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GRASSY ISLAND

ARCHAEOLOGICAL AND BOTANICAL INVESTIGATIONS OF AN INDIAN SITE IN THE TAUNTON RIVER, MASSACHUSETTS

BY
FREDERICK JOHNSON
AND
HUGH M. RAUP

PHILLIPS ACADEMY · ANDOVER, MASSACHUSETTS
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PREFACE

BETWEEN 1939 and 1942 a large group of scientists worked on problems which were defined when the Boylston Street Fishweir was rediscovered. This work focused attention upon the relationship between the location of evidences of human occupation and the position of sea level. A group of us turned our attention to Grassy Island, an Indian site, previously described by Delabarre, which promised to provide additional data pertinent to the whole problem. The results of this investigation are presented here.

Although the work at Grassy Island forms the basis for this account, our work was not confined to the immediate neighborhood of the site. Many features of the archaeology of southeastern Massachusetts were brought to our attention by the members of the Massachusetts Archaeological Society. Of particular interest was the site at Stuart's Island in Marion Harbor, Massachusetts. The late Ernest Clarke had found there arrowpoints and fragments of steatite vessels beneath the peat of the marsh. The preliminary investigations which Clarke and the rest of us made have been summarized by Mr. Maurice Robbins in the Bulletin of the Massachusetts Archaeological Society.

The three sites, Boylston Street, Grassy Island and Stuart's Island constitute the background for a number of problems which are extremely wide in scope. The present study treats but one section of these. The report appears as an archaeological one, but geological and botanical problems are of equal importance; in fact, unless these can eventually be solved the full significance of the archaeological data will not be known.

During the course of the work the authors have been substantially aided and certainly encouraged by many enthusiastic people. Mr. Stuart Robertson of Taunton, Massachusetts, the owner of Grassy Island, has been exceptionally generous. He permitted us to excavate on the Island in the face of the certainty that irreparable damage would be done to his property. Mr. Merle Barker, also of Taunton, allowed hordes of wet and muddy investigators to use the many facilities which he provided at Peter's Point.

We owe much to many members of the Massachusetts Archaeological Society, particularly the Warren K. Moorehead Chapter. These people—it is impossible to single out individuals—were of great material aid and we have profited greatly from their unequaled knowledge of the region.

We are indebted to Mr. Arthur Kirby of New Bedford. He spent several

days working in the broiling sun applying his expert knowledge of surveying to the establishment of levels and the drawing of a map of Grassy Island. Without this, our work would have been much less trustworthy. He was assisted by Mr. Joy and Mr. Pease of New Bedford.

The magnitude of the geological problem is such that an analysis which would be useful in evaluating details observed on the island was impractical if not impossible at this time. However, Dr. Kirk Bryan joined us at various times during the course of the work and to him we are indebted for his careful explanation of geological matters and points of view and for the encouragement which he has given us.

Many others have taken part in the work and we are sorry that the limits of space prevent proper acknowledgement. It is to be regretted that the work of Mr. William Benninghoff was stopped by his assumption of more important duties in the Navy. Dr. Elso Barghoorn's experiments with the peat were important as was the interest of the late Dr. David Linder. It is to be lamented that Dr. Delabarre, the discoverer of the site, did not live to see the completion of this study. He had a lively interest in the progress of the analysis and provided us with much valuable information. Mr. Ripley P. Bullen spent several tedious days screening the mud which should have contained more specimens. He was joined in this task by Mr. Douglas S. Byers. To Mr. Rudolf Haffenreffer of Bristol, Rhode Island, we are indebted for the courteous permission to photograph and publish an account of Dr. Delabarre's collection.

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GRASSY ISLAND

ARCHAEOLOGICAL AND BOTANICAL INVESTIGATIONS OF AN INDIAN SITE IN THE TAUNTON RIVER, MASSACHUSETTS

INTRODUCTION

GRASSY ISLAND has been recorded in the annals of the towns of Assonet and Berkley, Massachusetts, since 1640. It is in the estuary of the Taunton River just opposite the village of Dighton, and in a broad expanse of shallow water called Smith's Cove. The earlier references describe it as meadow or mowing land. Frequently it was given to the ministers of the gospel in order that they might have a supply of hay for their cattle. Early in the record it was said to comprise three acres "more or less," and this was copied in the succeeding deeds until comparatively recently when it was discovered that the island was little more than an acre in extent. When the late Dr. Edmund Burke Delabarre discovered an archaeological site there he bought the island so that he might pursue his investigations unmolested. Later owners have used it as a duck blind.

Dr. Delabarre carried on a series of excavations over a period of years and published, in 1925,[1] an account of what he had found. A supplementary paper, discussing fragmentary remains of a human skeleton, was published in 1928.[2] These descriptions are of considerable significance to New England archaeology and it is to be lamented that they have not received the notice they deserve. In a summary Delabarre included notes on all the artifacts he had found. There is sufficient evidence for concluding that the complex of stone artifacts found at Grassy Island is similar to those from other sites found in New England south of the latitude of Portsmouth, New Hampshire. This complex, with some modifications, may be identified in regions south of Connecticut and in New York state.

The location of the artifacts, and of a hearth which Delabarre found on Grassy Island, is striking. The artifacts are distributed vertically to a depth of nine inches and horizontally so that "the impression produced was that of a village or encampment site."[3] The surface of the stony and sandy soil which includes the artifacts lies just above low tide level. It is covered by a layer of peat the surface of which is located at the level of high tide. This peat is some two and a half feet thick at the northerly end of the Island and some five feet thick near the southerly end. The surface of the peat, which is nearly level, supports a growth of grasses and other herbs in a vertically

[1] Delabarre 1925.
[2] Delabarre 1928.
[3] Delabarre, 1925, p. 361.

shallow zone the upper and lower bounds of which are located but a few inches above and below the level of mean high tide.

Delabarre argued that since the Indians could not have built their village when the relation between tide and land levels was that of the present, the site is evidence of a rise in sea level (or subsidence of the land). He discussed various difficulties inherent in the estimation of the rate of the rise of sea level and used the idea current at the time that sea level had risen at a rate of about 1 foot per century. He also discussed the question of whether sea level is rising at the present time. The upshot of his calculation was the tentative dating of the occupation of the level beneath the peat at a time which "cannot be later, and may have been an indefinite time earlier, than about one thousand years ago."[4]

The present study corroborates most of Delabarre's factual information. Slight differences in measurements are due to the use of precise instruments which were not employed in the earlier work. It is also true that since Delabarre stopped his excavation, nearly twenty years ago, forces of erosion have made some changes in the island. A recent dredging of the channel has resulted in the deposition of a thin layer of sand on the shore. In any case, the difference between present and past measurements is negligible. Our work shows that beyond question an ancient Indian camp of considerable proportions for this section of New England was once located on the surface beneath the peat. Although present opinions only partially agree with Dr. Delabarre's interpretations it is obvious that his work is a distinct contribution to the archaeology of the region.

The significance of Delabarre's discovery at Grassy Island was enhanced by the excavation of the Boylston Street Fishweir.[5] This excavation proved that the weir had been constructed at a time when sea level was lower, and discussions of the problems surrounding it, as well as that of the site at Grassy Island, led to the investigation of the provenience of artifacts in Marion Harbor, Buzzard's Bay. It was found that these artifacts also were evidence of the existence of a large site lying below the level of high tide.[6]

The collection of human artifacts described in this report is composed of two parts. One, by far the larger, was purchased from the late Dr. Delabarre for the King Phillip Museum by its owner, Mr. Rudolph Haffenreffer. The second unit is located in the Peabody Foundation. It comprises artifacts presented by Dr. Delabarre, Dr. J. W. Goldthwaite of Dartmouth College and

[4] Delabarre, 1925, p. 368.
[5] Johnson, et al., 1942.
[6] Robbins, 1943.

the specimens which were collected by the authors and their collaborators during many trips to Grassy Island. The latter unit is quite representative of the smaller artifacts but it lacks the gouges, celts, large knives and spear points to be found in the Delabarre collection.

One of the many factors which has prevented the unraveling of the tangled skein formed by the thread of events in prehistoric New England has been the lack of an adequate chronology or even a date from which to begin reckoning time. By far the greatest proportion of the archaeological work has been done in the coastal sections of the region, where shell heaps have received most of the attention. Conceptions of the succession of types of cultural material based on data gathered in these investigations have been expanded by applying stratigraphic sequences observed in other regions. There are few, if any, assurances that actual sequences in New England are the same as those identified in surrounding localities, and the assumption that the prehistory of New England is identical with that of neighboring areas has no foundation as yet. Archaeologists must recognize the possibility that lags in the development of culture, combined with the somewhat specialized environmental and geographic factors in a marginal region, may modify human history. It is not yet possible to suggest with any confidence even a useful "relative dating" based upon sequences of artifact types in New England, and certainly the cultural data cannot be employed to estimate actual periods of time. Some progress can be made, on the other hand, by the study of situations such as that which exists on Grassy Island.

The emphasis upon technology in the modern world obscures the perpetual and very intimate relationship between human culture and the land which supports it. People are continuously at work organizing themselves so that they may employ their artifacts to better advantage in the attempt to modify the face of the earth. Opposing natural forces are constantly resisting and covering up the works of man. In the end nature seems to be victorious, for while human life and culture continue and look toward the future, the ancient works of man are eventually covered over with the materials of which the earth is composed. Archaeologists, in delving into prehistory, find evidence of ancient occupations associated with layers of natural deposits. These deposits can be made to recount the events which accompanied the development of human life, but in order to secure the necessary information from the materials surrounding prehistoric human occupation, archaeologists must turn to other scientific fields. The interlocking investigations which result from such curiosity provide information from which periods of time and perhaps even dates can be determined. Furthermore the ecological data which accrues aids in reconstructing the details of prehistoric life. Geological science supplies a general scale, which can sometimes be refined, permitting the assignment of approximate though usually relative dates to specific features. More precise chronological details may be deduced from analyses of deposits accomplished by a collaboration among a number of scientific fields; thus, given a deposit in a certain geologic and geographic setting, botanists, pollen analysts, and others can supply details which are of great significance. Peat is one of the most useful of the deposits which are susceptible to this kind of analysis.

There are many kinds of peat deposits and each of these varies, to some degree, with the particular characteristics of its local environment. Peat is made up of preserved vegetable materials and it includes varying quantities of silt. Identifiable roots and culms of grasses, together with the remains of sedges and other plants, are preserved in the site where they grew and died. In addition, pollen, leaves, silt, diatoms and other materials which are washed or blown into the deposit are to be found in the locations where they came to rest. The identification of these materials at all levels in the deposit brings to light a succession which may reflect the history of the vegetation during the time the peat was developing. Varying with circumstances, this can represent either the local history or the development of the vegetation in the surrounding region.

In view of the development of the collaborative techniques in peat study, it was decided that a re-excavation of Grassy Island might be of interest. The results of the new work proved that a further extensive collection of artifacts was not essential, for the recent finds tallied so closely with those of Delabarre that there was no hesitation in including them with his collection of several hundred specimens.

The most interesting characteristic of the site is the layer of peat which overlies it. Obviously this was deposited after the site had been abandoned, so that a history of the development of the peat might yield an account of the events which took place after the aborigines had left the Island. If this history could then be correlated with that of all New England, the occupation of the area would take its proper place in the chronicle of eastern North America.

The study of peat beds, if it is to yield the results desired in the present instance, is complicated not only by the difficulties inherent in the investigation of the peat itself, but also by the necessity for "placing" any given vertical section of a deposit in a three-dimensional geographic setting. The third dimension involves both time and the results of physiographic change, the latter of which is complicated by many controversial issues. The Grassy Island deposit is no exception, as will be shown in the subsequent pages. When first examined it was supposed that a simple vertical section would contain a series of consecutive layers dating from the time of coverage of the island by high tides.

The section proved, however, to be entirely anomalous, requiring an investigation of all the salt marsh deposits in this part of the Taunton River estuary, and the construction of an interpretation of the island peat entirely at variance with the expected one.

The examination of the Taunton River marshes has led to some generalizations which we believe to be applicable to the study of all marine or brackish peats. These generalizations have to do mainly with sampling methods in their relation to the gross morphology of the marshes. Although they will be presented here only as they apply to the Grassy Island problem, we believe that they will prove especially useful for the clarification of the techniques of pollen analysis.

A new map of Grassy Island was made in June, 1942, by Arthur Kirby and Frederick Johnson (Fig. 2). Since one of the crucial features of the study is the relation between strata and tide levels, it was necessary to establish a temporary bench mark on the island, to which all measurements could be referred. On June 13 Mr. Kirby and his associates fixed this bench mark, and all elevations given in our report are referable to it. It is based upon the "Sea Level Datum of 1929," which is designated by the United States Coast and Geodetic Survey. Leveling was done with a transit from Bench Mark No. 27A17 established in Dighton by the Coast and Geodetic Survey and the State of Massachusetts. The level of the island bench mark (el. 3.102 ft.) was checked by a second leveling with the same instrument from Temporary Bench Mark No. 742, also located in Dighton.

The work of excavation was begun immediately at several points on the shores of the island. Also in June of 1942 a botanical collection was made on the island, with a preliminary map of the plant communities. Further collecting was done in October of the same year in order to secure data on the seasonal aspects of the flora, and to complete the botanical map (Fig. 3). Samples of the island peat were obtained by boring with a post-hole digger and a peat sampling implement of the Hiller type. Mr. William Benninghoff, with the assistance of the authors and Professor Kirk Bryan, did most of the peat sampling. The work of making a pollen analysis was undertaken by Mr. Benninghoff. Further examination of these peat samples soon demonstrated the anomalous structure of the island, making it clear that much more information was needed before an adequate interpretation would be possible. In November we made a hurried reconnaissance of peat deposits along the lower Taunton River, with special attention to the Shove's Creek marsh.

At this point the investigation was temporarily halted. Mr. Benninghoff went into the Navy, and the authors became involved in other projects which, with war restrictions on the use of gasoline, precluded further attention to the problem. Late in May, 1945, we again took it up, spending three days in more probing of the peat at Grassy Island and the Shove's Creek marsh. The present paper embodies the results of the whole study so far as it has been carried to date. At the time of our last visit Dr. Edward Deevey collected samples for pollen analysis. He expects to publish the results of this work in a separate report.

GEOGRAPHY OF GRASSY ISLAND AND THE TAUNTON RIVER VALLEY

THE Taunton River drains about three hundred square miles of southeastern Massachusetts. Its watershed extends from the town of Attleboro on the west into the townships of Plympton and Carver on the east. The southern boundary is at Fall River where the estuary joins with Mount Hope Bay, the upper and easterly arm of Narragansett Bay. The northern boundary runs irregularly east and west through the latitude of Stoughton, including the city of Brockton. In general this boundary is a complex of hills and ridges, averaging two hundred feet in height, which separates the Taunton River drainage from that of the Neponset River flowing northeastward into Boston Bay, and the North River which flows into the Bay at Scituate.

The area drained by the Taunton River is of low relief, there being but few hills and ridges rising more than about one hundred feet above the surrounding country. The slopes are gradual and the valleys of the river and its tributaries are wide. In some sections, particularly east of the city of Taunton, the river meanders through a wide valley of low gradient. In this region, as well as in others nearer the sea, swamps and marshes have developed in protected places along the shore of the river.

The area is studded with ponds, some of which may be ice block holes originating during the last glaciation. The largest of these ponds, Assawomsett, Long and Great Quittacus, are located on the boundary between the townships of Middleboro and Lakeville. The low relief has also contributed to the development of many swamps, the history of which is not known. It is obvious, however, that they hold the key to many aspects of the post-glacial history of the region.

In spite of the large area of drainage the gradient of the river is low and the current is usually slow. The discharge of water from 260 square miles of the drainage basin has been calculated from the records of a gauging station maintained by the United States Geological Survey at the State Farm one mile upstream from Saw Mill Brook. Records over ten years show that there has been an average discharge of 478 second feet. The maximum discharge observed was 3,050 second feet on April 14, 1935, and the minimum was 9 second feet on August 22, 1934. Further study of the long record of the observations may be of considerable value in that it will provide information concerning the salinity of the upper tidal portion of the river. Very brief examination of the figures indicates the probability that the estuary is flooded with large quantities of fresh water during the spring and early summer.

The lower reaches of the Taunton River are tidal, with the head of the tide located in the vicinity of the city of Taunton, more than twenty-five miles from the mouth of the estuary at Fall River. The gentle slope of the river bed continues south of the mouth of the river into Mount Hope Bay which empties into Narraganset Bay through the narrow opening to the southwest between Bristol Point and Aquidneck Island. The waters of Mount Hope Bay also reach the ocean through a second, narrower opening called the Sakonnet River. This narrower arm of the sea runs almost directly south between the eastern shores of Aquidneck Island and the mainland.

In a number of places along the river terraces may be seen. In the region south of Taunton one of these, about nine feet above high tide level, is a prominent feature of the topography. In the region around Grassy Island remnants of this terrace are clearly visible, particularly on the east side of the river. Back of the terrace the land rises to a pitted sand plain which has an elevation of 50 to 70 feet. Terraces higher than the nine-foot one were not identified here.

The city of Fall River is built on a series of terraces. Four of these were tentatively identified. The lowest one is some ten feet high and the upper ones appear at intervals of about twenty feet. South of Fall River a terrace about twenty feet above high tide level is particularly prominent; others will probably be identified when a detailed geological study of the region can be made.

The estuary of the Taunton River, not including Mount Hope Bay, is some twenty-five miles long, but at no place is it more than two-thirds of a mile wide. At Peter's Point, seven and one-half miles north of Fall River, the estuary narrows to a few hundred yards and at Taunton it is only a few hundred feet wide. The mouth at Fall River is less than one-quarter of a mile wide. An important tributary to the estuary, a shallow, marsh-skirted body of water, Assonet Bay, lies on the eastern side some six miles from the mouth. The drowned mouths of smaller tributaries are found distributed along both shores.

The topography of the estuary no doubt has a considerable effect upon the tide. At Newport there is a mean range of 3.5 feet with an extreme of 4.4 feet. At Fall River these means are 4.4 and 5.5 feet respectively. At the city of Taunton there is a mean range of 2.8 feet and the extreme is 3.5 feet. At Taunton high tide reaches its peak one hour and fifty minutes after it has turned to go out at Newport. Mean high tide at Taunton is 0.9 feet above mean sea level. The figures for Grassy Island have to be interpolated, for no tide gauge has been established in the vicinity (See Table I).

