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the rolling green shores of southern New England and its neighboring islands, and allows one to see Boston as a whole, skirting its beautiful harbor and spread over the many hills and lowlands. There is no better way of seeing the general relations of Boston to its surroundings and no other way of really appreciating the sea conditions that have made this one of the leading commercial cities of the nation. A later paper describes the features of the harbor, which give it a beauty not to be found in the other harbors of the Atlantic coast, except perhaps the one at Portland, Maine.

THE GENERAL GEOGRAPHICAL FEATURES OF BOSTON AND VICINITY

BY PROFESSOR GEORGE H. BARTON

President of the Appalachian Mountain Club

BOSTON, the capital of the "Old Bay State," and the largest city and principal seaport of New England, lies at the head of Massachusetts Bay which forms an indentation along the central part of the eastern coast of the state.

Massachusetts Bay, and Cape Cod Bay directly to the southeast, including the waters between the two salient points of the coast line, Cape Ann and Cape Cod, form the southwestern extremity of that body of water which is sometimes known as the Gulf of Maine, and which has the Bay of Fundy for its northeastern extremity.

Cape Cod Bay is more than three fourths enclosed by the mainland and the long arm-like extension of Cape Cod, but its shores are low and sandy, and its harbors are small, shallow, and poor. Massachusetts Bay is broadly open to the ocean, but most of its coast line is bold and rocky, with numerous jutting headlands, many of which enclose good but small harbors. Such are the harbors of Gloucester, world famous for its fisheries, of Salem, of Marblehead, and of Lynn. South of Boston the coast at Cohasset is rocky, but there are no indentations of sufficient size for harbors. Boston Harbor is finely sheltered, though directly facing the open sea. From the main coast line at the northward the long peninsula of Winthrop extends southeasterly, and with the very slight break of Shirley Gut is continued by Deer Island in the same direction. From the south shore the long narrow peninsula of Nantasket and Hull projects northwesterly directly toward Winthrop till the two approach within about four miles of each other. Directly

within the intervening space lie several large islands, Lovell, Long, and Georges, as well as a number of smaller ones, while just outside and almost opposite the entrance, like protecting watch-dogs, lies another group of islands, containing the Brewsters, the Graves, and others. These together enclose the greater or outer harbor, affording abundant protection against the severest storms.

Within this larger harbor, the harbor proper lies, bounded on the north and south by the small headlands of East Boston and South Boston respectively and protected from the outer harbor by Governor's Island and Castle Island.

Few harbors are more picturesque than that of Boston, and in passing it is of interest to note that the greater number of the islands owe the principal part of their size and all of their beauty to the accumulations of the Glacial Period, being mostly drumlins, or combinations of several drumlins. Previous to the Glacial Period, these hills and the principal islands of the harbor were lacking in our landscape, and the harbor had not then its present beauty.

The debris produced through the action of the waves, in wearing away the whole or portions of the drumlins, has furnished sand for the waves and currents to build up the long, low, flat necks of land which connect many of them together. This is especially well shown at Nantasket and Hull, in Revere Beach, and in Lynn Beach which joins Nahant to the mainland. This debris has also produced the fine bathing beaches of which these are all good and now famous examples.

Three rivers empty into the waters of the larger harbor, but all are comparatively small, the extreme headwaters of the larger taking their rise within thirty miles of its mouth.

The Mystic, which drains the country to the north and northwest, is very short, its extreme length being not over fifteen miles. It has one large tributary on the north, Malden river, and it drains a series of beautiful small lakes, or ponds as they are termed in New England, the chief of which are Spot Pond in Stoneham, Fresh Pond in Cambridge, Spy Pond in Arlington, Horn Pond in Woburn, and the Mystic Lakes in Medford and Winchester.

The Charles*, the largest of the three rivers draining the country to the west and southwest, has a very winding course, and though rising in Hopkinton, at a distance of less than thirty miles from its mouth, it has a length, through its various meanderings, of sixty-nine

*See "The Geological History of the Charles River," by Frederick G. Clapp, *Tech. Quar.*, 1901, Vol. XIV, pp. 171-201, etc.

miles. In general it flows through a flat, open country, but there are many picturesque features along its course. Hemlock Gorge in Newton is a beautiful, romantic spot which has been reserved as a part of the Metropolitan system of parks. On the banks of this river are situated many manufacturing establishments, the most important of which is the watch factory at Waltham. Dedham, Newton Upper Falls, Newton Lower Falls, Newton, Auburndale, Waltham, Watertown, and Cambridge are important places situated along its course. Longfellow, who looked upon its winding course through the broad marshes near

FIG 1. A mass of highly decomposed rock (diabase) at Medford Centre, Mass., containing residual boulders in situ, which was not swept away by the ice-sheet. This is one of a few exceptional cases of chemical erosion. The whole shows every step in gradual transition from fresh, unchanged rock to fully formed soil.

