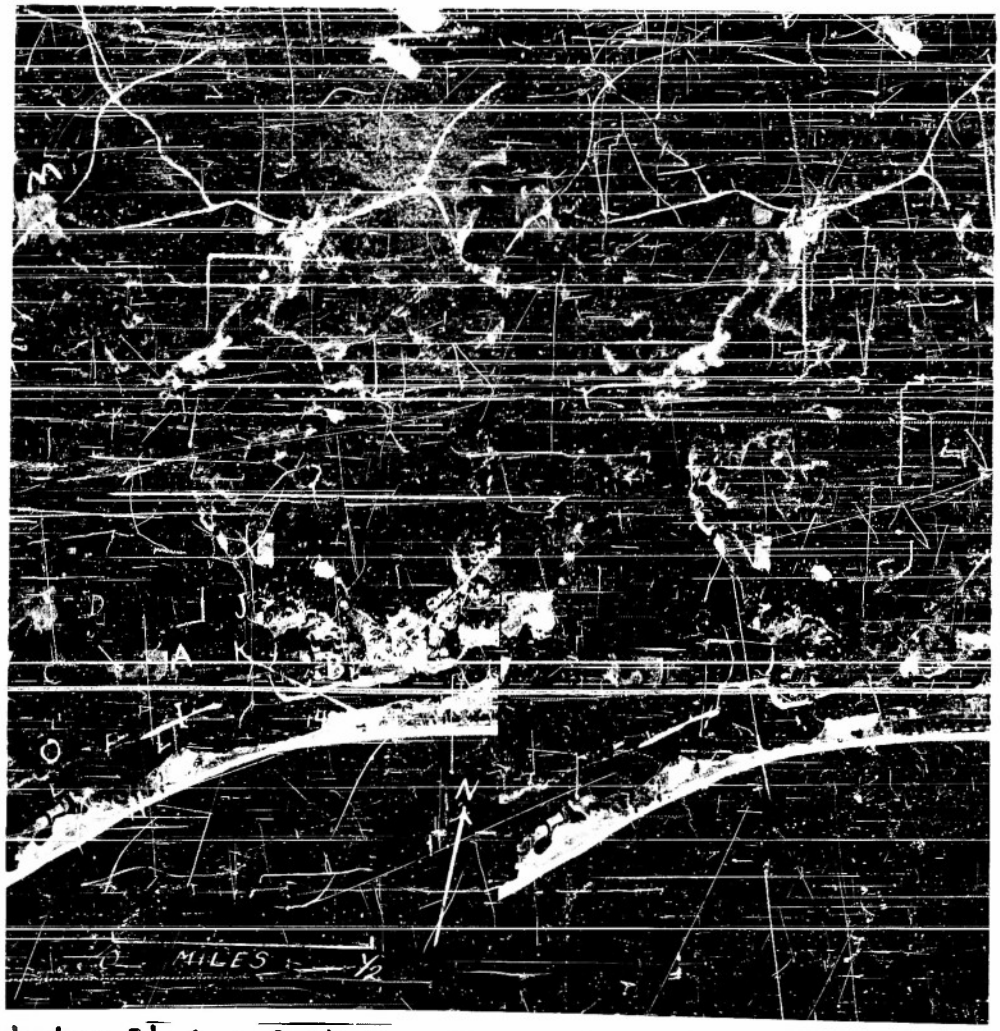


Ground Photos 12-A and 12-B. Stereopair of view of low bluff in low rolling moraine, looking westward toward Cobbs Village, Hyannis quadrangle. (See map, page 93; see text, pages 44-45; and Airphotos 12-A and 12-B, above).