Grassy Island is a little less than seven and one-half miles north of Fall River. It lies at the head of the widest part of the estuary opposite the town of Dighton (Fig. 1; Plate I). South of Peter's Point the main channel of the river, which here is about 200 feet wide, runs along the western shore. Between the channel and the eastern shore is an expanse of mud flat lying, for the most part, at about mean low tide. At full and new moon, when the tides are longer, the flats are exposed. At these times channels, but a few inches deep, are visible in the flats (Fig. 8d). One of them runs parallel to the southern shore of Peter's Point and around the northern end of Grassy Island. It then turns south past Dighton Rock and from thence southwestward into the river. A second, shallower channel runs parallel to the west bank of Grassy Island connecting the northern arm of the channel with its southwesterly end. Between this channel and the river the flat is in the form of a mound not over six inches high. The surface of this mound is relatively smooth except in places, particularly southwest of the island, where there are piles of pebbles. Some of these piles are one foot or so high, and are exposed during practically every low tide.

TABLE I
RANGE OF TIDE AT GRASSY ISLAND AND OTHER POINTS

	Newport, R. I.	Fall River, Mass.	Taunton	Estimated at Grassy Island*
Height of High Tide above Mean Sea Level	1.6**	2.5	0.9	2.2
Mean Range of Tide	3.5	4.4	2.8	2.8
Mean Range of Spring Tides	4.4	5.5	3.5	3.0

* Based on calculations from "Tide Table, Atlantic Ocean, 1942" U. S. C. and G. Survey, 1941, modified by observations at Grassy Island made during the week following June 15, 1942.
** Figures for June 15, 1942.

Several small creeks enter the river north and east of Grassy Island. Their lower courses form small replicas of the main river estuary, and one of them figures largely in the discussions that follow. This is named Shove's Creek, and it flows into the river almost due east of the island. It rises in the pitted plain northeast of Hospital Hill, and has a total length of about two miles. The lower half of its valley is a long narrow swamp having an east and west trend. Approximately the lower two-thirds of the swamp are affected by the tides and are salty or brackish. The upper third is fresh. As it nears the river the Shove's Creek marsh is bordered by the prominent terrace previously mentioned as being about 9 feet above high tide level. The marsh is separated from the river by a gravel ridge in the form of a bay-mouth bar, through which the creek has cut a deep channel. The top of the ridge is approximately at the level of high tide, so that its surface is nearly flush with that of the

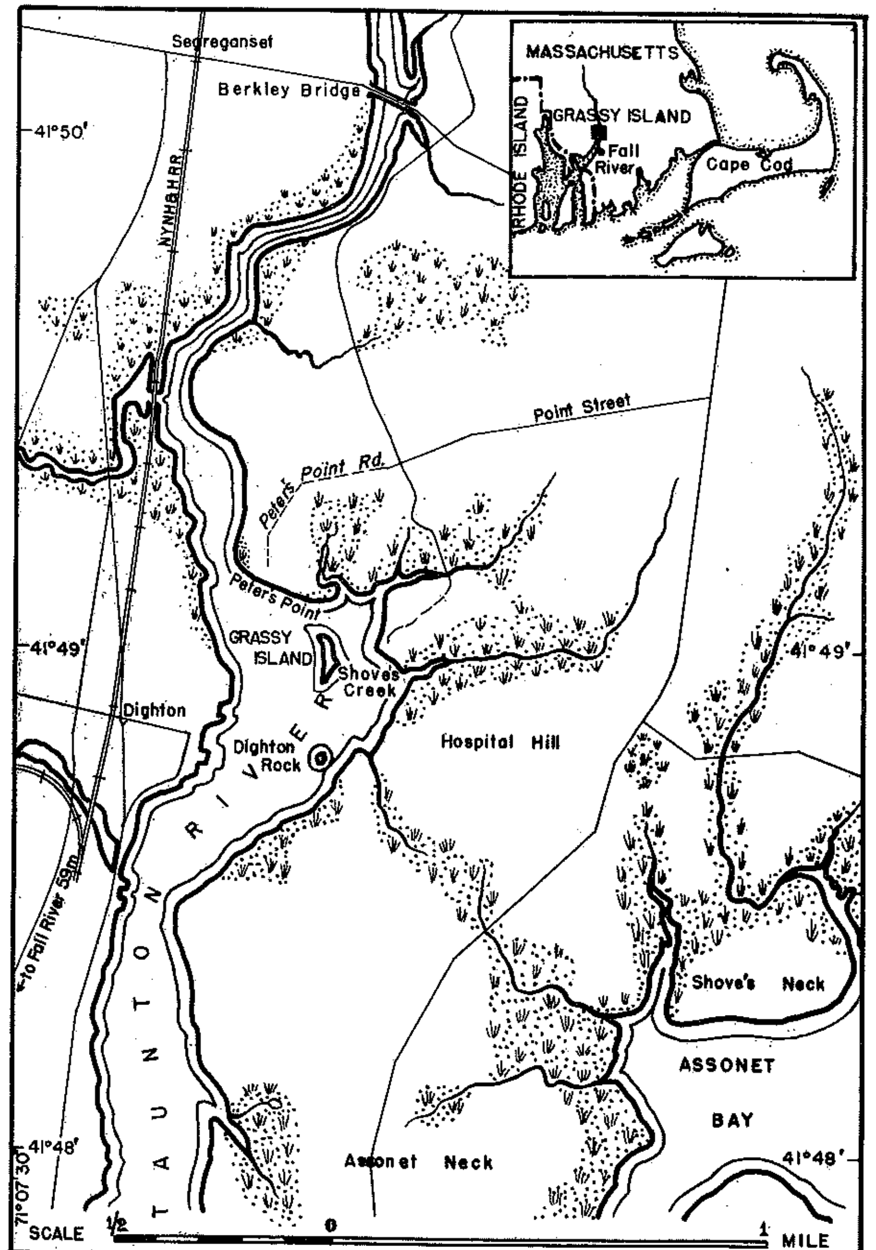


Fig. 1. Map of Region in the Neighborhood of Grassy Island.

Plate I

Aerial photograph of Grassy Island, Shove's Creek Marsh and vicinity. From photograph made by United States Geological Survey in 1941.

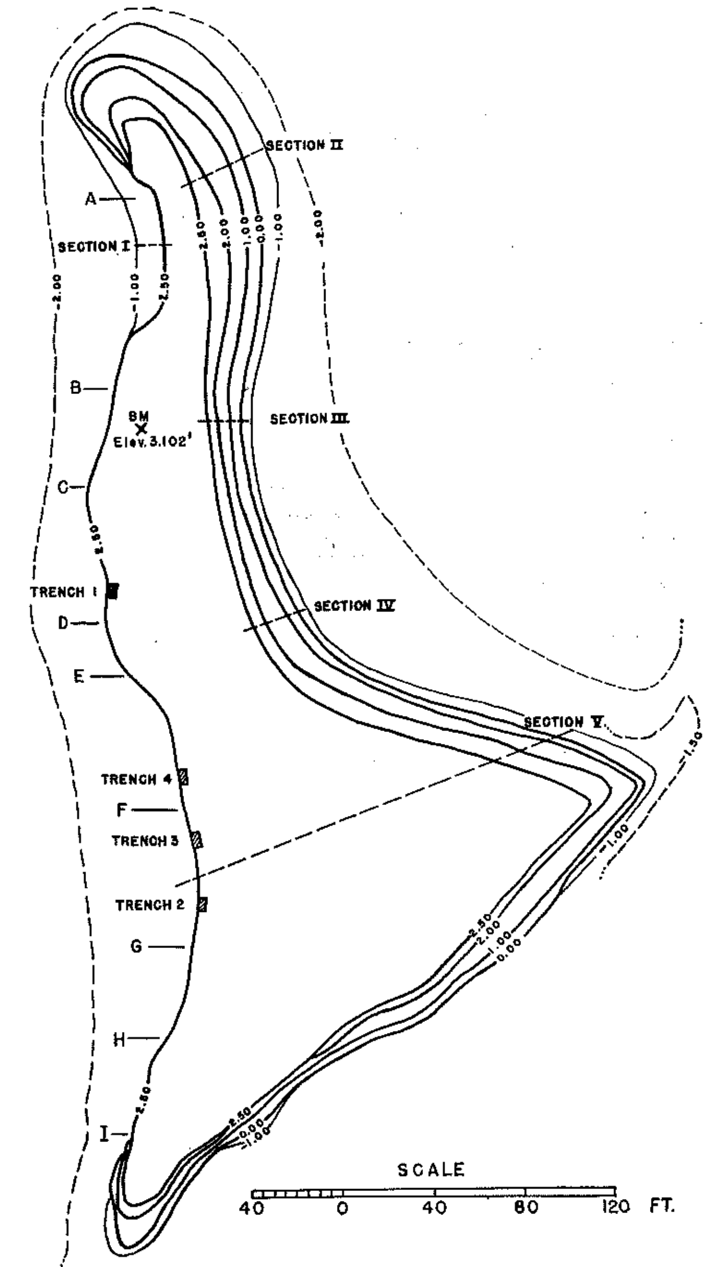


Fig. 2. Map of Grassy Island.

marsh behind it. Shove's Creek has meanders characteristic of tidal marsh streams.

Grassy Island itself is about 500 feet long, with its longest axis trending north and south (Fig. 2). Its widest part, some 200 feet, is at the southern end, while the northern portion is a long "point" which averages about 70 feet in width. As previously noted, the whole surface is nearly awash at ordinary high tide. It is covered with marsh herbs and a scattering of river-borne debris. The entire island is composed of peat except at low tide, when a part of the underlying gravel and sand are exposed on the west and south shores. When the tide is out these shores appear as undercut banks of peat, while the incurved easterly side shows a shelving, depositing bank above a wide mud flat.

Considerable quantities of sand appear on the narrow beaches exposed at low tide. The beaches are most prominent on the western shore, on the north point, and on a small spit on the southeast point. The sand is coarse, with included pebbles of various sizes, and appears to be similar to that in a spit on the main bank of the river north of the island. This sand spit is derived from a deposit placed there during a comparatively recent dredging operation in the ship channel of the river. It is presumed that most of the beach sand at Grassy Island is from this source.

DESCRIPTION OF GRASSY ISLAND

THE following description of Grassy Island is composed of four parts: first, an account of the plant communities that now cover most of the surface; second, a description of the peat of which the island is composed; third, a brief study of the configuration and composition of the mineral substratum; and fourth, an account of the excavation of the artifacts which are evidence of the human occupation of the site.

PLANT COMMUNITIES

The vegetation of Grassy Island is composed entirely of marsh herbs and a few algae. There are no woody plants on the island, nor is there any surface evidence of there ever having been any. The present treatment is concerned primarily with the vascular flora, since remains of the precursors of this flora have formed most of the peat of which the island is composed, and since these remains appear to have been derived from a flora similar in general appearance to some parts of the present one.

At high tide the island is nearly or completely covered with water that is at least brackish. Hence the vascular flora is drawn from the small assemblage of plants characteristic of "mid-littoral" and "upper littoral" salt marshes of the southern New England Coast.[7] Even within this small group (there are only about 40 common species) not all are represented in our collections and observations on Grassy Island. Only 23 species and varieties were found there, although the island was visited twice during the season of 1942. (June 15 and October 6).

Fig. 3 is a map showing the arrangement of plant communities, with suitable symbols indicating the characteristic plants of each. The following is a more detailed floristic description of the communities.

Spartina alterniflora association:

Primary sp.

Spartina alterniflora Loisel.

Secondary spp.

Triglochin maritimum L.
Spartina patens (Ait.) Muhl.
Panicum virgatum L.
Eleocharis parvula (R. & S.) Link
Acnida cannabina L.
Sium suave Walt.
Lilaeopsis lineata (Michx.) Greene
Solidago sempervirens L.

[7] Nichols, 1920, pp. 525-533.

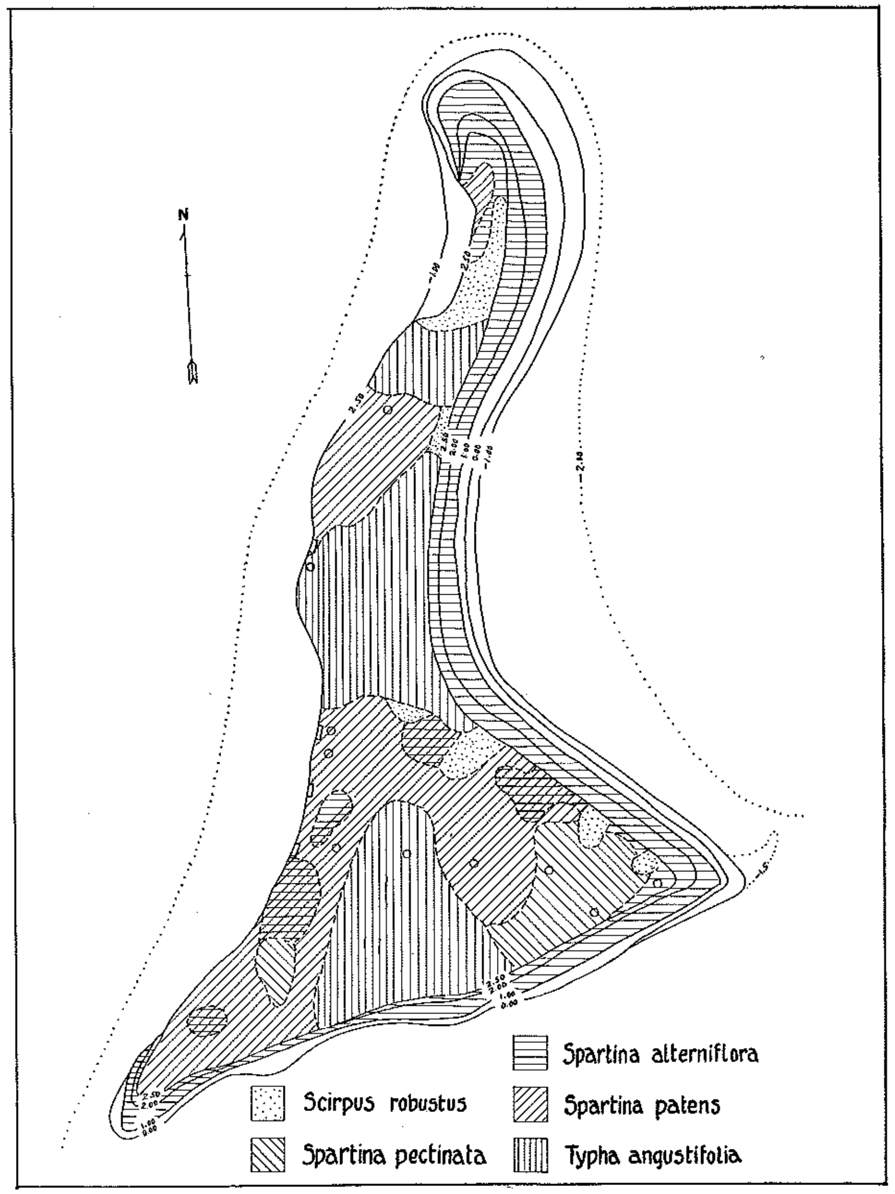


FIG. 3. Map of Plant Communities on Grassy Island.

As shown on the map this association is of wide occurrence at the lower elevations. The secondary species listed are of no consequence in area covered or "root-space" occupied. For the most part, and particularly below high tide level, the stand of *Spartina alterniflora* is nearly pure. At the lower edge it appears to be invading some of the newly formed mud flats, largely by the extension of its underground stems. Most of the secondary species occur as occasional individual plants; but *Eleocharis parvula* and *Lilaeopsis lineata*, both of very low stature, are abundant in a few places on the mud between the stalks of *Spartina*.

Spartina patens association:

Primary sp.

Spartina patens (Ait.) Muhl.

Secondary spp.

Typha angustifolia L.
Triglochin maritimum L.
Festuca rubra L.
Spartina patens var. *caespitosa* (A. A. Eat.) Hitchc.
Agrostis stolonifera L. ? var.
Scirpus americanus Pers.
Juncus Gerardi Loisel.
Rumex occidentalis Wats.
Atriplex patula L.
Atriplex patula var. *hastata* (L.) Gray
Acnida cannabina L.
Potentilla pacifica Howell
Solidago sempervirens L.
Aster novi-belgii L.

Not only are there more secondary species here than in the preceding, but also a few of them are common and conspicuous. This is true especially of *Juncus Gerardi* and *Triglochin maritimum*, which in some places could be considered of primary significance. Over most of the area designated on the map for *Spartina patens*, however, this species forms its characteristic matted tangle of culms and leaves. *Juncus Gerardi*, where it occurs, grows on about the same type of ground as the *Spartina patens*, either alternating or mixed with it. *Triglochin*, on the other hand, is most abundant in small holes where tidal water stands for a while. Scattered about the southern half of the island, and to a certain extent near the northern tip, there are mixtures of *Spartina patens* and *S. alterniflora*, suggesting that, if tide levels exercise a controlling influence, areas occupied by such mixtures are on the borderline between mid-littoral and upper littoral conditions. The extent and distribution of the areas indicate a rather sensitive adjustment of conditions over much of the upper surface of the island.

Scirpus robustus association:

Primary sp.

Scirpus robustus Pursh

Secondary spp.

Typha angustifolia L.	*Eleocharis halophila* (Fern. & Brack.) Fern.
Spartina alterniflora Loisel.	*Acnida cannabina* L.
Panicum virgatum L.	*Solidago sempervirens* L.

Scirpus robustus usually occurs in dense stands, with its heavy underground stems and roots tightly intertwined. The only secondary species in the association that shows any ability to occupy much space is *Juncus halophilus*, which forms rather close stands among the *Scirpus* stems in a few places.

Typha angustifolia association:

Primary sp.

Typha angustifolia L.

Secondary spp.

Acnida cannabina L.
Solidago sempervirens L.

This is one of the most conspicuous plant communities on the island. The *Typha* is in dense, nearly pure stands. In mid-June it was throwing pollen so profusely that any disturbance of the stems, such as was caused by walking through, set off yellow clouds which were blown about by the wind.

Spartina pectinata—Festuca rubra association:

Primary spp.

Spartina pectinata Link
Festuca rubra L.

Secondary spp.

Similar to those of the *Spartina patens* association.