Cambridge, has immortalized it in his verses. The Longfellow Park still preserves unbroken the view from the windows of his former mansion to the river which he so well loved. The Charles and the Mystic unite and flow into the harbor as one stream between Boston and East Boston.

These rivers are both navigable in the lower parts of their courses, the Mystic as far as Medford, and the Charles as far as Watertown.

The Neponset, which drains the country to the south and empties into the southern portion of the harbor between Quincy and the Neponset district of Boston, is intermediate in length between the Mystic and the Charles. For many miles above Readville and Hyde Park it flows

through a very extensive marsh, probably caused by the damming back of its waters owing to the deposition of materials along its lower course during the Glacial Period. Tributary to the Neponset are Massapoag Pond in Sharon, Reservoir Pond in Canton, and Ponkapog Pond in Randolph. The villages of importance along its course are Hyde Park, Mattapan, Milton Lower Mills, and Neponset.

The surface features of eastern Massachusetts are due to the effects of pre-glacial erosion, modified by the erosive action of the great ice-sheet during glacial times, and to the distribution and deposition of materials by the direct action of the ice-sheet and later by the waters produced by its melting. The pre-glacial characteristics of the surface are best retained and shown in the region north of a line drawn inland from the coast at Lynn to Waltham, about twelve miles directly west of Boston. Here, from a region of considerable width, mostly composed of crystalline rocks, the ice-sheet swept clear nearly all the decomposed and loosened materials, leaving a large proportion of its surface as bare rock or coated with a very thin layer of debris. (See Fig. 1.) The whole region is hilly, the general elevation of the higher summits being from 200 to 300 feet above sea-level. Along the southern margin of its higher summit, Arlington Heights, 370 feet in altitude, affords a fine view of the country on the north side of Boston. A large area, distinctly wild and picturesque, lying between Melrose and Winchester has been reserved as a part of the Metropolitan Park System under the name of the Middlesex Fells. Many of the villages of this region nestle in the larger valleys cut through these hills—such are Lexington, Winchester, Woburn, Stoneham, Melrose and Wakefield—while just at the foot of the southern slope of this highly dissected plateau are situated the villages of Waltham, Belmont, Arlington, West Medford, Medford, Malden, Linden, Saugus, and Lynn. In a region of such slight elevation as this it is of great interest to note how fully the distribution of the population is determined by the prevailing topography. The slope with which these highlands terminate at the south is steep and well marked throughout nearly its full length, while it often nearly forms escarpments. The elevations throughout the area whether small or large are distinctly of the *roché moutonnée* type in outline in variable degrees of perfection. Their summits are always well rounded, while their northern slopes are often beautifully polished, and covered with striae or plowed with deep furrows. Arlington Heights, on a broad scale, and the hill just northeast of Malden village, are fine examples of this kind.

Stretching southward from the southern margin of the above area and extending to the Blue Hill range lies the generally low plain of the Boston Basin, though dotted with numerous elevations which are usually not of rock but due to glacial accumulation. Very much of this area, especially on the north, just reaches, or is slightly above sea-level. Broad areas of salt marshes extend along the coast from Lynn through Revere into Winthrop and reach westward to the village of Linden. Other and smaller areas lie along the Mystic and its tributaries, along the Charles where, between Cambridge and Brighton, they have recently been reclaimed from the higher tides by extensive dikes and now furnish beautiful drives and an extensive park, and also along the lower course of the Neponset. A broad area of swamp or very low land lies along the line of the Fitchburg division of the B. & M. R. R. between Fresh Pond and Spy Pond in Cambridge, Belmont, and Arlington. Other large areas, not above 40 feet in elevation, lie in various parts of the basin and are extensively built upon. Could the glacial drift be removed from this basin, which is bounded on the west by Prospect, Bear and Doublet Hills in Waltham and Weston, a large portion of the territory would be covered by the waters of the present sea. During the Carboniferous Age this basin, hollowed out of the older crystalline rock, was filled by the waters of an extension of the sea, in which were laid down sediments that now form the slates and conglomerate which underlie the accumulations of the drift. The present basin-like depression in the general topography of the country is due more to the rapid wear of these softer rocks than to the surrounding crystallines. This is more strongly evident in the slate areas at the north than in the conglomerate areas at the south. In but few instances does the rock in either rise to any great height above sea-level. The hills of the basin are principally drumlins and will be discussed below.