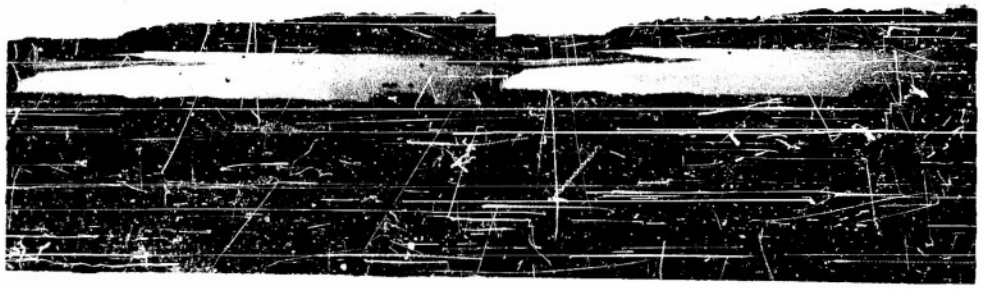


Airphotos 13-A and 13-B. Stereogram of area extending inland from Manomet Bluffs and Fisherman's Landing, Manomet quadrangle. (See map, page 91; see text, pages 50-52).

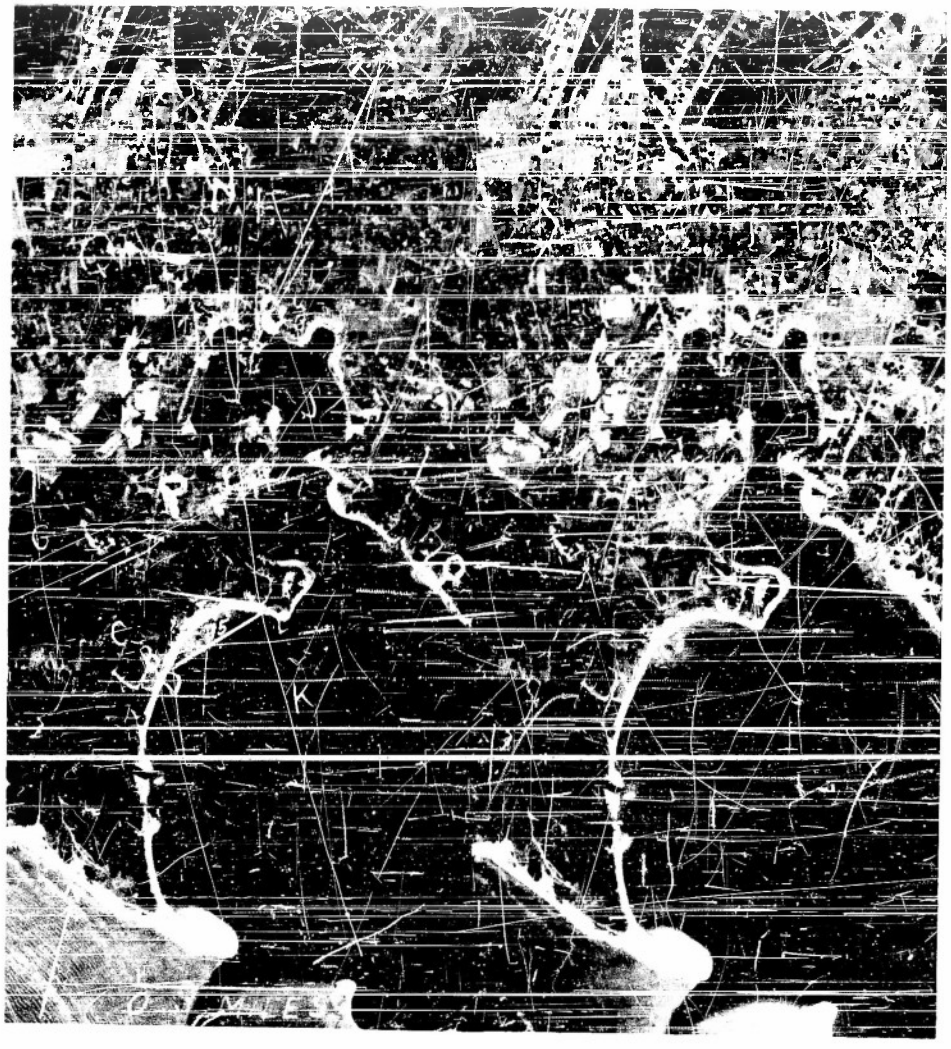
Ground Photos 13-A and 13-B. Stereopair of view to south from Manomet Bluffs, showing high bluff developed by wave action on high pitted outwash plain. (See map, page 91; see text, pages 50-52; and Airphotos 13-A and 13-B, above).