This association is distinguished by having marked seasonal aspects, although these are noticeable to a lesser extent also in the *Spartina patens* communities. When the area was visited in the spring *Spartina pectinata* was not visible

at all, while *Festuca rubra* and *Triglochin maritimum* were very prominent, the former being in bloom at the time and appearing as a dominant species. *Festuca* also appeared rather commonly in the *Spartina patens* association in the spring, but in neither community was it easily discernible in the fall. The two primary species in the *Spartina pectinata* association, therefore, refer to spring and fall aspects.

In general the boundaries between the associations are rather well-defined, although mixtures of the *Spartina patens* and *S. alterniflora* associations are not uncommon, as indicated above. The simplest communities are those of *Typha*, which occurs in nearly pure stands. As previously noted, most of the secondary species of the *Spartina alterniflora* association are in the upper part, where it merges with *Typha*, *Scirpus* or *Spartina patens*. Of the twenty-three species noted, only two, *Acnida cannabina* and *Solidago sempervirens*, were listed in all five associations. Neither of these species is of primary significance in any association. A more thorough examination of the area than we were able to make would probably show more species with this wider spread. On the other hand, only four species were noted in one community each: *Eleocharis halophila*, *Scirpus robustus*, *Lilaeopsis lineata*, *Sium suave*. All of these are of little significance in the associations except *Scirpus robustus* which is a primary species in certain areas.

Some other features of the Grassy Island communities are worthy of mention. The small size of the flora has already been pointed out, but it is of interest that some of the species *not* yet collected on this island are among the commonest in other salt marshes. Most conspicuous by their absence were *Distichlis spicata*, *Suaeda linearis*, *Salicornia herbacea*, *Limonium carolinianum*, *Plantago oliganthos*, and *Aster subulatus*. Of these the most difficult to account for is *Distichlis*, which is a common, and often primary, constituent of the upper salt marsh associations.[8] On some marshes it forms nearly pure stands. In the peat just beneath the surface, however, were a few remains of what appeared to be *Distichlis* rootstocks. Some of the other species: *Suaeda*, *Salicornia*, and *Limonium*, usually grow in the "pans" that are characteristic of our coastal marshes, and the absence of such pans on Grassy Island would serve to keep them out.

The areal arrangement of the communities on the island is not readily explainable by any obvious controlling factor except that of relative salinity. The only association that is clearly set off topographically is that of *Spartina alterniflora*. This species is usually classed as mid-littoral in position, for there it has its broadest expanse; but it is notable for the wide tidal range it can with-

[8] Nichols, 1920; Chapman, 1940, p. 128.

stand. Chapman[9] gives its possible vertical range on the Lynn marshes as 7.93 feet, a figure much greater than for most other salt marsh plants. On Grassy Island it forms a margin at the eastern, southern, and northern sides, extending from approximately mean sea-level (0.0 feet) to about 2.5 feet. The western shore is a precipitous cliff of peat that will not support the community.

The other four associations are all near the contour of 2.5 feet. The surface of the island is not entirely flat, but such relief as occurs has a range of less than .5 feet and is difficult to define. Whether or not there are sufficient differences in elevation to affect the relative salinity of the high tide water in the various areas has not been determined. It is notable, however, that the *Scirpus robustus* communities are all on the easterly side of the island, where they merge directly with *Spartina alterniflora;* and all of the *Spartina pectinata* is on the broader southern part of the island.

Using the studies of Nichols, Chapman and others,[10] it is possible to construct a sequence among these five associations according to a descending order of salinity, as follows: *Spartina alterniflora—Spartina patens—Scirpus robustus—Typha angustifolia—Spartina pectinata.* By this arrangement the most mesophytic portions of the island are on the southeast and southwest points, while the narrower, northern section shows alternating areas of slightly different conditions indicated by *Spartina patens, Typha* and *Scirpus.*

A striking feature of the whole surface vegetation of the island is the abundance of plants such as *Typha angustifolia, Scirpus robustus,* and *Spartina pectinata,* which indicate conditions verging on those of fresh water marsh. Similar communities are common to all the tidal marshes in the vicinity, but it is necessary to go only a short distance down the estuary to find notable changes. Even the marshes at the mouth of the Assonet River, scarcely more than two miles away, are almost entirely without these species, and the latter do not again appear along the main river between this point and the sea. It is presumed that the influx of fresh water from the upper Taunton river is responsible for the mixture at Grassy Island and vicinity, and that the southern limit of its effect is in this area. The intermediate salinity of the water, indicated by the existing high tide communities, appears to have an effect upon the nature of the island peat. As will be noted below, this effect was probably of considerable importance in the early history of the island.

THE PEAT

The peat of which the island is composed has been deposited in three clearly definable layers. The arrangement of the layers (Fig. 4) was determined by

[9] Chapman, 1940, p. 143.
[10] Nichols, 1920; Chapman, 1940.

examination of the undercut western and southern shores, and by numerous borings scattered over the whole island.

The uppermost layer is composed of dark brown to blackish fibrous peat made up principally of the rootstocks of high tide species. By far the most conspicuous of these is *Spartina patens.* The upper surface of the layer, as previously stated, is nearly level, though marked by small shallow depressions here and there. The lower surface, however, slopes gradually upward from west to east, so that the layer is thickest, 22-24 inches, at the western side of the island and tapers to 12-16 inches at the eastern side. Judging by the measurements taken, the lower surface is a fairly even one.

Immediately below the *patens* peat is a thicker bed composed of mixed materials in which parts of the coarser rhizomes of *Spartina alterniflora* are conspicuous. In some places *alterniflora* is so abundant that most of the bulk is made up from it. However, this layer differs notably in color and texture not only from *patens* peat but also from typical *alterniflora* peat. When washed of its fine silty materials the *patens* peat is dark brown in color, fibrous, and coherent in tangled masses. The mixed layer when washed proves to be largely of much fragmented plant parts, most of which are somewhat blackened. The silt content of this layer is notably greater than that of the *patens* peat. Typical *alterniflora* peat, on the other hand, though usually very silty, is pale brown in color, and the rhizomes of the grass are often nearly intact.

The boundary between the high tide and mixed peat beds is well defined and usually involves a transition layer of only a couple of inches. It is easily seen on the western shore of the island, where it marks a level below which undercutting is much more active than above. The more closely bound high tide peat does not erode so rapidly as the fragmented mixed peat, so that an overhang is developed. This is clearly visible in one of Delabarre's photographs.[11]

Reference to the diagram (Fig. 4, Section V) will show, therefore, that a large part of Grassy Island is made of a mixture of peat in which the remains of both high and mid-tide grasses are conspicuous. This mixture forms a definite layer in the island peat, thickest toward the eastern shore. It is capped by the bed of high tide peat previously described, while its lower surface appears to conform with the contours of the mineral substratum. It has a high silt content, and most of its plant materials are fragmented and poorly preserved (oxidized). There is, however, a certain amount of *alterniflora* peat that is fairly typical.

Between the mixed peat and the mineral base of the island is a thin bed

[11] Delabarre, 1925, Plate I.

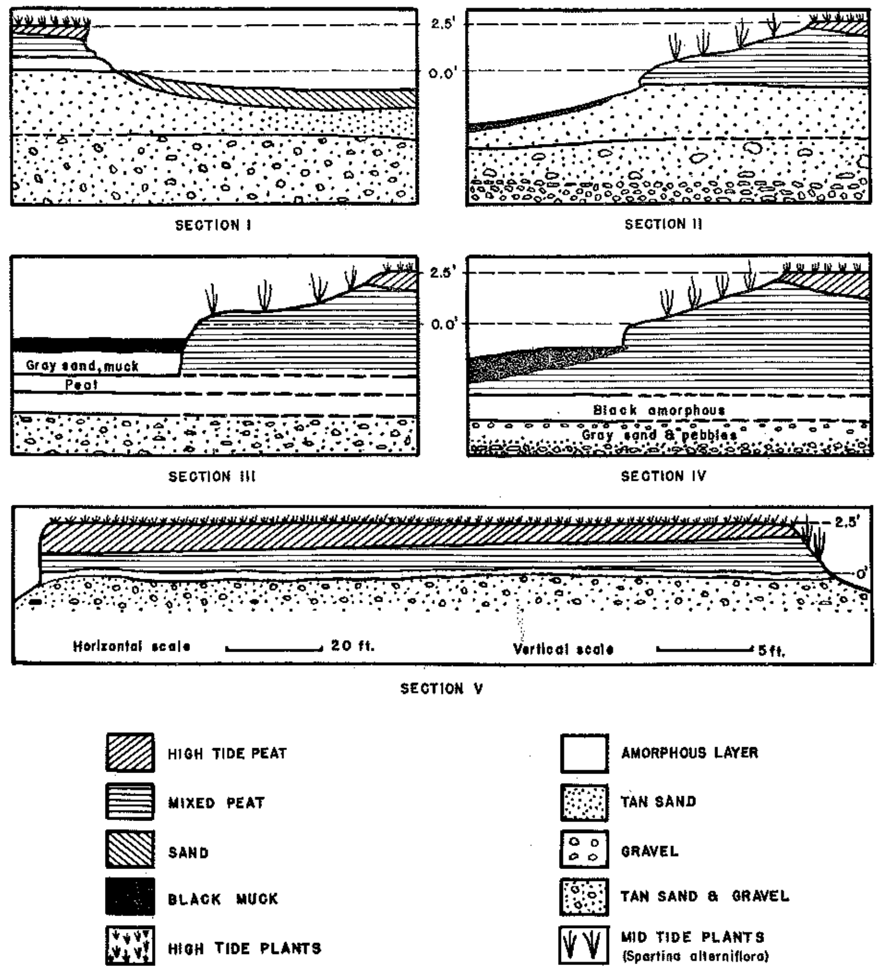


FIG. 4. Cross Sections of Grassy Island.

which, for want of a better term, we have called the "black amorphous peat." It averages about four inches in thickness, passing without sharp lines of demarcation into the mixed peat above and the sand or gravel beneath. It is composed principally of very finely divided organic matter in which are pollen grains, fungus hyphae, a few fungus spores, and a small number of sponge spicules. Diatoms are entirely wanting or are extremely rare. No fragments of wood have been found in it except in the fireplace left by the aboriginal

occupants. When the fines are washed out there is a residue of a few fragments of plants similar to those found in the mixed layer.

The dark brown to black color of all of the island peat is indicative of a greater amount of oxidation than is usual in salt marsh deposits. Samples of high tide peat taken only a short distance down the estuary are notably lighter brown in color, and more securely bound together by interlacing rootstocks than those from the island. We presume this to be due to the lower percentage of salinity near the head of the tide, a condition evident in the modern plant communities.

THE MINERAL SUBSTRATUM

The Grassy Island peat rests on a substratum of sand and gravel which appears to overlie a glacial till. Its upper layers are mixed with the black amorphous peat; so that, passing downward, the color changes gradually from black to gray, then to tan or dark yellow. A more detailed account of the content of the substratum, and that of its upper contact zone, will be found below, in the description of the excavation.

The surface of the sand and gravel is somewhat irregular and hummocky, with a maximum relief of approximately thirty inches. It slopes downward from north to south and from west to east. On the basis of our measurements and surveys it is possible to arrive at an acceptable figure for the relation between this surface and the present tide level. It is now about forty inches below mean high tide. Since the estimated tide range for Grassy Island is about thirty-four inches it is obvious that the mineral substratum would never be exposed at high tide.

EXCAVATION OF THE ARTIFACTS

METHODS USED

Four trenches were excavated in the west bank of the island (Fig. 2). Each of these was about six feet wide, along the bank, and three feet long. Trenches could not be located in the northern portion of the island because such would hasten the process of erosion, resulting in the obliteration of that part of the island. It was therefore not possible to continue work in the area from which Dr. Delabarre obtained the larger portion of his collection (A to C, Fig. 2). The trenches were located some distance apart in localities where the tide exposed the ancient surface as long as possible. This was done in order that they would show any variations in the surface which might be present. The location of Trench 1 between Delabarre's C and D and Trenches 2, 3 and 4 between E and G made possible the correlation of Delabarre's information with the present discoveries.

The relation between the ancient surface and tide level made it necessary to devise a special method of excavation. This method produced satisfactory results but, unfortunately, it was impossible to observe the artifacts in situ. The artifacts can only be located within the range of arbitrary levels. The original surface was exposed for about one hour and during this space of time little meticulous excavation could be accomplished. Actual digging with a trowel was attempted in Trench 1 but it was given up because the wet muddy gravel could not be cleaned from the artifacts in situ nor could any significant amount of material be excavated in the time permitted by the tide.

In order to dig below the level of the tide a strip of peat was left as a sort of dam across the seaward edge of each trench. By commencing the excavation during the ebb tide it was possible to have several hours in which to work. Excavation back of the dam was done by shoveling out layers of known depth. Careful records of the depth and thickness of these arbitrary levels were made. The materials so removed were distributed in piles upon the bank. When the rising tide either flooded the trench or broke the dam, making further work impossible, the deposit under the dam was removed. The next step was to sift the materials. This was done conveniently in the water during the flood tide.

Preliminary examination showed that the upper layers of the peat contained nothing of interest to this phase of the investigation and so, excepting the amorphous layer, it was discarded. Occasional pebbles were found in the upper layers of the peat but it was discovered that these had been thrown up on the bank by the waves or by previous collectors only to fall into the numerous holes bored by fiddler crabs. Because stones were found throughout the amorphous layer it was examined with some care. It was impossible to determine an exact location of the contact between the amorphous layer and the surface of the gravel or sand underlying it. This contact occupies a zone from one to several inches thick. An attempt was made to segregate the material from this layer or "Contact Zone." The sand and gravel underlying the amorphous layer were removed by peeling off layers, the thickness of which varied with expediency.

The holes made with a peat borer and the excavations in the trenches did not permit a proper identification of the deposits which lay beneath the peat. It is probable that they are made up of modified glacial material which may be either till or outwash. For convenience it is here called till, but it should be emphasized that use of this term carries no implication of origin. The color of the material ranges from light to dark yellow or tan. It was not cemented together. The till contains many smoothly rounded pebbles the largest of which are usually less than four inches in their largest diameter. Stones six inches in

diameter were infrequent; one about eighteen inches in diameter was found in Trench 1. The consistency and appearance of this material was uniform with localized exceptions. In Trench 4 the upper few inches were gray in color and contained only a few very small pebbles (Fig. 5). In the southern part of the same trench it was entirely free of pebbles.

In Trenches 3 and 2 the till was overlain by a bed of fine yellow sand. The sand was slightly darker in color than the till and was distinguished from the latter by its texture and lack of pebbles. The discovery of chips and other debris of human occupation in the top of the sand established its surface as the ancient

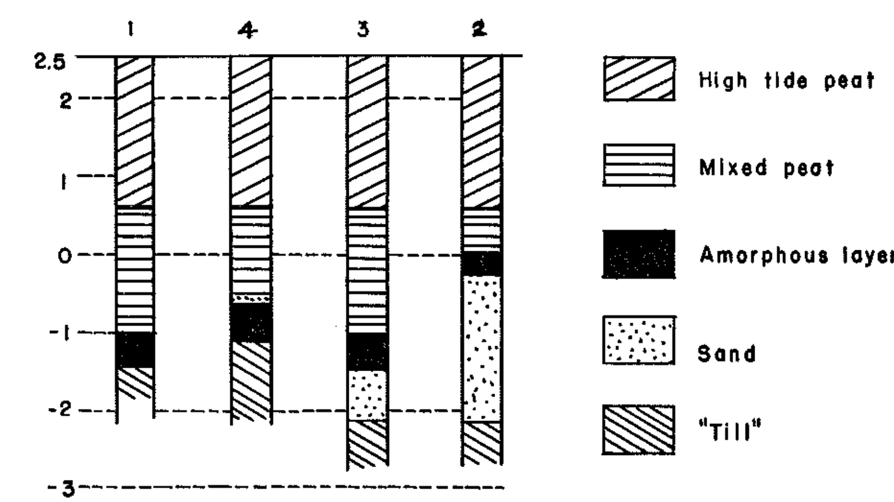


FIG. 5. Cross Sections of Trenches on Grassy Island.

one. That is, the sand layer was not intrusive, at least since the time at which the island was occupied by the Indians. Other layers of sand were occasionally found higher in the peat. They are of local occurrence, and appear to be due to washing during the later period of deposition.

Location of the Archaeological Site

Artifacts were found in the amorphous layer, the zone of contact between it and the underlying till, and in the upper part of the till itself. In Trenches 1 and 4 the amorphous layer contained no debris of occupation and very few small pebbles. The latter could have been either washed or blown into the deposit as it was forming. In Trench 4 this layer was capped by one of sand. Roots from the peat overlying this sand passed through it into the amorphous layer. In Trenches 3 and 2 the amorphous layer included irregularly shaped rocks. In Trench 3 these rocks were small, but in Trench 2 they were several inches in diameter. In both trenches pebbles and angular fragments of stone were also found. Chips certainly of human manufacture occurred. The majority of these chips were of quartz, but various hard rocks having a conchoidal fracture were also represented.

The thickness of the Contact Zone varies, but in no place is it more than four inches. As a rule it appears as a mixture of amorphous peat and sand or till. The change in color from black to gray, tan or dark yellow was general. This layer produced a large variety of stones. Many of these were pebbles varying in size from a few about six inches to many less than one quarter of an inch in diameter. There were many angular fragments most of which exhibited some form of erosion. Some of the stones could be crumbled in the hand. Other chunks of rock may have been burned. Pieces of rocks in the form of blocks or cores were common. These lumpy pieces were part of the refuse discarded by the aborigines after flakes had been knocked off them. Quartz and quartzites were common. A great many chips were found. These were obviously the refuse from the stone industry of the former inhabitants. The chips were of many varieties of rock, most of which exhibited the bulbs of percussion and other characteristics of conchoidal fracture. The chips varied in size from about one inch to about an eighth of an inch in their largest diameter. A fragment of a spearpoint or knife was found in this contact zone in Trench 2.

In the upper surface of the till, in addition to many pebbles and other forms of rock indigenous to it, fragments similar to those described for the Contact Zone were discovered. These fragments, including chips of human manufacture, were found scattered through a layer, some four inches thick, below the Contact Zone. One tiny fragment, the tip of an arrow point, was found in the upper part of this layer.

Chips, blocks and angular fragments of stone, and very rarely pebbles, were found in the sand layer of Trenches 2 and 3. These specimens were most common in the upper part of the layer. In the lower part, in Trench 2, chips were more common than the other types of fragments. One arrow point was found in the upper part of the layer in Trench 2.