The most marked feature in the topography of the coastal area of Massachusetts is that known as the Blue Hill range. This consists of a nearly linear though slightly curving range of hills of varying heights extending generally in an east-west line, but at its eastern extremity curving to the northeast. The extreme length of the range, considering the hills of Quincy as essentially a part, is about six or seven miles. Its highest eminence is the Great Blue Hill, the extreme western summit, 635 feet in altitude above sea-level, which is the highest elevation on the Atlantic coast south of Green Mountain, on the Island of Mt. Desert, on the coast of Maine. Holding this peculiar relation,

it has served as an admirable site for the Blue Hill Meteorological Observatory, established some years since by Mr. A. Lawrence Rotch of Boston. The other summits, lying to the eastward, are Hancock Hill, 550 feet, Bear Hill, 500 feet, Chickataubut, 500 feet, and many lesser summits from 200 feet, as those at Quincy, to 300 and 400 feet. All are well rounded summits, smoothed and furrowed on their north-western sides, with steeper and more ragged slopes on the southeast. Seen from the north and northeast the *roché moutonnée* outline is fairly well defined. Deep valleys intersect the main range at two points, one southeast of Hancock Hill and a second between Bear and Chickataubut. Through these run the main highways of the country, at elevations of 240 feet above sea-level in each case, or 310 feet below the summit of Hancock in the one case, and 300 below the summits of Bear and Chickataubut in the other. These highways, together with the one passing just west of the Great Blue Hill, furnish very pretty drives.

Next to the Blue Hills in elevation is Prospect Hill, at the north-west of the village of Waltham, which rises to an altitude of 460 feet. From the summit of this eminence there is obtained a fine view of all the surrounding country, including the northwestern portion of the Boston Basin. This hill forms a fine example of the *roché moutonnée* type, with long, very gentle, and smooth slopes to the north and northwest, and steep, precipitous slopes on the south and

FIG. 2. A drumlin of the typical Massachusetts form near Groton, Massachusetts. This is an exceptionally fine example.

FIG. 3. *Erosion on a drumlin cliff, the effect of rain action, during a period of fifteen years. This is a vertical section of an artificial excavation in the northwest end of Parker Hill, Roxbury, Massachusetts.*

southeast, often accompanied by piles of talus and huge angular blocks. No better example for class study of this type is found near Boston. Doublet Hill, three miles to the south, 360 feet in altitude, furnishes from its summit an exceptionally fine and picturesque view of the winding Charles, which flows directly at its eastern base.

The great ice-sheet of the Glacial Period, in its direct action and through the action of the waters produced by its melting, furnished our landscape with a diversity of topographic forms, major or minor as the case may be, which in general add a great beauty to its original appearance. The more prominent among these is the drumlin, or lenticular hill as it was called by the New Hampshire State Geological Survey, which, with its smooth, flowing outlines, long, gentle slopes on the ends, and somewhat steeper slopes on the sides, is at once the most symmetrical and the most graceful hill that Nature ever produces. (See Fig. 2.) These have already been spoken of as forming the larger number of the islands and the most picturesque features of Boston Harbor, and they also form the larger number of summits within the limits of the Boston Basin, while in the highlands outside the Basin they are almost if not entirely wanting. On the northeast, the hills of Revere afford fine examples, and before the recent excavations along its sides, Breed's Hill, just beyond East Boston, would have been selected as a type form.

Practically all the hills within the limits of the city proper, of East Boston, of Chelsea, Everett, Somerville, Cambridge, and Watertown, including the site of the Soldiers' Home in Chelsea, of Tufts College in Medford, the famous Bunker and Breed's Hills in Charlestown, and of Beacon Hill in Boston, are drumlins. South of the Charles, fine examples are seen in Parker Hill in Roxbury, (See Fig. 3.) Corey and Aspinwall Hills in Brookline, and very many in Brighton and Newton. Still farther south the hills near Roslindale and West Roxbury, the higher summit of Bellevue Hill, with Clarendon Hill, and Forbes Hill in Quincy are other examples. Rising in general to altitudes varying in from 200 to 300 feet, they compete with all but the higher of the rock hills surrounding the Basin, and they relieve the Basin from the low monotony of surface that would otherwise prevail over a large part of its extent.