Airphotos 14-A and 14-B. Stereogram of area on south shore of Cape Cod including Craigville Beach, Hyannis quadrangle. (See map, page 95; see text, pages 56-58).



Ground Photos 14-A and 14-B. Stereopair of view of low wave-cut bluff in low pitted outwash plain, looking to west across lagoon from Craigville Beach. (See map, page 95; see text, pages 56-58; and Airphotos 14-A and 14-B, above).



Airphotos 15-A and 15-B. Stereogram of area including Hyannis and western Lewis Bay, Hyannis quadrangle. (See map, page 96; see text, pages 61-63).

Ground Photos 15-A and 15-B. View to west from Harbor Bluff, showing beach and low bluff developed by wave action on low non-pitted outwash plain, Hyannis quadrangle. (See map, page 96; see text, pages 61-63; and Airphotos 15-A and 15-B, above).

Airphotos 16-A and 16-B. Stereogram of area extending from coast westward to Megunticook River, just north of Camden, Maine, Rockland quadrangle. (See map, page 98; see text, pages 67-68).

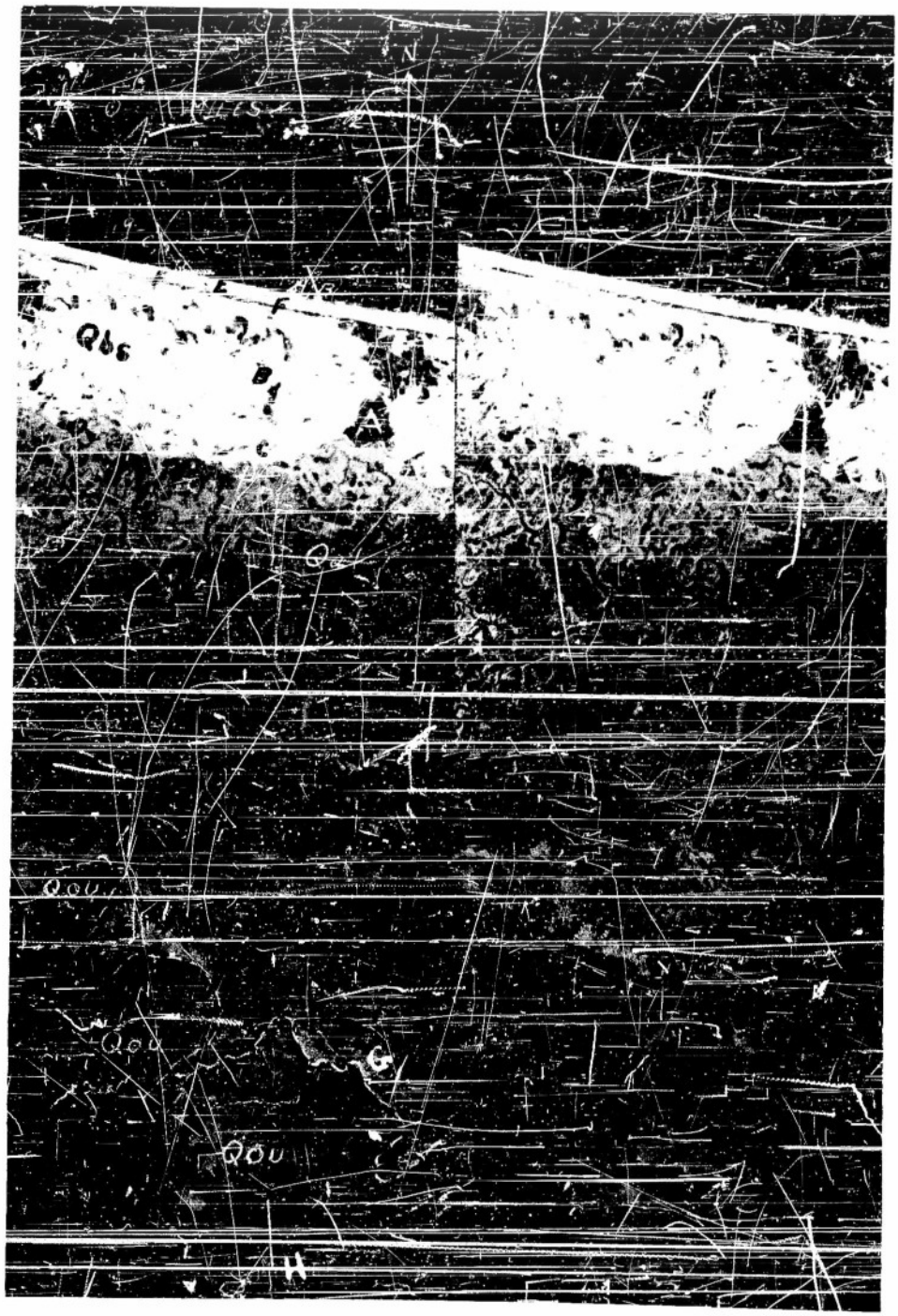
Ground Photos 16-A and 16-B. Stereopair of view southward along steeply cliffed rocky shore, north of Camden, Rockland quadrangle. (See map, page 98; see text, pages 67-68; and Airphotos 16-A and 16-B, above).