The remains of what probably was a fire-pit were discovered in the center of the eastern wall of Trench 2. The pit was oval in plan, sixteen inches in the diameter exposed on the face of the trench. The western margin was sixteen inches from the face of the trench. The section of the pit east of the trench could not be excavated, for the trench had been dug to the maximum dimensions permitted by the owner of the island. In cross section the pit was in the form of two lenses which were in contact for a distance of about .5 feet. The upper lens was .46 feet thick and the lower about .8 feet thick. The maximum horizontal dimension was difficult to determine for the boundaries were not clearly marked; it was greater than sixteen and probably about twenty inches wide. The pit contained large chunks of charcoal.

Preliminary identification of this charcoal has been made by Dr. Elso Barghoorn of Harvard University. Six specimens were large tree fragments of oak. Two or three species were represented or at least the fragments came from two or three sources, not the same tree. A fine-grained specimen may be of willow or some similar hardwood. Another fragment of a different hardwood awaits identification. The number of species of trees and the fact that the wood comes from the trees themselves, not the stumps or roots, is reason for believing that the deposit is the remains of a fire kindled in the pit.

The excavation of the four trenches described above corroborates the findings of Dr. Delabarre, *i.e.*, evidences of aboriginal occupation were found beneath the peat of Grassy Island. The recent excavations brought to light only one spearpoint and two arrowpoints, or parts of them. However, the refuse from the stone industry of the inhabitants is of equal interest and significance. This material ranges from cores which were the source of the flakes from which tools were made to the tiniest of chips which were removed during the final process of finishing the implements. It is obvious that tools were made on the island. The raw materials for this industry may have been indigenous to the island or they may have been imported by the people. The fire-pit is perhaps evidence that the island was the scene of homely, domestic activities. In other words, present discoveries add weight to the opinion that a thriving community once existed upon the site of Grassy Island.

Measurements taken during the excavation of the trenches and in borings through the peat show that the surface upon which the artifacts were dropped is now below water level everywhere at mean high tide. Many places are submerged even at mean low tide. It is impossible to ignore the fact that the Indians could not have existed on the site unless sea level were lower than it is now. They could not have stayed there for more than two hours a day and it is impossible to conceive of people making stone tools under these conditions. It is inconceivable that the industrial material is not in situ. Arguments that the tools were deposited upon the top of the peat and have sunk through it to the ancient surface and below are not worthy of consideration.

THE ARTIFACTS FROM GRASSY ISLAND AND NOTES CONCERNING THEIR DISTRIBUTION

DR. DELABARRE'S catalogue of his collection in the King Phillip Museum and the record of specimens he sent the Peabody Foundation is extraordinarily complete. Each specimen is numbered and described. Entries locate specimens on the "surface of the beach," the "ancient surface," and the "ancient surface beneath the peat." In addition, depths below the ancient surface are recorded in nineteen instances. Aside from this there is considerable descriptive matter in the catalogue. These data formed the basis for the several published accounts of Grassy Island made by Dr. Delabarre and for the interesting letters he wrote us. Dr. Delabarre has also reported the discovery of human and other bones in the deposit.[12] These were broken into very small fragments. The conditions under which the discovery was made and the character of the material recovered prevent any satisfactory explanation of the occurrence. Recent inspection of the bones now reposing in the King Phillip Museum led to the inexpert opinion that a large majority of the bones were not human and that many had been burned.

The conclusion to be derived from the data concerning provenience is that the collection is a homogeneous one. Comparison of the artifacts from different vertical positions determined by Dr. Delabarre and by us reveals no typological differences indicating a stratigraphy which might have been missed during the excavation of the site. The unexcavated surface collections do not contain any significant number of types which cannot be associated with the remains from the ancient layer. The following analysis is therefore based upon an opinion that during the time the island was occupied there was no significant change in the stone industry and that the site was abandoned at or before the end of the twelfth century A.D. (See p. 50 for the determination of this date.)

The present account includes a description and classification of artifacts from all sources. Those in Dr. Delabarre's collection were, by courtesy of Mr. Haffenreffer, photographed and segregated according to the locations given in the catalogue. The artifacts in the Peabody Foundation were arranged in a similar manner. Following this the classified collection was compared with collections and sites located in New England and then with selected sites in northeastern North America.

The classification, summarized in Table II, is based upon a method employed

[12] Delabarre, 1925, 1928.

TABLE II

SUMMARY OF THE CLASSIFICATION OF ARTIFACTS FROM GRASSY ISLAND

Type	Excavated from Old Surface	Excavated Depth recorded	Excavated from beneath Peat	Collected from surface of beach	Illustrated
ARROW POINTS					
Ovate	5	1—6"		4	Pl. II, 1
Trianguloid, Straight Base	1			5	Pl. II, 3, 4
Trianguloid, Concave Base	15		5	22	Pl. II, 5, 6
Trianguloid, Crude, Unclassifiable				4	
Trianguloid, Tri-excurvated	1				Pl. II, 7
Trianguloid, Corners removed	4			4	Pl. II, 10–14
Trianguloid, Corners notched				2	Pl. II, 8, 9
Trianguloid, Stemmed	3			7	Pl. II, 15, 16
Trianguloid, Stemmed, Sharp corners				4	Pl. II, 17
Trianguloid, Stemmed, Rounded corners	8	1—4"	1	9	Pl. II, 18, 19
Trianguloid, Side notched	3			6	Pl. II, 20–22
Lanceolate	43	1—6–8"		8	Pl. II, 23–26
Lanceolate, Straight Base	1			6	Pl. II, 27–28
Lanceolate, Straight base, Side notched				3	Pl. II, 29–31
Lanceolate, Straight base, Corners notched	5			1	Pl. II, 32, 35–37
Lanceolate, Straight base, Corners removed	11	1—6"		22	Pl. II, 33, 34, 38–41
Lanceolate, Concave base	2			5	Pl. II, 42, 43
Lanceolate, Concave base, Side notched				1	
Lanceolate, Stemmed	13	1—2", 1—3" 1—6", 2—4"	7	34	Pl. II, 44–46
Lanceolate, Stemmed, Concave base				1	
Elongate	2		1		Pl. II, 47
Elongate, Stemmed	4			7	Pl. II, 48, 49
Elongate, Side notched	2			3	Pl. II, 50, 51
Elongate. Corners removed				1	Pl. II, 52
SCRAPERS, THUMB-NAIL	2			4	Pl. II, 53, 58
SCRAPER, LARGE				1	Pl. II, 59
DRILLS				6	Pl. II, 54–56
AMORPHOUS, TURTLEBACKS	6	1—6–8" 1—4–6" 1—8½"		10	Pl. II, 57
GOUGES	1			2	Pl. III, 16–18
CELT	1				Pl. III, 20
CELTS, UNPOLISHED	2			3	Pl. III, 1, 12
CHOPPER	2		1	4	Pl. III, 13
NOTCHED SINKER				1	Pl. III, 14
NOTCHED AXE				1	Pl. III, 19
SPEARS, OR LARGE BLADES	7			13	Pl. III, 6, 15
MISCELLANEOUS, UNCLASSIFIABLE	21	1—4", 1—9"	1	12	Pl. III, 1–4, 7–11
FRAGMENTS OF ARTIFACTS, UNIDENTIFIABLE	16	1—5"		73	
TOTALS	181	15	16	287	

in the study of the artifacts from the Hornblower Shellheap.[13] The method of classification was described in some detail in this work and since there have been no revisions it will not be repeated here.[14] It should be re-emphasized

[13] Byers and Johnson, 1940.

[14] There have been some objections to the use of the term "type." The categories into which the artifacts have been segregated are called types. Thus a type of artifact is the perfect example of a particular form; it is the mean falling between extreme variations. In view of this definition and the lengthy previous discussion, the objections appear to be academic. Reference to type of artifact should not be confused with "culture type" or "pottery type" which is a totally different idea. As a matter of fact the term culture type has seldom been used in discussions of northeastern archaeology.

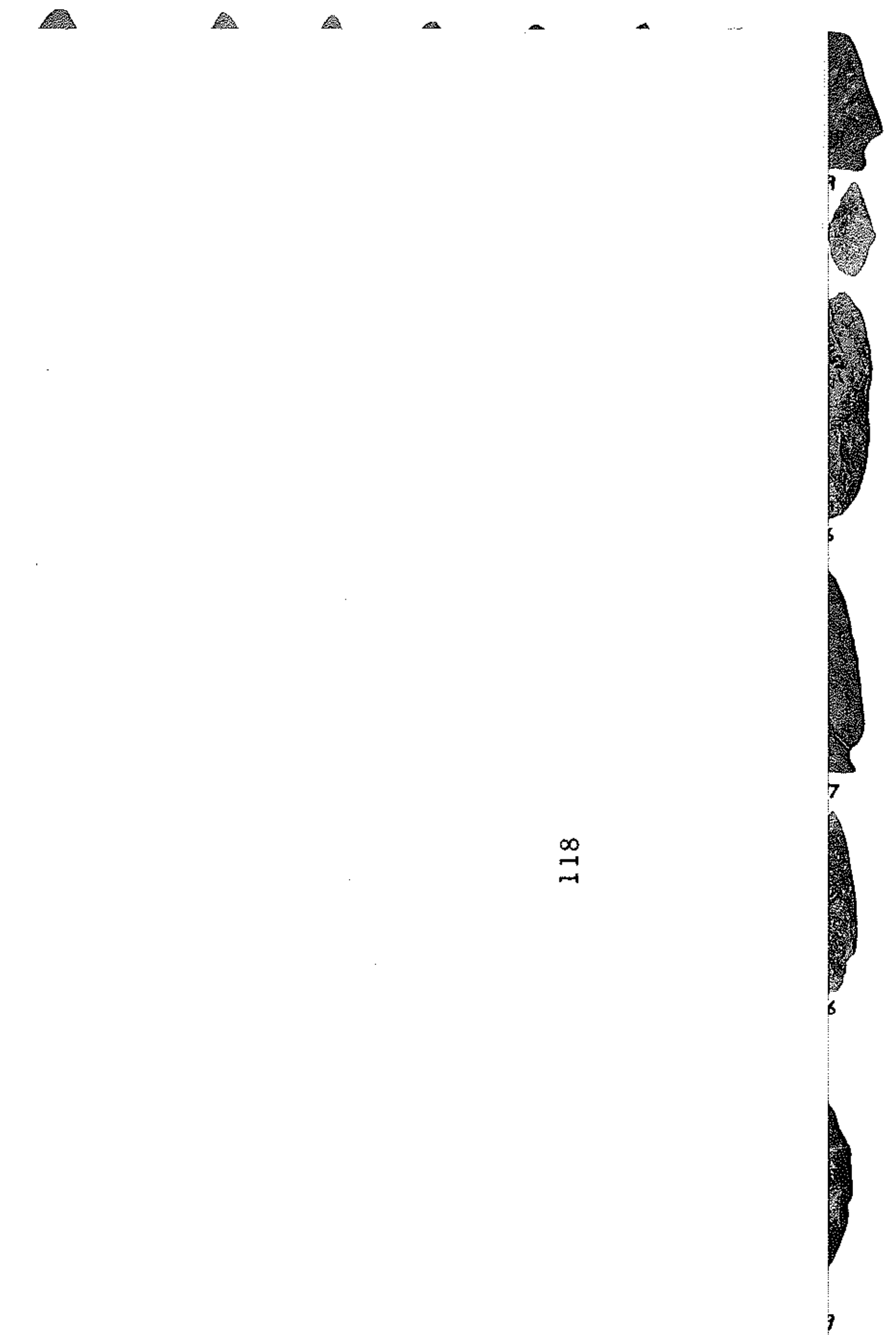
that the classification is an arbitrary system based upon opinions concerning the form of the artifacts plus some general assumptions of function. For example, the tools are labeled arrowpoints, scrapers, sinkers, drills and so forth. The classification has been made for convenience in description. It is not an explanation of aboriginal habits nor has it any historical implications.

The 373 classifiable artifacts from Grassy Island can be segregated into a number of major groups. There are 305 arrowpoints. Six thumb-nail scrapers and one large scraper were recovered. The six drills found are classifiable into two categories; (1) unmodified for hafting, and (2) expanded base, which may or may not be notched for hafting. The nineteen specimens classified as Amorphous, turtleback, are irregularly shaped, thick blocks of stone generally flat on one face and crudely chipped about the edges. There are three gouges. One of these is a fragment of an implement which probably was channeled its entire length. The other two are channeled for short distances from the cutting edge. One rectanguloid, polished celt was excavated. The five unpolished celts are crudely chipped on all surfaces and the cutting edges are chipped; slight smoothing on the edges may be due to use. Seven choppers are similar to the unpolished celts but they are very much smaller; they are chipped on the faces and the cutting edges and tend to be thick, *i.e.*, a flat oval in cross section. The notched sinker is simply a beach pebble on two sides of which notches have been pecked or battered. The single notched axe is identified with some hesitation. It is roughly rectangular in cross section and two distinct notches have been crudely battered near the upper end of the two sides. The blade tapers to a point but it has been so modified by rough use that its original shape cannot be determined. Of the twenty spearpoints identified only two can be classified;

PLATE II

Arrowpoints and other Chipped Implements from Grassy Island

1. Ovate.
3, 4. Trianguloid, Straight base.
5, 6. Trianguloid, Concave base.
7. Trianguloid, Tri-excurvate.
8, 9. Trianguloid, Corners notched.
10-14. Trianguloid, Corners removed.
15, 16. Trianguloid, Stemmed.
17. Trianguloid, Stemmed, Sharp corners.
18, 19. Trianguloid, Stemmed, Round corners.
20-22. Trianguloid, Side notched.
23-26. Lanceolate.
27-28. Lanceolate, Straight base.
29-31. Lanceolate, Straight base, Side notched.
32, 35-37. Lanceolate, Straight base, Corners notched.
33, 34, 38-41. Lanceolate, Straight base, Corners removed.
42, 43. Lanceolate, Concave base.
44-46. Lanceolate, Stemmed.
47. Elongate.
48, 49. Elongate, Stemmed.
50, 51. Elongate, Side notched.
52. Elongate, Corners removed.
53, 58. Scrapers, Thumb-nail.
54-56. Drills.
57. Amorphous, Turtlebacks.
59. Scraper, Large.



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Arrowpoints and other Chipped Implements from Grassy Island

1. Ovate.
3, 4. Trianguloid, Straight base.
5, 6. Trianguloid, Concave base.
7. Trianguloid, Tri-excurvate.
8, 9. Trianguloid, Corners notched.
10-14. Trianguloid, Corners removed.
15, 16. Trianguloid, Stemmed.
17. Trianguloid, Stemmed, Sharp corners.
18, 19. Trianguloid, Stemmed, Round corners.
20-22. Trianguloid, Side notched.
23-26. Lanceolate.
27-28. Lanceolate, Straight base.
29-31. Lanceolate, Straight base, Side notched.
32, 35-37. Lanceolate, Straight base, Corners notched.
33, 34, 38-41. Lanceolate, Straight base, Corners removed.
42, 43. Lanceolate, Concave base.
44-46. Lanceolate, Stemmed.
47. Elongate.
48, 49. Elongate, Stemmed.
50, 51. Elongate, Side notched.
52. Elongate, Corners removed.
53, 58. Scrapers, Thumb-nail.
54-56. Drills.
57. Amorphous, Turtlebacks.
59. Scraper, Large.

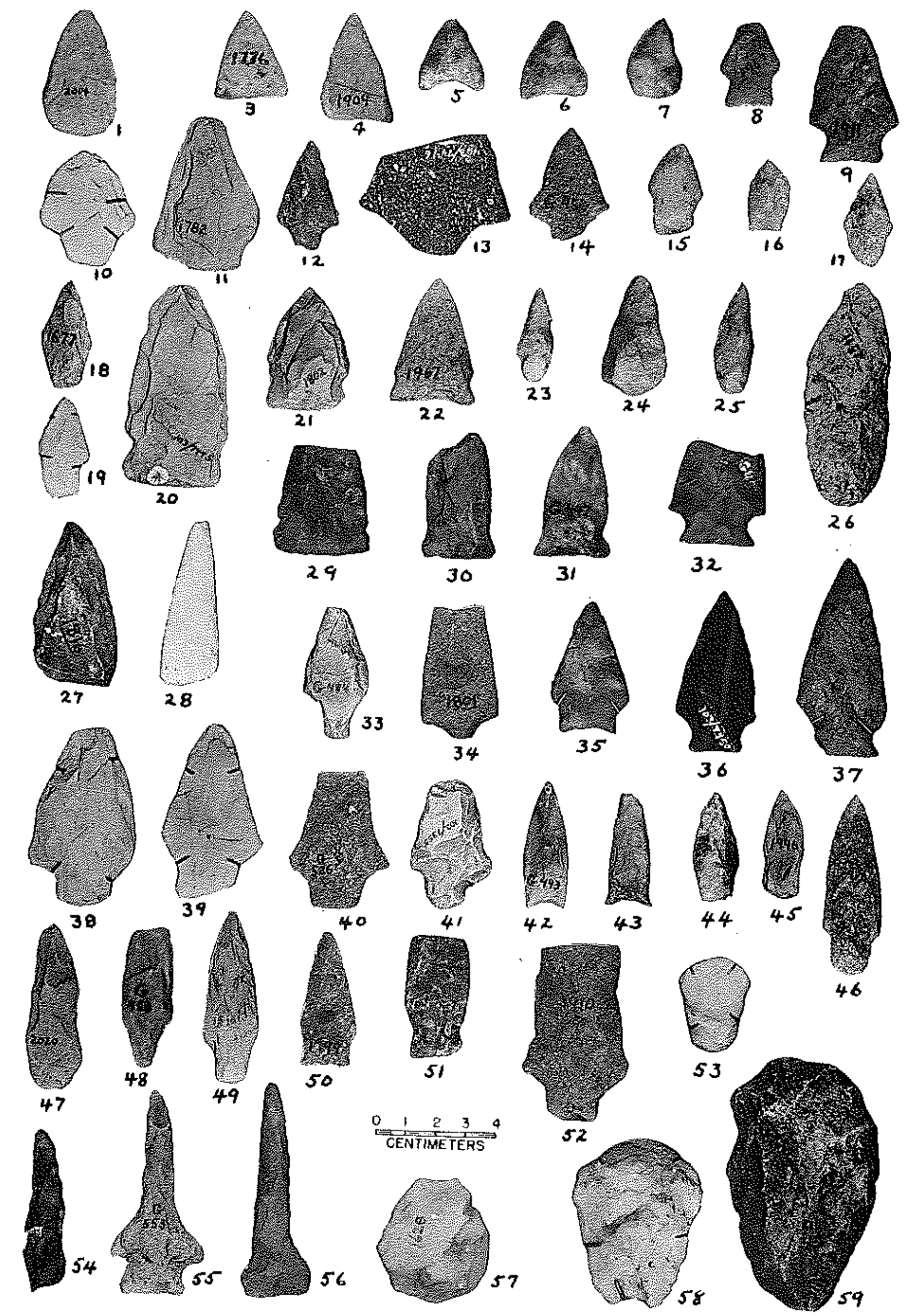

PLATE II
(See opposite page for explanation)

they are crude varieties of Lanceolate. The size of the other specimens makes it necessary to call them spearpoints, but, being only fragments, their shapes cannot be described. Added to this list are 126 specimens which are unclassifiable because of their somewhat amorphous shape, which is a noteworthy character, or because they are fragmentary.