Of the minor topographic forms, the most interesting and attractive as well as perhaps the most noticeable, are the long, winding, serpentine ridges of gravel and sand, the accumulations in the beds of streams flowing upon or underneath the ice-sheet during the period of its melting. Many of these ridges, to which the name of *esker* is now more generally applied in place of the former designation of *kame* by which they were long known, exist in various parts of the country around Boston. The best and most easily accessible examples, however, are in Newton. At Auburndale, one runs southerly from near Lasell Seminary to the neighborhood of Newton Lower Falls, a fine characteristic ridge, rising in some places to an elevation of 60 feet above the general level of the surrounding country. A section of its internal structure is exposed where it is cut through by the Brookline Circuit Branch of the B. & A. R. R., not far southeast of Riverside station. About three miles east of this another of these ridges, though not quite so perfect an example, runs from near Newtonville toward Newton Center, terminating in the very perfect delta formed at the mouth of the glacial stream. This delta, the broad sand-plain northwest of Newton Center, shows a very perfect northern border, with a steep slope. It has a nearly straight east-west line where it was in contact with the southern margin of the ice, about three-fourths of a mile north of Newton Center, and a fine lobate southern border along the street running from Newton Center to West Newton. No better example of a glacial stream delta for the purposes of class teaching is found near Boston, and this is constantly utilized for the purpose. The studies and publications of Professor W. M. Davis of Harvard

University and his students have rendered this particular esker and sand plain classic examples of their types. A fine series of eskers can also be seen crossing the Charles river west of Waltham, which, continuing southerly, are connected with one at Auburndale. (See Fig. 4.)

The small and large streams flowing through the highlands outside the Basin are usually bordered on each side by terraces, the narrow or broad remnants, as the case may be, of their flood plains during the waning of the ice-sheet re-excavated by the later streams. One fine example for easy inspection is in the valley of Stony Brook in Weston, a few miles west of Waltham on the line of the Fitchburg R. R.

FIG. 4. *A Kame Esker or Osar, crossing Charles River, and disappearing below the surface of the water, near Roberts Station on the Fitchburg Railroad, Waltham, Massachusetts.*

The old pre-glacial valley has been largely cleared of its detritus of glacial times by the present stream, leaving a narrow marginal area along the sides which, just opposite Kendall Green and Hastings Station, forms a typical example for class instruction.

Another minor but very interesting type of form is shown in the small terminal moraine, consisting principally of an accumulation of boulders, along the southern slope of Arlington Heights not far below the summit, and extending for perhaps a half mile in well defined out-lines, and for a half mile further in more indefinite form. Most of the lakes of the region are kettle holes in origin or formed by the damming of natural drainage lines by glacial detritus. Of the former, Fresh Pond in Cambridge is a fine example.

The present city of Boston comprises the old Boston, or city proper, and several districts which were formerly separate towns but have been annexed to the city at various periods during its later history. Of these, East Boston, formerly Noddle's Island, and Charlestown, on the north, and South Boston on the east are entirely separated from the city proper and from each other by water, and are connected only by means of bridges or ferries. Dorchester, Roxbury, and West Roxbury on the south, are closely connected with each other and the city. Brighton, at the west, is almost surrounded by other towns or cities, and is only connected with the main portion of Boston by a very narrow strip along the south side of Charles river. Roxbury and the city proper were formerly connected only by a long, narrow neck of land along the present line of Tremont and Washington streets. This former neck has been so far widened on both sides by filling up the water areas, that it is now a part of the widest portion of the city. The former city proper has been very much enlarged beyond its original area by filling portions previously covered by water. A large portion so reclaimed from the expanded part of the Charles river, known as the Back Bay, now forms the principal portion of the chief residential section of Boston, and retains in its built-over condition the name of Back Bay. This comprises nearly all the area lying between Charles street on the north, Tremont street on the east, and the village of Longwood on the southwest. The principal shipping by water is confined to the east and north sides of Boston proper, to the southwestern sides of East Boston, and to the southeastern side of Charlestown.

EXCURSIONS IN AND AROUND BOSTON

BY CHARLES F. KING
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BOSTON, built upon an enlarged peninsula which protrudes somewhat into the Atlantic Ocean, lends itself readily to excursions by land and by sea. On account of its age and early importance as a center, it provides numerous excursions to historical spots, and plenty of trips can be taken to study geography or for pleasure alone. In fact there are so many attractive trips from Boston that the writer is embarrassed in making a fair selection and pronouncing them the best.