Airphotos 17-A and 17-B. Stereogram of Annisquam and adjacent coastal areas, Gloucester quadrangle. (See map, page 101; see text, pages 75-76).

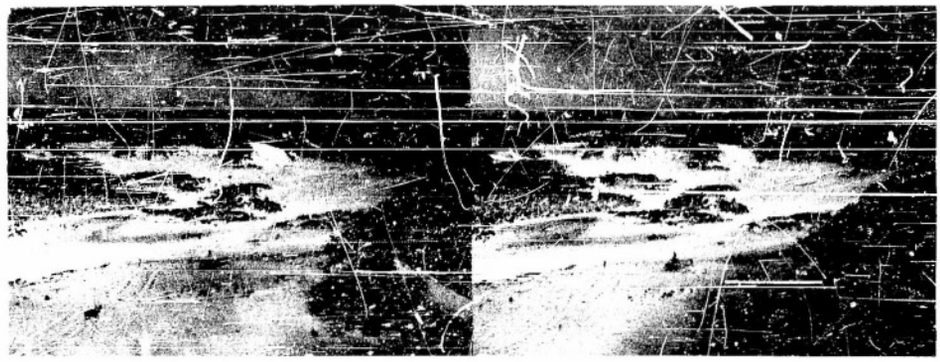
Ground Photos 17-A and 17-B. Stereopair of view to southwest from near Annisquam Lighthouse, Gloucester quadrangle, showing rocky shoreline developed on gently rolling bedrock upland. (See map, page 101; see text, pages 75-76; and Airphotos 17-A and 17-B, above).

Airphotos 18-A and 18-B. Stereogram of area including Magnolia, Gloucester quadrangle. (See map, page 99; see text, pages 77-78).

Ground Photos 18-A and 18-B. Stereopair of view to north along east shore of Magnolia Harbor, Gloucester quadrangle, showing shore features in an area of gently rolling bedrock upland. (See map, page 99; see text, pages 77-78; and Airphotos 18-A and 18-B, above).



Airphotos 19-A and 19-B. Stereogram of area extending north from West Barnstable to Cape Cod Bay, Sandwich and Hyannis quadrangles. (See map, page 102; see text, pages 81-82).



Ground Photos 19-A and 19-B. Stereopair of view to northwest from top of high dune, White Hill, Hyannis quadrangle. (See map, page 105; see text, pages 81-82; and Airphotos 19-A and 19-B, page 125).

Ground Photos 19-C and 19-D. Stereopair of view to west along beach and dunes, Sandy Neck, Sandwich quadrangle. (See map, page 102; see text, pages 81-82; and Airphotos 19-A and 19-B, page 125).

Airphotos 20-A and 20-B. Stereogram of Sandwich and adjacent area, Sandwich and Sagamore quadrangles. (See map, page 103; see text, pages 84-85).

Ground Photos 20-A and 20-B. Stereopair of view to northeast to tidal river, salt marsh, and coastal dunes, from near Sandwich. (See map, page 103; see text, pages 84-85; and Airphotos 20-A and 20-B, above).