The 305 arrowpoints have been divided among 24 categories. This classification segregates out a number of rather minute details which at the moment are not useful simply because too few collections have been subjected to similar treatment. There are several ways of reducing the classification to a point where the specimens may be compared with those from other collections. One of these reduces the 24 categories to the following 19.

Type	*Number of Specimens*
Trianguloid, unmodified for hafting	53
Trianguloid, stemmed (all forms)	33
Lanceolate	52
Lanceolate, straight base, corners removed	34
Lanceolate, stemmed, straight base	59
Ovate	10
Trianguloid, corners removed	8
Trianguloid, corners notched	2
Trianguloid, side notched	9
Lanceolate, straight base	7
Lanceolate, straight base, side notched	3
Lanceolate, straight base, corners notched	6
Lanceolate, concave base	7
Lanceolate, concave base, side notched	1
Lanceolate, stemmed, concave base	1
Elongate	3
Elongate, stemmed	11
Elongate, side notched	5
Elongate, corners removed	1

In this list there are five types of arrowpoints each of which is represented by 33 specimens or more; the total number being 231 or approximately two thirds of the collection. The characteristics of these 5 types may be summarized as follows:

Type	*Number of Specimens*
Lanceolate	145
Trianguloid	86

Of these, 105 are unmodified for hafting, 92 are stemmed and 34 have their corners removed. The latter comprise a single type, Lanceolate, straight base, corner removed.

The remaining 74 specimens are divided among fourteen types, 11 specimens being the largest number in a single category. The characteristics of the 74 specimens may be summarized as follows:

	Number of Specimens	*Totals*
Unmodified for hafting	27	27
Modified for hafting		
stemmed	12	
corners removed	9	
corners notched	8	
side notched	18	47

The descriptions and especially the seriations have been presented in this manner in order to make possible comparisons between the Grassy Island material and the artifacts from other sites in the northeast. The features were selected after a preliminary examination of published illustrations and descriptions from a large number of sites in New York, New England and New Jersey. It was found that collections from the Hornblower Shellheap, the Faulkner Spring site, the Old Lyme Shellheap and the South Woodstock site[15] could be compared in some detail. The comparison is summarized in the first part of Table III. Only types of artifacts which are found in two or more sites have been entered. There are some significant figures which do not appear in this table.

1. There were eleven types present at Hornblower, representing one third of the number of artifacts, which were not found at Grassy Island or at the other three sites.
2. Four types were present at Faulkner Spring but not at Grassy Island. One of these was found only at Faulkner Spring, the others were present also at Hornblower.
3. Six types, representing about twelve percent of the total collection, were present at Old Lyme and not at Grassy Island or the other sites.
4. More than twenty types were present at South Woodstock and not at Grassy Island or the other sites. The number of specimens represented was not relatively large.

It will be noted in Table 3 that the Hornblower collection lacks two types

[15] Byers and Johnson, 1940; Robbins, 1944; Prause, 1942, 1945.

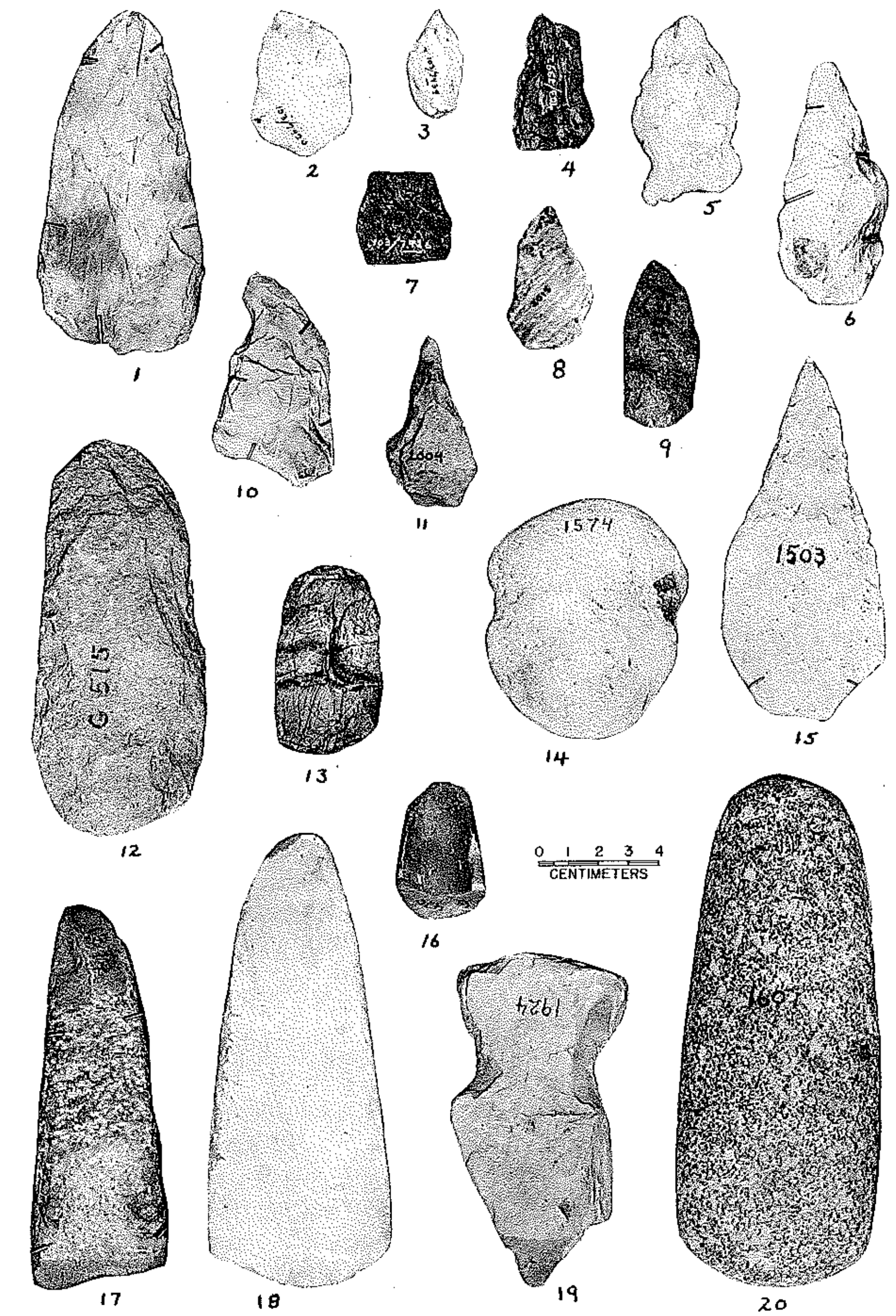

PLATE III
Chipped and Polished Stone Implements from Grassy Island

1-4, 7-11. Miscellaneous, Unclassifiable.
6, 15. Spears or Blades.
1, 12. Unpolished Celts.
13. Chopper
14. Notched Sinker.
16-18. Gouges.
19. Notched Axe.
20. Celt.

TABLE III
DISTRIBUTION OF TYPES OF ARTIFACTS

	Grassy Island	Hornblower	Faulkner Spring	Old Lyme	South Woodstock	Lamoka	Frontenac Focus	Robinson	Oberlander	Schermerhorn	Point Peninsula Focus	Canandaigua-Levanna
ARROWPOINTS[1]												
Trianguloid, unmodified for hafting	xxx	xxx	xx	xx	xxx			xxx[3]		xx[2]		*
Trianguloid, stemmed (all forms)	xxx	xxx	xxx	xxx	xxx	*	xxx[4]		*	xxx		
Lanceolate	xxx	xx	xxx			*[5]					*[6]	
Lanceolate, straight base, corners removed	xxx	x	x			*		*		*	x	
Lanceolate, stemmed, straight base	xxx	xxx	x	xxx	x	*	*		*	*		*
Ovate	xx	x	x	xx	x						*[6]	
Trianguloid, corners removed	xx	xxx	xxx					*	*		*	
Lanceolate, concave base	x	xxx										
Lanceolate, straight base	x	xx				*				xx	x	
Lanceolate, straight base, corners notched	xx	x	x			*		*		*		
Elongate, stemmed	xx	x	x	xxx	x		xx[4]			xx		
Trianguloid, side notched	x	x	xx	x		*	xx	*	*		xx	*
Trianguloid, corners notched	x	xx	x	xx		*		*	*		x	
Lanceolate, straight base, side notched	x	x	x	xx			xx	*	*		xx	*
Elongate	x	x	x						*			*
Elongate, side notched	x	x	x	x				*				
Elongate, corners removed	x		x									
Lanceolate, stemmed, concave base	x		x									
DRILLS	*	*	*	*	*	*	*	*	*	*	*	*
GOUGE	*	*	*		*		*	*	*	*[7]		
CELT	*		*	*	*	*	*	*	*		*	*
GROOVED AXE			*	*	*					*		
ADZE			*	*	*	*	*	*	*	*	*	*

[1] The number of crosses indicate an estimate of the number of specimens relative to the total collection from each site. Stars indicate only the presence of a type at each site.
[2] Many of these are the so-called "Owasco points." Some also are isosceles in shape. These variations do not appear at Grassy Island. They are rare at the other New England sites.
[3] Many of the arrowpoints are isosceles and thus differ from the equilateral trianguloids characteristic of the New England sites.
[4] The two types recorded here are included in one category, "narrow stemmed" by Ritchie.
[5] These are called "Ovate knives" by Ritchie.
[6] These are called "cache blades," sometimes "triangular cache blades," by Ritchie.
[7] The gouge is said to occur in the "Early" Focus of the Coastal Aspect, a division of culture to which the Schermerhorn site is assigned by Ritchie. (1944, p. 104) The same author says, on p. 112, concerning the Schermerhorn site, "Thus far absent are gouges, plummets, celts . . . all important traits of one or another of the Laurentian, Vine Valley, and Owasco Aspects." Specific reference to the occurrence of the gouge in the Coastal Aspect has escaped us.

found at Grassy Island. Faulkner Spring lacks two types found at Grassy Island. The Old Lyme Shellheap did not have eight of the types found at Grassy Island. The South Woodstock site lacked thirteen of the Grassy Island types.

The interpretation of the significance of Table III is not easy. Grassy Island and the Hornblower Shellheap exhibit the closest similarity. Similarity between Grassy Island and Faulkner Spring and Old Lyme appears to be of the same general order but of a different nature. South Woodstock is similar to Grassy Island in only two instances. In three other instances correspondences between South Woodstock, Faulkner Spring and Hornblower may be observed.

The distribution of basic forms is a factor of possible significance. In all sites Lanceolate and Trianguloid forms are the largest groups.[16] They are not quite so numerous in the Connecticut sites. At Grassy Island the Lanceolates are more common than Trianguloids. At the other four sites Trianguloids predominate over Lanceolates to about the same degree as the reverse occurred at Grassy Island. In all five sites artifacts modified for hafting predominated over those which were not so modified. Rather wide variations in the character of modification prevents any valid judgments concerning the significance of the distribution of specific characteristics.

The other implements do not throw any additional light upon the foregoing comparisons. Gouges were found in all sites except Old Lyme, Point Peninsula, Canandaigua and Levanna. Celts are common to all sites except Hornblower and Schermerhorn. The crude notched axe from Grassy Island is vaguely similar to those found at South Woodstock. The notched sinker from Grassy Island is the sort of thing which might or might not be picked up at any site. The absence of adzes and grooved axes from Hornblower and Grassy Island is puzzling. Adzes were found at Old Lyme and both adzes and grooved axes were found at Faulkner Spring and South Woodstock. Drills were found at all sites; there is a general similarity in type and relative number. Pottery is reported from all sites except Grassy Island. However, only three small sherds were found at Faulkner Spring. It is probable that the pottery from Old Lyme and South Woodstock belongs in the same tradition in spite of considerable variation. Also the pottery from Hornblower seems to be not too far removed from the varieties found in Connecticut.

The preceding remarks have indicated that there are, in Massachusetts and Connecticut, at least five sites which have produced series of artifacts numbers of which are similar in type. However, the number of each type found at each of the sites is comparable in only a very few instances. It is found, also, that each site includes features which are either unique or at least peculiar to but one or two of the other sites. These observations render it impossible to conclude that the products of the industries at the several sites are identical.

In spite of the lack of identity it is not possible to ignore the fact that there is a broad similarity of types found in each location. Five types are found in each of the five sites and, if we remove the South Woodstock site, a total of nine

[16] Excepting Grassy Island, all the figures from the several sources have not been supplied. Types and sub-types, especially Lanceolate forms found on one or more of the four sites but which do not appear in Table III, have been included in these calculations.

types are common to the remaining four sites. Of these nine types there are two in which numerical correspondence is similar, they are: Trianguloid, unmodified for hafting and Trianguloid, stemmed. Omitting the South Woodstock site makes it possible to add four more; Trianguloid, side notched, Trianguloid, corners notched, Lanceolate, straight base, side notched, Elongate, side notched. The predominance of modification for hafting at all sites is a factor pointing to similarity. Dissimilarity, aside from discrepancies in numerical occurrences of types, is emphasized by the predominance of Lanceolate at Grassy Island. Probably of even greater significance are the types of artifacts which are peculiar either to single sites or to a minority of the five under consideration.

The question comes, do these data permit the formulation of useful hypotheses? Strictly speaking the data are inconclusive and we could take refuge in the time-worn remark that the available information is insufficient. However the situation is not as bad as that for in spite of the many frustrations, only a few of which have been mentioned above, a number of useful generalizations can be made. It is obvious that a number of types of artifacts are irregularly distributed over southern New England. These appear to occur in two groups which overlap. One is found at Grassy Island, Hornblower and Faulkner Spring. The other occurs at Old Lyme and South Woodstock. Further reduction of the material segregates the five sites into separate units.

It is well known that there have been a number of statements, tentative or otherwise, concerning the distribution of complexes of culture traits in the northeast. The complexes include various types of arrowpoints which have been segregated in a manner comparable to that employed in the present paper. We will now attempt to discover whether or not the artifacts from Grassy Island can be collated with any group of artifacts discovered in regions contiguous to New England.

At the outset of this phase of the investigation data from thirty-one sites in New York and New Jersey were entered on a single table. However, as the analysis proceeded the number of modifications and exceptions which had to be made rendered the original table incomprehensible. There were two major reasons for this. There is no criticism intended when we note that the data have not been published in a uniform manner. Classifications of artifacts using different criteria have been developed, or they have simply evolved, to serve the purposes of a number of investigators. Because of this it is often impossible to compare descriptions of one site with those of another. It is also true that it is not always possible to discover how many specimens of a certain class have been found. For example, Ritchie employs the term "narrow stemmed" to describe a type of artifact that we consider to include a combination of "Trianguloid, stemmed" and "Elongate, stemmed." The estimates of the relative numbers entered in the last part of Table III are but guesses.

A second problem arises during the attempt to identify details observable on the artifacts themselves. Such unfortunately are not easily seen in illustrations nor can text descriptions make them clear. Differences in material and in workmanship contribute to significant variations in the form of an artifact. This applies particularly to such features as the formation of stems, corner removal, corner notching, and so forth. For example there will be objections to our record in Table III that "Trianguloid, stemmed" specimens are found in several sites representing different time periods. A careful inspection of the illustrations will show, however, that the form exists. Differences in small details of shape and construction have been used to establish sub-classes differentiating one stratum from another. Probably much of this is due partly to variation in the tractability of the stone available in different regions combined with the manner in which the artifacts were chipped. The significance of such features must eventually be discovered. We must determine whether or not the choice of a particular kind of stone, if a choice were possible, is a factor of historical or technical importance in aboriginal industry. We must be able to determine whether a variation in form is due to the character of the raw material, the ability of the aboriginal artisan, or the possibility that he had a choice of several techniques producing predictable variations. Until we have more of this sort of information controlled comparisons between forms of artifacts will have to be limited to the grosser characteristics of them. Unless we so limit ourselves ideas concerning types of artifacts will be conditioned by extraneous factors, even the subconscious desire to prove the integrity of a stratum.

The last section of Table III is an attempt to indicate roughly the distribution in New York of types of artifacts which were found at Grassy Island and the four other New England sites. Types not found at Grassy Island have not been listed. The table has been compiled from published data; eventually it should be completed and corrected in its details by careful study of each collection. Nevertheless when used with caution the table serves to indicate a number of significant features.

The New York sites selected have served as the basis for the establishment of a temporal sequence for the region. This has been accomplished expertly by the employment of some stratigraphic factors and by the use of classificatory and pseudo-statistical methods. A glance at Table III shows that the varying numbers of types of artifacts found at Grassy Island are found irregularly distributed in at least seven New York Indian sites. We find that of the five types having the greatest number of specimens at Grassy Island four are found at Lamoka, Robinson-Oberlander, and Schermerhorn. Two each appear at the other sites. The exceptions noted in the footnotes to the table are reason for believing that the quantity of each type may not be comparable.

Of thirteen minor types ten are found in New York state and it seems probable that they occur in numbers comparable to those from Grassy Island. Combining Robinson and Oberlander, we note that seven out of thirteen are present. Of these seven, four are also found at Lamoka, three at Schermerhorn, six in Point Peninsula and three at Canandaigua-Levanna.

Comparisons of the incidence of types most numerous at Grassy Island with those which are found in lesser numbers shows that both groups have considerable significance. It is not possible to assume, in this case anyway, that a particular relative frequency of occurrence is a factor of importance in comparing these sites. The whole collection from each site must be employed. In view of this remark objections may be raised to the procedure used in compiling Table III. The table records only instances where similarity was observed. In all locations in New York a majority of the types of arrowpoints were found either sparsely and sporadically in the New England sites or not at all. It seems wise to record this observation here; it is of course an important one and it is sufficient for present purposes. An attempt to show the distribution of these uncommon types lengthens and complicates the table unduly, especially when a discussion of the details of the distribution of these types does not come within the scope of the present study.

If we add to these analyses observations concerning artifacts which have not been given as detailed a treatment we do not progress much further. Of some special interest is the distribution of gouges. In New York, gouges are found on sites which have been assigned to an Archaic period. They are present on the New England sites, except for Old Lyme. Ritchie's note that they occasionally occur in the "Early" Focus of the Coastal Aspect appears to be the same as our record from the Connecticut sites. Gouges are not, apparently, an indication of antiquity in eastern New England. It does not appear that the New England sites discussed here belong wholly in the Archaic period as defined in New York. The occurrence of the gouge may indicate a conservatism on the part of the New England Indians or it may have been introduced into the area at a relatively late date.

The distribution of the grooved axe is also of some interest. One of these tools was found on the Schermerhorn site and others were found at Faulkner Spring and the sites in Connecticut. The absence of grooved axes at Grassy Island and Hornblower is not explainable in terms of culture relationship or history. In view of the idea that grooved axes are evidence of "late" cultures it is of special note that, in southern New England at least, they are associated with the gouges, a presumed "early" tool.

The distribution of adzes is not definitive. This implement was found in all sites except Grassy Island and Hornblower. Its absence in these sites is not explainable.

The distribution of the polished stone tools recorded here is admittedly incomplete. It is possible that the inclusion of minute details of construction may bring out differences and also similarities which would permit a more adequate comparison. This is not feasible at the moment because the number of specimens available does not permit any statement which is at all definitive of the situation at Grassy Island.

At the present time it is impossible to compile a table comparing the New England and New Jersey artifacts because the systems of classification are completely different. There is a suggestion that the distribution of the five types most numerous at Grassy Island is somewhat different in New Jersey. Trianguloid, not modified for hafting, are numerous on eight of the twenty-two sites. Trianguloid, stemmed, are not found in large numbers; moderate numbers may be present in four of the twenty-two sites. Numbers of Lanceolate, straight base, corners removed, could not be determined. The presence of this type in at least eight sites was recorded. Lanceolate, stemmed, straight base, could not be identified in the published report from any site. Of the remaining types Lanceolates were present in small numbers in twenty sites; in two of these sites the number may be moderate. Trianguloid and Lanceolate, side notched arrowpoints could not be separated. The combined group were found in all sites in small numbers except in three instances where moderate numbers are recorded. Trianguloid, corners notched, appear in thirteen sites. A few of the other types we are discussing were found in varying numbers of sites.

These data can hardly be called useful. However, it seems probable that a careful study of the collections will eventually reveal a certain degree of similarity between the New Jersey, New York and New England collections. One is tempted to suggest that the New Jersey material does not parallel the New England material as closely as it does the New York material. This is a question which is beyond the scope of this discussion.

DEVELOPMENTAL HISTORY OF GRASSY ISLAND

STATEMENT OF THE PROBLEM

IN THE preceding discussions, and in the field work upon which they are based, we have confirmed Delabarre's original observations concerning the prehistoric occupation of Grassy Island. We have also restated the problem which arises from the fact that the site could have been occupied by Indians only at a time when the level of high tide in the Taunton River estuary was at least about forty inches lower than it is now. Our principal contribution to the investigation at the island has been a careful examination of the peat which overlies the site. This has been done in the hope that the peat would yield, if not a time scale for the period since the site was submerged, at least a sequence of events that might reflect changes in vegetation or climate, or both—changes that could be correlated with others thought to have occurred in this region.

Before proceeding to an analysis of the peat section at the island, it will be necessary to state some premises that have come to be widely accepted among students of salt marsh development in southern New England. They are based upon a long series of careful investigations of the coastal marshes in this area.[17] The consensus of opinion is that the formation of our coastal peat deposits is highly conditioned by a long-continued rise of water levels with relation to the strand line. The situation was adequately summarized by Nichols[18] somewhat as follows:

Given a shoreline with quiet shallow water, a marsh forms on deposits of silt and the remains of aquatic plants that grow immediately off-shore (Algae, *Zostera*, etc.). At and above mid-tide the marsh is made up primarily of *Spartina alterniflora*, and this species covers most of the upper part of the tidal zone. Just below high tide level it gives way to meadows chiefly of *Spartina patens*, *Distichlis spicata*, and a variety of other salt marsh plants that are more or less occasional. If the strand line were stable, one could expect the peat under any of the higher parts of the marsh to contain a series of layers which would be a counterpart of the above-described zonation. The accumulation of all the layers of peat, and the development of a vegetation on the surface which

[17] Mudge, 1858; Davis, 1910; Bastin & Davis, 1909; Bartlett, 1909; Johnson, 1925; Nichols, 1920; Raup, 1937; Chapman, 1938, 1940.
[18] Nichols, 1920.

verges on a non-halophytic community, constitutes the "maturation" of the marsh.[19]

It was soon discovered, however, that such an ideal condition could not be found along the southern New England coast. The peat deposits here consist almost entirely of the high tide species, *Spartina patens, Distichlis spicata,* and *Juncus Gerardi.* The only conceivable way to account for such an arrangement, given the characteristics of the plants as we know them today, is through a slow, continuous drowning of the shoreline by advancing sea water. It is also necessary that the accumulation of peat from high tide grasses should be at about the same rate as that of the rise of the water level with relation to the land surface. If the rise of sea level were much slower than the growth of the high tide peat, large accumulations of mid-tide peat should be found deep in the sections, as in the case of a stable water level. If the rise were much faster than the growth of high tide deposits, then layers of the latter should be found in the sections, buried under layers of mid-tide peat. Neither of these types of section have been observed on the southern New England coasts except under unusual conditions. Uniform beds of high tide peat are so much the rule that the rate of advance in sea level is generally regarded as about the same as the rate of accumulation, so that the top of the section of peat remains in the high tide zone and contains principally the remains of vegetation from this zone. A possible source of error in this calculation might be found in the tidal range of the high tide plants as peat-forming agents. However, many observations in the region of Grassy Island show that this range is small, probably under 10 inches, and in sections of five or six feet such as are common in the area it would become negligible as a source of error.

If such an advance of the strand line is postulated, needless to say, non-halophytic vegetation would be encroached upon continuously by the high tide grasses; and if the area invaded should contain a fresh marsh or bog, there should be, at the bottom of the high tide peat developed over it, a preserved layer of fresh peat. This is the state of affairs in many of our coastal bogs. If the encroachment should be upon sandy or gravelly ridges, then no fresh peat could be expected.

With these premises in mind, the peat section of Grassy Island becomes anomalous; for instead of high tide grasses all the way to the bottom, they are confined to the upper 12 to 24 inches. Below them is a mixed, fragmented peat, clearly recognizable only in places as having been formed in situ of mid-tide grasses. The thin bottom layer of the section is of "amorphous" material, possessing none of the characteristics of old fresh water deposits except that it

[19] See Chapman, 1938.

is black. There are no recognizable remains of fresh water swamp plants in it, and no diatoms such as are almost universally distributed in quiet water.

An explanation of these anomalies based upon either of the alterations in rate of change in sea level mentioned above is not feasible. The absence of buried layers of high tide peat in the island section precludes the likelihood of any sudden increase in the rate of advance of the strand line. On the other hand, if it could be shown that a mixed peat layer containing large amounts of mid-tide grass remains was universal in the Taunton River estuary, then a period of near-stability in the strand line might be postulated. With this in view, marsh deposits on both sides of the river in the neighborhood of Grassy Island and as far south as the town of Somerset were examined. In all cases, except under certain conditions to be described below, thick, continuous beds of high tide (*Spartina patens*) peat were found extending down to the mineral substratum or to recognizable beds of fresh water peat. In fact, deep beds of this nature were found on the bank of the main river immediately east of the island. It thus becomes clear that the island section is peculiar to the island itself, and does not reflect any changes in rate of movement of the strand line which are general to the whole estuary.

In making our reconnaissance of neighboring deposits we put down a series of borings in the marsh bordering Shove's Creek, which comes into the river just east of Grassy Island. The location there of some peat sections resembling that of the island led to further examination of this marsh, and since the conclusions reached bear directly upon the island problem, the Shove's Creek area will be described in some detail.

THE SHOVE'S CREEK MARSH

The geography of the Shove's Creek Marsh has already been described. A series of borings was made, beginning at the bank of the main river during low tide, and extending back over the bay-mouth bar into the marsh. From this line of holes branch lines were made at angles to it leading out to the banks of the meandering tidal creek. Other borings were made at intervals in the upper (eastern) portion (Figs. 6, 7).

The outer surface of the bay-mouth bar is covered at present with an association of *Spartina alterniflora* which reaches down approximately to mid-tide (Fig. 6, Section A). Beneath the living *Spartina* is a layer of peat composed entirely of *alterniflora* remains and silt, varying from a very thin layer at the upper and lower edges to a thickness of approximately a foot at the middle level. The top of the bar is covered with a thin layer of *Spartina patens* peat upon which are growing the characteristic species of high tide levels, *Spartina patens* and its associates. Immediately back of the bar, the *patens* peat gradually thickens, and a few yards away extends to a depth of four or five feet. This deeper portion shows a continuous section of *patens* peat underlain by a thin layer of black greasy muck in which pieces of wood are occasionally found. It

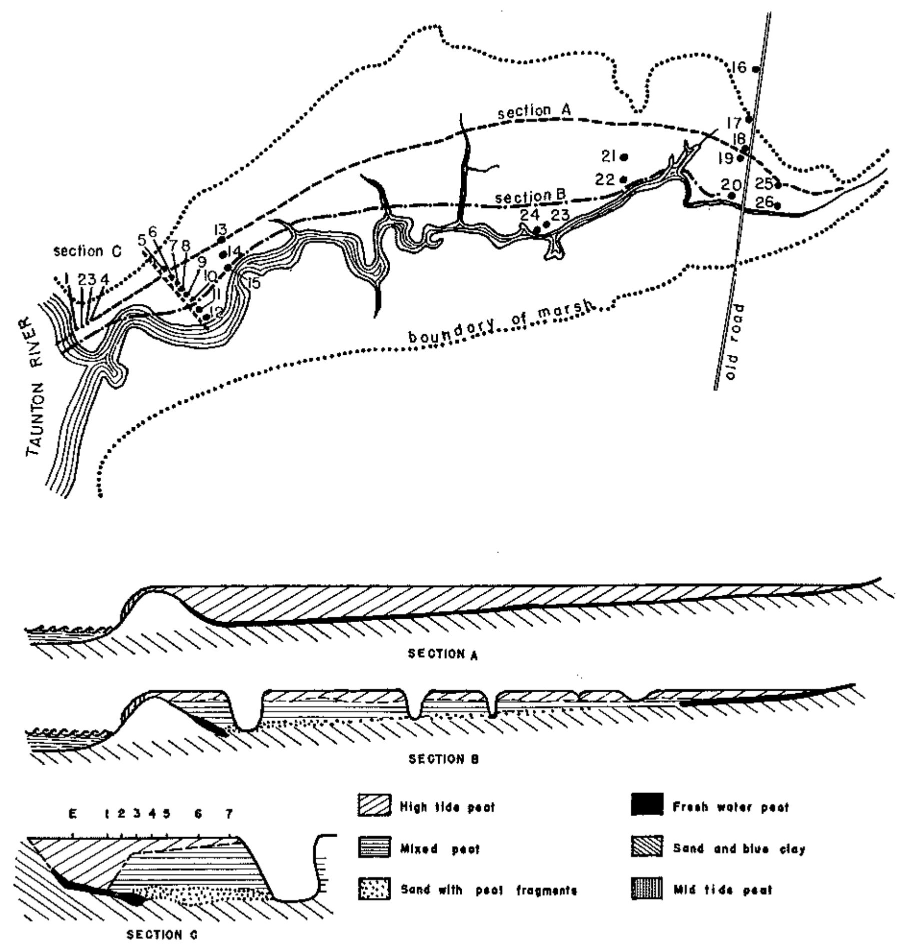

FIG. 6. Map and Cross Sections of the Shove's Creek Marsh.

is presumed that this muck represents an old freshwater swamp deposit. The whole area is underlain by clay and sand variously mixed or stratified, and often discolored. Occasional thin intrusive sand layers are met with in the upper parts of the sections.

A continuation of this line of borings eastward to the head of the marsh, keeping well away from the meandering stream, shows a gradual thinning of the entire section. At about 3/8 of a mile from the mouth of the creek the fresh marsh emerges, with only about ten inches of fresh peat over a substratum of clay and sand. The high tide peat throughout this line of borings is continuous.

Borings along lines that extend toward the creek show an entirely different series of sections. Beginning about 110 feet from the bank of the creek along the line of Section C (Fig. 6) a layer of mixed peat containing masses of

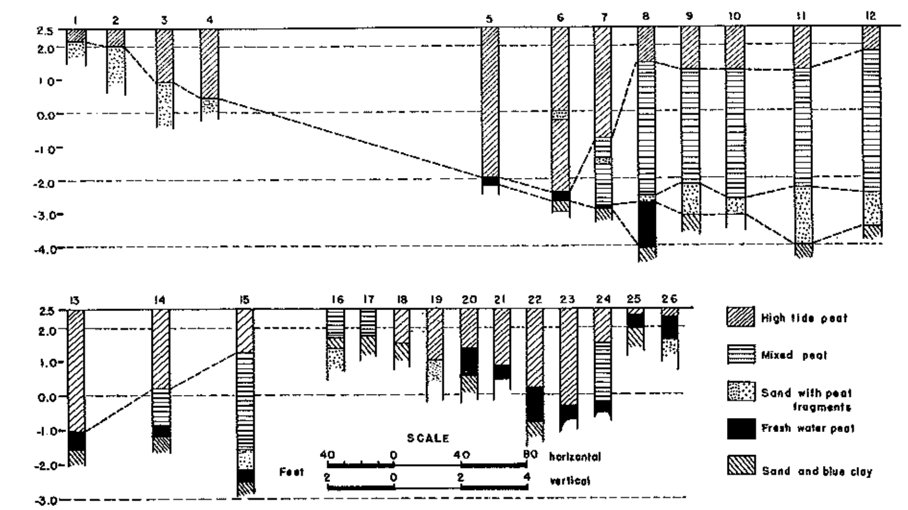

FIG. 7. Logs of Borings on Shove's Creek Marsh.

the rootstocks of *Spartina alterniflora* in a good state of preservation appears near the bottom of the sections. It has much silt and fragmented material in it, and occasional thin intrusive layers of sand. It is underlain in part by the greasy muck of the ancient fresh water swamp, but mostly by a layer of sand mixed with fragmented peat. This layer gradually thickens as the line of borings is carried toward the creek, until on the bank of the latter it has a thickness of between 4 and 5 feet. At the same time, of course, the layer of high tide peat becomes thinner, and at the bank of the creek it is reduced to about 8 inches. It should be noted that as the creek is approached, the underlying freshwater muck is replaced for the most part by the mixture of sand and fragmented peat. Similar series of sections were obtained at other places farther up the marsh (Fig. 7). They show progressively reduced dimensions as the deposit thins out in that direction.

From the above notes it becomes clear that there is a mass of peat in the central part of the Shove's Creek marsh which differs sharply from the prevailing high tide deposits on top of it and toward the margins. In section it is roughly lens-shaped, with its lower surface conforming in general to the contours of the mineral substratum, and with its upper surface more markedly convex and reaching to within about 8 inches of the surface. It is made up of a mixture of silt, fragmented peat from both high and mid-tide sources, and masses of fairly well preserved mid-tide peat in situ. The whole mass, including the over-lying high tide peat, is dissected, near its center, by the creek, which has cut its channel through to the sand at the bottom.

A reasonable explanation for this deposit of mixed peat can be found in the ordinary erosional and depositional activities of the meandering creek, together with the growth habits of the mid-tide grass. The profiles of the stream channel on the meander curves are not symmetrical, because the inner banks of the curves tend to accumulate material while the outer banks are being undercut and eroded away. Thick stands of *Spartina alterniflora* cover the depositing banks approximately between mid- and high-tide levels. As a result of this process *alterniflora* peat is being laid down on the depositing shores, in a matrix of silt and fragmentary material derived from the erosion of all the layers of the marsh. This is the mixed peat of the central portion of the area.

If this hypothesis is acceptable, and there is a genetic relation between the meandering activities of the stream and the development of the mixed peat, then there are interesting corollaries concerning the history of the stream channel. The base of the mixed peat is much wider than its upper levels; consequently the creek must have meandered far more widely when it was shallow, and soon after the tides invaded the Shove's Creek valley, than it does at present. As the high tide level continued to rise there must have been a continuous narrowing of the meander zone. If there had ever been a break in the continuity, the high tide peat deposit at the top of the section would not be continuous and would not show a gradation from thick to thin. At the same time the essential continuity of the mixed peat deposit lengthwise of the marsh strongly suggests that the meander curves have progressed longitudinally as well as laterally with relation to the general course of the creek.

It will be noted that the top of the "lens" of mixed peat is not an evenly curved surface. It rises sharply in the first thirty feet or so, then remains at about the same level for a distance of about sixty feet, and finally rises gradually in the last thirty to forty feet. A number of suggestions can be made to account for this. A rather obvious one is a varying rate of deposit on the "point" of the meander curve. A relatively slow rate would produce the steeper part of the surface, while a rapid rate would make for a very low gradient. Another suggestion involves the compression of the peat. The mixed layer is very wet and muddy, so much so in fact that in boring into it the level at which the tool enters usually can be detected by the greater ease with which the mass is penetrated. This peat would probably be more subject to shrinkage than the more tightly interwoven high-tide deposits, especially if it were laid down very rapidly, as proposed above. A slight compression such as this might account for the nearly level part of the upper surface. A third theory would be that high-tide level had remained nearly constant for a short period during the development of the meander. If it had done so, however, the results should be found elsewhere in the peat sections of the region; but as previously stated no evidence to this effect has been observed.

Additional evidence of the ancient meanders of the creek is to be seen in the lower layer of the deposit. The continuity of the freshwater muck is broken near the outer margin of the mixed deposit, so that most of the latter is underlain by a mixture of sand and peat fragments such as would have been formed in turbid water at the bottom of the creek (Fig. 6, Section B).

A review of the published descriptions of salt marsh deposits in southern New England has yielded only one other instance suggestive of the above arrangement of beds. This is described by D. W. Johnson,[20] from borings made in the Neponset River marshes, Boston Harbor, by N. J. Bond. Masses of silty mixed peat are occasional there, and Johnson proposed that they were due to the meandering of the river, but he gave no indication of the way they were formed.

APPLICATION TO GRASSY ISLAND

One of the outstanding characteristics of Grassy Island, as already noted, is that its western margin shows a steep, eroding cliff of peat while its eastern shore has a more gradual slope and is receiving deposits of silt and peaty materials. The erosion on the west is due both to currents and to wave action. We have made careful observations of currents about the island during the ebb and flow of the tide, and find that much of the material taken from the western shore is being carried around the ends of the island to be deposited on the shallow flats on the east side. When the tide is all the way out, these mud flats are often exposed, and are seen to be dotted with masses of peat ranging in size from an inch to a foot in diameter. Some of them are composed of high tide peat and others are from the mixed layer which is exposed on the

[20] Johnson, D. W., 1925, pp. 549-557.

west side of the island. The small embayment on the east shore is floored with the broken-up remains of these masses of peat, and as the tide rises and falls it lifts and deposits some of the material on the sloping shore. There it goes into a matrix of mixed peat around the rootstocks in the turf of *Spartina alterniflora* that grows above the mid-tide level.

The similarity between the depositing shore of the island and those of the meander curves in Shove's Creek is at once apparent; likewise the similarity in the nature of the mixed peat deposits. The principal observed difference in these deposits is the greater quantity of well-preserved *alterniflora* peat along Shove's Creek than on the island. This can be accounted for by the greater erosional and depositional activity around the island due to both waves and currents, resulting in a greater proportion of fragmented peat in the deposits there. Another notable similarity in the two deposits is the sloping contact between the high tide and mixed peat beds. Along Shove's Creek there is good indication that this has been due to a lateral shifting of the channel during the period of advance of the strand line, and it is to be expected that something of like nature has happened at Grassy Island.

If the processes of erosion and deposit at the island have been going on for a long time, and there is no reason to think they have not, then the island can be thought of as migrating or developing from west to east, or possibly from southwest to northeast. A large part of its total mass must of necessity be composed of reworked materials, but since the high tide level appears to have continued to rise throughout the period of migration, there has been continued accumulation of high tide peat on the upper surface. A further corollary is that the western side of the island must be the oldest and should therefore have the thickest deposit of high tide peat. Reference to measurements given above (see also Fig. 4 Section V) will show that this is the case.

The question naturally arises as to where the island started. Judging by the continuity of the high tide peat deposits in the neighborhood the advance of sea level has been at a fairly steady rate. If this is the case the sloping lower surface of the high tide peat on the island should be a plane which, if projected westward, would intersect the bottom of the Taunton River some distance to the westward or southwestward. Our measurements indicate that the lower surface of the high tide peat is a fairly even plane which dips westward at approximately 10 inches in 200 feet.

The amorphous layer at the base of the island peat requires some further discussion. It has little in common with the freshwater muck under the Shove's Creek marsh, and can hardly have had such an origin. The absence of diatoms indicates further that it could not have been laid down in any kind of quiet water, whether salt or fresh. It could, however, have been

deposited in turbid water under these conditions; and its general similarity to the material now being laid down in the bottom of the eastern embayment of the island strongly suggests that it was deposited in similar embayments at earlier positions of the island, to be covered by the advancing beds of mixed peat.

We are now in a position to picture conditions during the early history of the island. As high tide levels slowly advanced up the estuary the low hummocky plain upon which the Indians lived was slowly made uninhabitable. Judging by the terraces on the banks of the present river, this plane was the bed of a glacial stream, the remnant of which was a river that flowed in a channel near the present west bank. This stream received tributaries from the east which probably united to form a single creek somewhere to the southeast of the present site of the island. In the lower valleys of the tributaries there were, presumably, fresh water swamps (Fig. 8, a).

The broad shallow tidal basin which now contains the island is a shoal area in which there are two poorly marked channels separating low elevations (Fig. 8, d). At present these elevations have an altitude of between -1 and -2 feet, and are just exposed at extreme low tide. Their surfaces slope gently southward, and they must have been broad low ridges on the ancient surface. The present island is on the easternmost of the two. Between them is a shallow channel whose bottom is near the -3 foot contour. Eastward and southeastward from these ridges the bottom slopes off to the channel of the old tributary stream noted above. North of the present site of the island the bottom is also very shallow, and nearly exposed at low tide.

The advancing high tide would have affected first the edges of the main stream channel, giving rise to brackish conditions and the initiation of deposits of *Spartina patens* peat. Very soon this salt marsh must have extended into the lower part of the tributary creek (Fig. 8, a). Mean high tide at that time probably did not reach much above the present -3 foot contour. With continued rise of tide levels, the whole surface of the ancient river bed must have been covered gradually by a salt marsh, with the higher ridges the last to be inundated (Fig. 8, b). The tributary stream would by then have become a meandering tidal channel, and the marsh would have begun to extend into the lower valleys of Shove's and other creeks.

The question can properly be raised as to the necessity for postulating this broad marsh, with its developing high tide peat. The principal reason is that from what we know of the origin and growth of such deposits it seems inevitable that one should have appeared here. The same processes are going on in similar situations everywhere on our coasts at the present time. The most difficult problem involved is not the development of the marsh, but

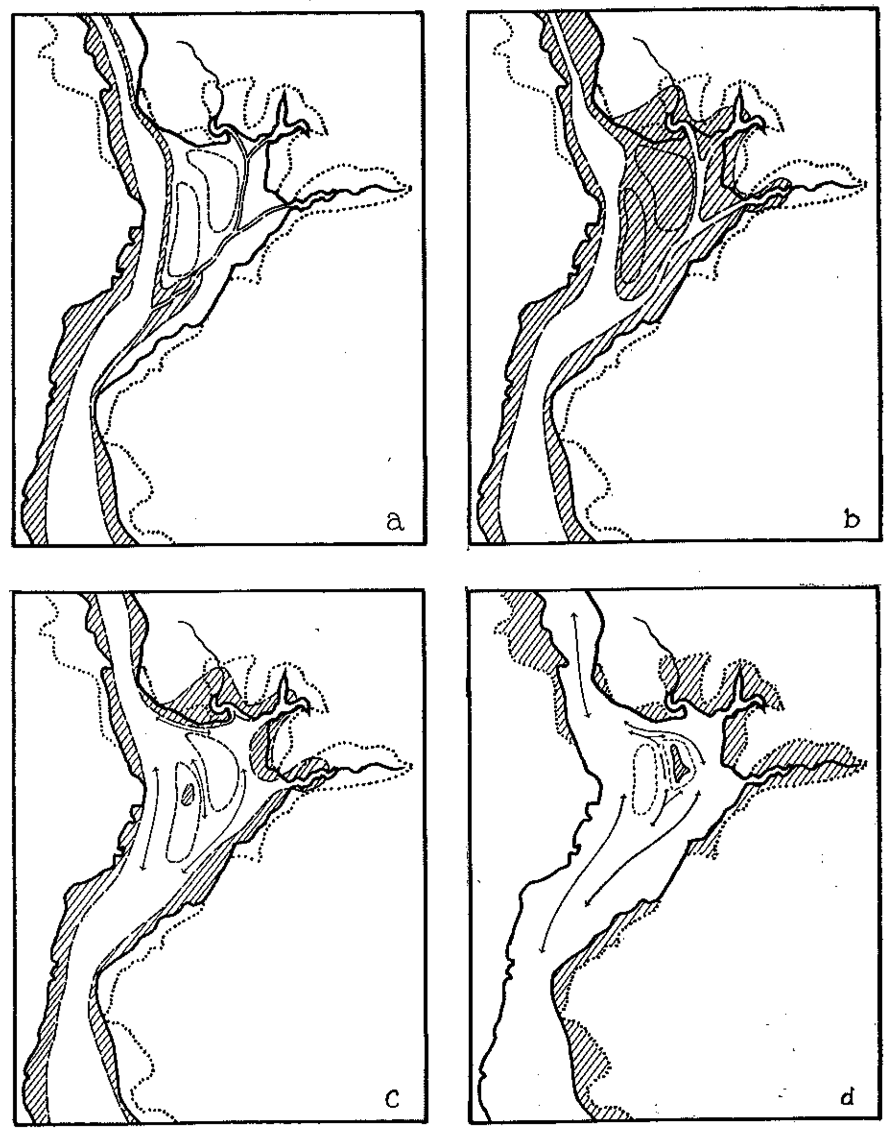

FIG. 8. Hypothetical Stages in the Development of Smith's Cove and Grassy Island.

what became of it. Actual evidence for its existence is to be found at several places around the shore of the present basin, where there are deposits of high tide peat which extend down nearly or quite to the −2 foot contour. Under Grassy Island, however, there is no trace of it.

We suggest that as the tide levels continued to rise, tidal scour became a more effective erosional factor. As tidal currents rose above the confinement of the old channels in the mineral substratum of the glacial stream bed, they began to erode the newly formed peat, and eventually broke through it south of Peter's Point. With currents once formed in the broad tidal basin south of the point, most of the newly formed peat was slowly disintegrated and carried away (Fig. 8, c). The removal was probably greatly facilitated by the poorly preserved condition of the peat, for it was undoubtedly formed under somewhat less saline conditions than exist here today. It has already been noted that the modern deposits are considerably oxidized and fragmented. Presumably a remnant of this peat was left on the westernmost of the low ridges previously described, while other remnants persisted on the landward margin of the basin. The small remnant in the river became the ancestral Grassy Island. It began its eastward migration while it continued its growth in thickness as the strand line continued to rise. The present arrangement of shores and currents is shown approximately in Fig. 8, d.

If this explanation of the form and history of Grassy Island can be accepted, the island archaeological site was first covered by a salt marsh, later exposed by the erosion of this marsh, and again covered by island peat as the latter developed eastward. The site is now being exposed again by the continued eastward migration of the island.

AGE OF THE GRASSY ISLAND SITE

AS STATED at the beginning of this paper, it was hoped that an analysis of the peat of Grassy Island would yield information as to possible consecutive changes of climate and vegetation during the period since the Indian site was rendered uninhabitable by the tide. It was hoped that such information could be correlated with other studies that have been made in New England, and that it might yield some sort of time scale. The impossibility of accomplishing these things by the usual methods of peat sampling is now evident. There appears to be an interval for which there is no material record whatever at the island—the period of formation and dissolution of the early salt marsh, together with the time required for the island to move to its present position. The thickness of the high tide peat layer at any given point might give evidence of consecutive events, but the sequence could only apply to the interval during which that particular point had been covered by the advancing island. The mixed peat is useless for analysis, either by macroscopic methods or by pollen studies, because it is a heterogeneous mass derived from several sources, and because it is poorly preserved.

It is possible, however, to find a continuous section of high tide peat covering most of the island period by going to the neighboring marshes. Sections nearly five feet thick are available in the Shove's Creek marsh. Since we are concerned only with a section about 5 feet thick, representing the rise in sea level from coverage to its present position above the site, the Shove's Creek sections could be considered approximately equivalent to a section that might have developed over the site of the early marsh had it not been removed.

The vicinity of Grassy Island has been the scene of much speculation concerning the antiquity of Indian habitation. This is due not only to the existence of the archaeological site but also to the presence of the famous Dighton Rock with its puzzling inscriptions. The rock is on the main shore of the estuary somewhat less than a thousand feet south of the island. Delabarre has been the principal recent student of both problems, and has assembled a formidable mass of information concerning them.[21] In the course of his work he published two estimates of the date at which the Indians ceased to inhabit the Grassy Island site. The first of these was about 900 years ago, and the second about 1200 years ago.[22]

In the establishment of each of these dates, and in allowing the difference

[21] Delabarre, 1916, 1917, 1919, 1925, 1928.
[22] Delabarre, 1919, p. 401; 1925, p. 376.

between them, Delabarre was troubled by three variables. He accepted in principal the theory that the Indians were driven from the site by a rise of sea level with respect to the land, citing the evidence presented by Davis and others that this had taken place. The first of his three variables was the probable rate of rise in sea level. The second grew out of the question as to how high above extreme high tide a site had to be to make it habitable to the Indians. The third was concerned with the problem of whether or not sea level has continued to rise with respect to the land up to the present time.

The rate at which the sea has encroached upon the southern New England shores has been calculated by various methods.[23] The mean of these calculations is about 12 inches per century. Delabarre accepted this figure, and added some corroborative observations of his own in the Assonet area.[24]

With regard to the second variable he sets an arbitrary figure of "at least two or three feet" above extreme high tide. This, it seems to us, is a matter of conjecture, and for purposes of argument might well be eliminated. If the Indians were well established in a camp site of the size and permanence that this one appears to have had, it seems more reasonable to think they would not have vacated it until they were actually forced to.

In dealing with the third variable Delabarre found himself in the midst of a controversy among geologists and botanists concerning the continuance of rise in sea level. He was impressed by the weight of evidence presented by the botanists and by C. A. Davis—that the level still continues to rise; but at the same time the arguments for stability advanced by the late D. W. Johnson caused him to doubt such a continuance. Furthermore, he thought he saw some evidence for recent stability of the shores in the Assonet and Grassy Island areas. Historical study of the salt meadows gave little or no indication that these meadows had ever been much larger than they are today. He argued that if the sea had been advancing for a long period and was still doing so, over the broad shoals that occur around Grassy Island, there ought to have been wide meadows there when the early colonists came to New England. With all these questions in view, he appears to have compromised by tentatively dating a halt in the advance of the sea at about A.D. 1600, just before the period of colonization.

Delabarre estimated that the present extreme high tides are about six feet above the lowest part of the Indian site. To this he added three feet for the elevation of the site above the tide, divided by the figure of twelve inches per century, and got an estimate of 900 years. Again, he added another 300 years for a period of stability and got his figure of 1200 years.

[23] See Chapman, 1938, and Raup, 1937, for reviews of this work.
[24] Delabarre, 1925, p. 366.

His observation that salt meadows must have been formed on the shoals of Smith's Cove was an acute one. We have already discussed the necessity of postulating such meadows. Delabarre did not reckon, however, with the effects of tidal scour and the semi-brackish nature of the peat deposits. These we believe to have caused the early removal of the old salt meadows, so that within historic times the shore marshes may not have varied greatly in size. In fact, unless such a process of removal is invoked, it is difficult to see how most of the estuary could now be open water.

Assuming that a rate of sea level rise amounting to about twelve inches per century is correct, the Indian site as it appears at the base of Trenches 1 and 3 was covered by high tide vegetation about 400 years ago. At present, extreme high tides, as marked by the upper edge of drift on the nearby shores, are about two feet above the lower limit of the high tide vegetation. If, then, the Indians were driven back by the reach of extreme tides, they left the place about 600 years ago. This is on the assumption, of course, that the range of high tides was the same then as it is now. Delabarre arrived at a somewhat similar figure when he left out his period of stability and his three feet for the original elevation of the site.[25]

It seems to the present authors that the evidence for a steady advance of sea level with respect to the land is overwhelming, and that a present continuance of the advance is necessary to explain the nature of our peat deposits. We believe that the absence of wider salt meadows in the Grassy Island area in colonial times can be adequately explained on the basis of tidal currents and the nature of the peat. By this reasoning we can eliminate the third of Delabarre's variables; and as stated above, we are inclined to eliminate also his arbitrary figure of "two or three feet" for the original elevation of the site. The problem, therefore, is reduced to the old question of the rate of rise in sea level. Here we can only make another estimate, based this time upon a type of data, however, which at least has the advantage of novelty.

The sloping plane of the lower surface of the high tide peat on the island suggests a method of calculating age. The line at which this plane, if projected, would intersect the bottom of the Taunton River west of the island would give the approximate position at which the latter started its migration and the formation of its mixed peat layer. We do not have an exact contour map of the river bottom; but assuming the bottom just east of the main channel to be near the contour of -3 feet, and allowing a gradient of about ten inches in 200 feet (see above), the line of intersection would be approximately 850 feet west of the western shore of the present island. This distance would

[25] Delabarre, 1919, p. 401.

bring the area of origin to the eastern edge of the deep channel, where it should be if our explanation of the history of the early tidal marsh is correct.

A chart surveyed by A. M. Harrison in 1875 apparently gives the position of the island with considerable accuracy.[26] We have compared this chart with recent maps and aerial photographs, and find its delineation of detail in the Smith's Cove area to be exceedingly accurate, even to the finer details of shore lines and tidal creeks (Fig. 9, a). Careful comparison shows that the island has decreased in width in the northern part, and that as a whole it has moved eastward a little. The decrease in width appears to be due in large measure to the excavations of Delabarre, which were extensive. The amount of eastward movement, however, is difficult to compute on the scale with which we have had to work. We believe that a conservative figure is about 50 feet for the period since 1875, or about 70 years. This gives a rate of movement per year of about .71 feet.

As previously noted, the approximately plane surface of the contact between high tide and mixed peat layers on the island suggests that for a long time, at least, the movement of the island has been fairly steady. If the rate of movement derived above is now applied to the probable distance, we get a figure of approximately 600 years since the migration began. During the same period the elevation of the high tide vegetation has been raised to the $+2.5$ foot contour, or about $5\frac{1}{2}$ feet above the contour of -3 feet.

We presume that the date of beginning migration was that of the dissolution of the ancient marsh which covered the shoals. It is improbable that this marsh lasted much beyond the time when the tides gained access to the shallow channels that mark the shoals. Consequently, we presume that the thickness of high tide peat which had accumulated before the migration began was not great, probably less than a foot. Consequently, during the period of migration (approximately 600 years) the high tide vegetation has probably risen in elevation about $4\frac{1}{2}$ to 5 feet. This gives a rate of about 10 inches or a little less per century, well within the range of estimates made previously in other places (averaging about a foot a century).

The high tide vegetation probably reached the -3 foot contour, then, some time between 600 and 700 years ago. Extreme high tides at that time were probably a foot or two higher, so that the present site of Grassy Island may have become uninhabitable at about the same time.

From the above discussion it will be noted that our estimate of the age of the site, based upon the rate of movement of Grassy Island, approximates that

[26] We have not seen the original of this map, but have a careful tracing of the portion covering Grassy Island and vicinity supplied by Dr. Delabarre.

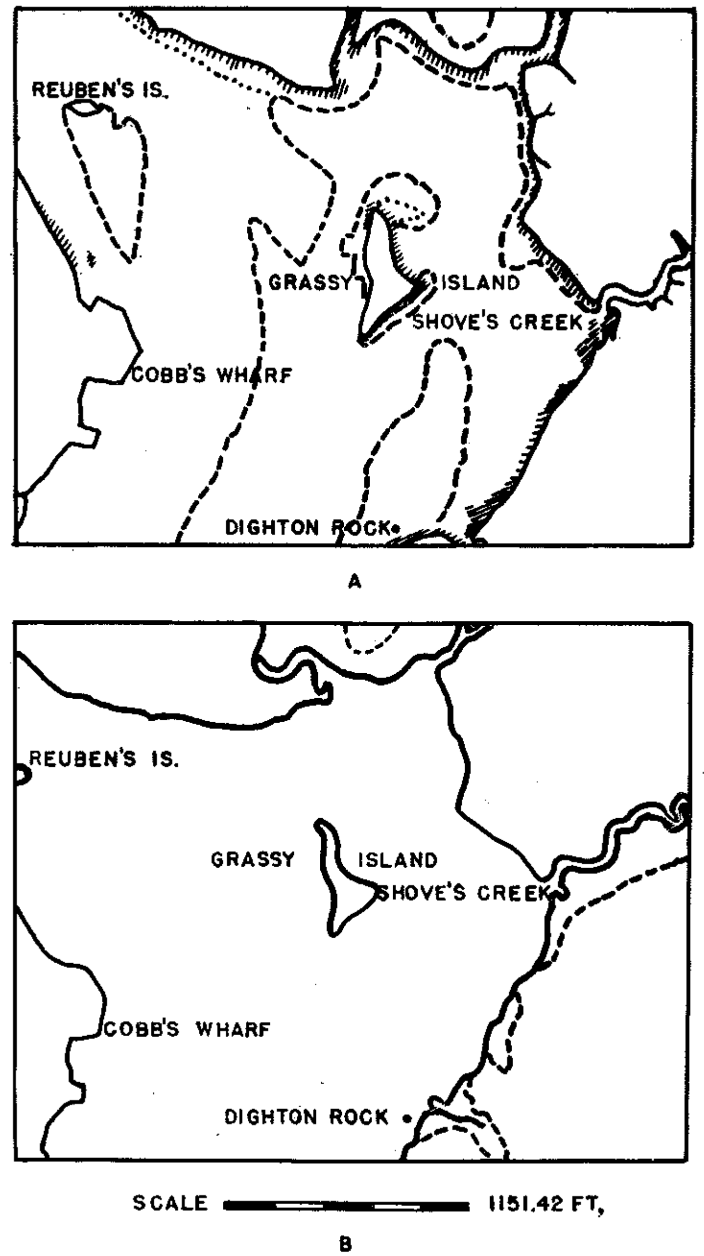

FIG. 9. Maps of Grassy Island and Immediate Vicinity; 1875, 1941.

of Delabarre when he left out his figures for original elevation and sea level stability. It also tends to corroborate the old estimates for the rate of rise in sea level made by Davis, Freeman[27] and others.

Attempts to use the history of Dighton Rock for evidence of the rise of sea level have thus far proved rather significant though not very precise. The top of the rock is now about 1.8 feet below the upper level of high-tide vegetation on the nearby shore, and about 3 feet below the level of extreme high tides. If it were at Grassy Island it would now be completely submerged in peat.

In all the writings about the rock, as collected by Delabarre, we can find no *measurements* of its relation to tide levels. If statements about this relationship are gathered together and arranged chronologically, however, we have the following results:

1690—"High tide covers part of it."
1712—"Part in, part out, of the River."
1720—"Appearing above water."
1730—Noted as being fully exposed at "extraordinary tides."
1767—"Tide generally covers half its height."
1767—"Flood and 1 ft. high."
1768—"It is partly covered at high tide."
1768—"The river covers it at high water."
1774—". . . the tide covered all but the upper part of it."
1788—"At the lowest tides the water retires from the foot of it, but at high water it is commonly covered."
1807—Top said to be covered at extreme high tide by 2 or 3 feet or more.
1834—Tide covers the rock.
1876—". . . ice and tides covering the rock."

About all that can be said of these records is that no one noticed the rock being covered by high tide until 1768, and that after that date nearly every one did. It is of interest that if the rise of one foot per century is admitted, mean high tide as located by the position of high tide vegetation finally covered the rock about 180 years ago, or about 1765. This offers some further evidence that the older estimates for the rate of rise have not been far wrong; and what is more significant, it brings the change well within colonial times, a period during which Delabarre thought the coast line was stable.

We have examined with great care the many photographs of the rock reproduced in Delabarre's papers, in the hope that they would give clues to

[27] Davis, 1910; Freeman, 1903.

changes in level. The only one worth noting is the Burgess-Folsom photograph taken in July, 1868.[28] In the background of this picture two large boulders are clearly visible. Only a few inches of their basal portions are hidden by the neighboring salt marsh vegetation. From the same relative position today the smaller righthand boulder is entirely out of sight behind the tall grasses (*Spartina alterniflora*), and the larger one is just visible over their tops. There is a difference in height of the grasses of perhaps 8 or 10 inches, which is again as it should be if the rate of rise has been about a foot a century. We cannot be sure, however, of the condition of the grass when the photograph was taken. It may have been cut or trampled, or merely blown down by wind.

[28] Delabarre, 1916, Plate I.

SUMMARY AND CONCLUSIONS

OUR recent work on Grassy Island justifies a number of conclusions and suggestions concerning the location of the site and the peat which overlies it. We believe that the earlier findings of Delabarre are corroborated, and a well defined Indian camp site has been located between about three and one half and four feet below the present level of high tide.

Grassy Island would not now be an island, except for a low mound of the mineral substratum partially exposed only at low tide, if it were not for the deposit of peat. The island was not formed entirely of high-tide peat in situ. The position and character of the component strata are evidence that the island has migrated to its present position from an area about 850 feet to the westward. At the same time the peat has gradually attained its present thickness, keeping pace with the slowly rising level of high tide. In its original position, the ancestral Grassy Island appears to have been a remnant of a once continuous marsh extending eastward to the main shore of the river south of Peter's Point. Most of this marsh was removed by the opening of new tidal channels and the formation of the present tidal basin. From a comparison of charts it is estimated that the island has moved at the rate of about fifty feet in seventy years, requiring about 600 years to move the whole distance and to raise its surface about four and one-half or five feet. This is about the same length of time as that estimated by using the commonly accepted rate of twelve inches per century for the rise in sea level with respect to the land in southern New England. Interpreting these figures in terms of the habitability of the surface of the mineral substratum, the Indians probably had to leave it between 600 and 700 years ago, or about A.D. 1200. A rate of change in sea level which is approximately the same as that noted above may be inferred from the literature describing Dighton Rock; that is, the rock appears to have been covered by ordinary high tides about 180 years ago.

Substantiation of the rise in sea level in modern times is to be found in the continuous sections of high tide peat existing in marshes along the Taunton River and its tributaries in the immediate vicinity of Grassy Island. The sections are of sufficient thickness to cover most, if not all, of the period of origin and formation together with past and present migration of the island.

Studies of the small tidal marsh in the valley of Shove's Creek just east of Grassy Island indicate that a mixed peat bed somewhat similar to the lower stratum on Grassy Island occupies a "meander zone" along the tidal creek. The configuration of this mass of peat suggests that the meanders of the creek have decreased in spread during the accumulation of the peat, and that they have not only developed at right angles to the main axis of the stream, but also longitudinally. The direction of the latter movement is not known.

A general conclusion from all of these investigations seems to be applicable to peat sampling methods employed for the purpose of stratigraphic analysis. Pollen studies are the best example of this but other, unfortunately less common types of analyses, must be included. At least in the salt marshes of the southern New England coast, *random* sampling techniques can hardly be admitted because of the occurrences of beds of peat which are in part composed of intrusive, reworked materials. Before these marshes can be sampled intelligently for pollen sequences, or analogous investigations, it is necessary to learn their developmental history and the three-dimensional structure of the various masses of peat contained in them.

The analyses of the description and distribution of the artifacts consists of a series of pseudo-statistical acrobatics. It is a summary of a much longer analysis, the complete account of which has not been presented because it is so complicated that reasonable and clear discussion is next to impossible at this time. Some brief comments concerning the source and significance of the frustrations with which we have struggled are in order.

In northeastern North America the only data which are available to archaeologists are the products of a few of the native industries. These products are the basis for the writing of human prehistory, the ultimate aim of all archaeological work. This history is not, and must not be, confined to a recounting of changes, or the lack of them, which took place in the products of aboriginal industries. The industries are evidence of the existence of communities, and each of these possessed all the attributes of any gathering of human beings. Furthermore, not one of these communities existed in an historic or geographic vacuum. There were integrations with neighbors which, if we could follow them far enough, would embrace at least the whole continent.

In eastern New England knowledge of aboriginal history has only barely entered a descriptive stage. It is likely that few investigators have a reasonably complete and clear idea of what in the way of products of human industry has been found in the area. Much of the evidence we have has either not been adequately described or its location in the ground has not been properly recorded. Furthermore, only a very few investigations have been made in the region and much remains to be uncovered. Under such circumstances the principal and most significant contribution of a study such as this is the reporting of the discoveries.

By and large the study of all but the latter part of the cultural history of the

northeast must eventually depend upon analyses of the products of the stone industry for that is the largest and most complete body of evidence we have. It must be recognized that this industry has a number of peculiar properties. The products are simple, at least as we know them. Exceedingly few tools can be identified as specializations; an arrowpoint may have been used as a knife or vice versa, a celt may have been used as a hoe. Such things as pipes and bannerstones are, of course, welcome and valuable exceptions. They are, like styles of art, indications of cultural traditions which are more plainly visible. Questions concerning diffusion, development, sophistication and decadence are more easily answered by these specimens. This is not so with the great bulk of the material we have to use. A stone tool may not deteriorate rapidly while it is being employed. It can be used over and over again for many purposes. Furthermore while the larger classes of artifacts exhibit great differences, the variety within one of these classes is rather limited. Probably any Indian, if he were familiar with the types Trianguloid, unmodified for hafting, any one of the stemmed or corner removed types and a notched type, could, if he wished, haft and use any stone arrowpoint which was ever made. While this suggests the possibility that what we call shape may indicate something concerning cultural tradition, it may be true, on the other hand, that shape was of no particular consequence to a well educated Indian. He could use anything that his fancy prompted him to make or that technical accidents produced. The common inference, based on observations of the activities of living primitive peoples, is that forms made will be dependent upon cultural tradition. However, invention, substitution, expediency and improvization are obviously factors to deal with. Because of this the classification is presented with some hesitation.

The classification of the artifacts is empirical. All that it means is that the aborigines made what we, but not necessarily they, have recognized as different kinds of artifacts. The significance of the lists and tables is very doubtful. The pseudo-statistical treatment is arbitrary and subject to no consistent rule. No one has ever proved, so far as we know, that types of artifacts and numbers of types, made by a single person or by a group, fall into a pattern which can be described under the theory of probability. There are large numbers of some types and small numbers of others. We do not know what this may mean in terms of human habits or of cultural history or development. We do not know whether large numbers of one type, found at one site, mean the same thing as large numbers of the same type found at another site. It has been assumed that when similar relative numbers of similar types are found at two or more sites a comparative statement is justifiable. However, there is no assurance that the similar types, in similar relative numbers appeared at different sites for the same reason. There are so many variables in human life that it is to be doubted that the analysis in this manner of the products of human industry can reach valid conclusions. It is also doubtful if two or more groups of people, belonging in an identical position in history, will ever produce series of artifacts which are comparable. It is logical to assume that identical groups will produce a certain percentage of tools which are similar, but what this percentage may be is a completely unknown quantity. It is probable that a study of the industrial habits of living people, where proper controls could be instituted, might be of great value to archaeologists in this connection.

Having discovered a mass of implements we are confronted with the question of what to do with them. In these days when the principal aim of everyone is to bring order out of chaos the desire to arrange the artifacts and those from other Indian sites in some sort of sequence is irresistible. The success of such an arrangement is debatable for it is not possible to judge its significance. Until we can be reasonably sure that the sequences which can be developed along statistical lines have some close relationship to prehistoric cultural processes, the order we impose must be treated with the utmost caution. In the face of these warnings we may modify the conclusions which could be derived from strict attention to the figures and estimates presented in order to attempt a very generalized account of present transitory opinions concerning the place Grassy Island occupied in northeastern Indian history.

New England has many of the attributes of a marginal region. The peoples and their cultures which reached New England were the attenuated product of practically every major movement which took place in North America. There can be drawn through the region, particularly in northern Massachusetts, a number of boundaries the combination of which divides New England into at least two parts. To the north, environmental characteristics have attributes which suggest taiga influence if not origin. To the south there are the more moderate environments characteristic, say, of the hardwood forests which have their relationships in the south. When people carrying several cultural traditions migrated into New England and adjusted themselves to these varying conditions, and when they adapted ideas obtained over the years from their neighbors, an extremely complicated situation inevitably arose. Added to this is the time factor about which we know little or nothing. The migrants were, largely, colonists rather than explorers so that the assumption of a sloping time horizon is inevitable. Since time was required for the spread of settlements and the diffusion of ideas, the arrival and development of such, in New England, must necessarily have been later than it was at the source. Another circumstance may

be suggested. Culture complexes which are separated chronologically or geographically in contiguous regions may be "telescoped" into one unit on the margin.

At the present time a few events in New England aboriginal history may be dimly seen but it is as yet impossible to place these events in any order. Ritchie's researches[29] have led to the construction of a broad outline of history in New York state. With reservations this may serve temporarily as a basis for hypotheses outlining a section of New England history.

Aboriginal history in New York has been divided into four major periods: Archaic, Intermediate, Late Prehistoric and Historic.[30] The artifacts described here indicate that we are concerned largely with material characteristic of the latter part of the Archaic and the Intermediate periods. It has been postulated that during these periods two major cultural divisions, the Laurentian and Coastal Aspects, existed in southern and eastern New York. These divisions may have overlapped in time.

In its entirety, the Laurentian Aspect includes a very wide variety of types of implements only about one third or one half of which appear at one place or in a single stratum. Various features have led to the suggestion that the major portion of the Laurentian indicates a northern origin for it.

The Coastal Aspect is imperfectly known and certainly it is not understood. However, features of its composition and the distribution of its elements are grounds for suggesting southern affiliations for this material. Additional support for such an idea may be the probability that the Coastal Aspect is more recent than the Laurentian in sections where any pertinent information can be gleaned. Of some importance, however, is the fact that there are many types of implements which are common to both Laurentian and Coastal. Borrowing or diffusion from Laurentian to Coastal is the easiest explanation for this, but it may not be the only one.

Grassy Island and the other New England sites have produced artifacts which are common in both Laurentian and Coastal. It is difficult or impossible to justify the opinion that Grassy Island is closer to the Coastal than to the Laurentian. This opinion arises from the fact that Grassy Island has so many features in common with the Connecticut sites and that the latter have many characters, not found at Grassy Island, which set them off from Laurentian. The types of pottery in the Connecticut sites are perhaps the most striking example of this. It is also true that the approximate date, A.D. 1200, for Grassy Island forces us to decide whether the Laurentian, if it were ever present in

[29] Ritchie, 1944.
[30] Ritchie, 1944, Plate 2, p. 7.

Massachusetts, remained active to this late date or whether Coastal became established at or before this time. We can do no more than guess, but the latter seems to be the more promising possibility.

With considerable hesitation we may go one step further. As far as we now know sites producing Laurentian material in a more or less classic sense have not yet been brought to light in eastern Massachusetts. Implements considered to be indicative of Laurentian are frequently closely associated with artifacts which either are common to several divisions or which may even be distinctly non-Laurentian. This may be the result of "telescoping," or of any number of the vagaries which complicate human history.

There are other factors to consider. Indians built a fishweir in Boston at a date estimated to be about B.C. 1700 if not before.[31] There is no reason for believing that these people were the first to arrive in the region nor were they the only ones. Much of eastern New England was probably inhabited at this time. There is no reason for assuming that the region became depopulated after this occupation, and we are confronted with the proposition that eastern New England was inhabited for about 2900 years before Grassy Island was abandoned. The archaeological material we have to document cultural history during this period exhibits a discouraging similarity of content. If anything is true it appears that the aboriginal New Englanders, especially in eastern Massachusetts, were conservative, perhaps in the extreme. The modifications in their culture may have been so slight during this long period that distinct events marking points in the continuum can be seen only with the greatest difficulty.

These ideas provide some background for our problems. Searching for the predecessors of the Grassy Islanders must continue of course. However, unless there are conditions of which we are not aware, the analysis of the cultural content of the earlier sites especially will be of aid to historical interpretations only if such sites may be dated by means which exclude inferences concerning the rate and character of cultural change. Eastern New England appears to be an area in which conservatism was the rule. Under such circumstances the significance of variation in type and content will be unpredictable. We have seen how "early" and "late" types are closely associated. The material from the site, considered alone, would substantiate a guess that Grassy Island was a "pre-pottery" site. The unqualified observation of the rise in sea level might be

[31] Johnson, et. al, 1942. Further study of the Fishweir began in April 1946 when another deep excavation in the Back Bay was opened. At this writing no suggestions concerning the results can be made. However, it is likely that the date postulated in 1942 will be revised.

reason for assuming considerable antiquity. Comparative data and our tentative date suggest that this may not have been the case. That pottery was not discovered on the site seems due to factors which have little or no bearing upon problems involving cultural relationships. Even though there are major lacunae in the data presented, this study emphasizes the fact that events in aboriginal history can only be placed properly in an historical sequence if they can be dated. The process of dating archaeological remains is, for the most part, one which is carried on by scientists who are not archaeologists. In order to arrive at a full understanding of human history archaeologists must be prepared to devote an increasing amount of their time to the study of factors by which dates can be established. This involves, eventually, extensive collaboration among a number of scientific fields.

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