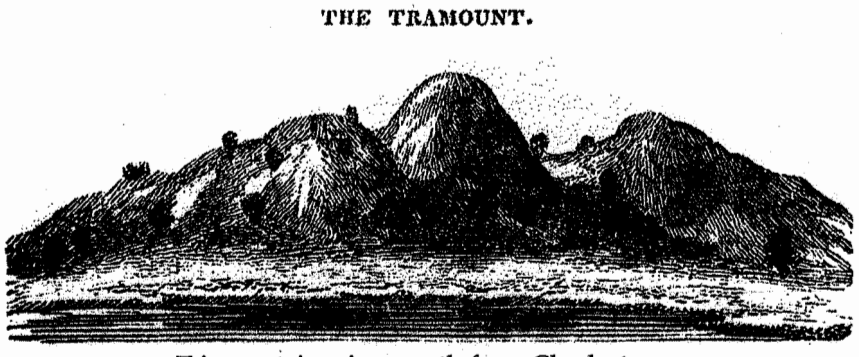
Directing Our Gaze Toward the City Upon a Hill

"For we must consider that we shall be as a City Upon A Hill.
The eyes of all people are upon us."
— Governor John Winthrop, June 12, 1630, aboard the *Arbella*



Trimountain, view south from Charlestown.
From J. Winsor's (1880-1882) history of Boston.

Boston, Massachusetts is considered — by many who have worked to understand its complex sequence of deformed unconsolidated material and bedrock — to be unlike any other city in the world and geologically unique. The same series of geologic events responsible for its founding have conspired to make foundation design a serious challenge to the engineering community. Boston's soils range from the softest compressible organic material to very dense glacial till (as well as an extreme variety of fill). Their complexity and unorthodox behavior gave rise to the sciences of engineering geology and soil mechanics at the Massachusetts Institute of Technology and Harvard University starting in the late nineteenth and early twentieth centuries, respectively. The variation in potential response to earthquakes of this material and the memory of the 1755 earthquake also led to the development of the first seismic hazard studies for insurance purposes. The bedrock is equally complex, and unravelling its variable rock types and myriad faults has further challenged those who work in the region.

When the Puritans first surveyed the site that would be Boston, they could not have conceived that it was a gift from plate tectonic movement: a remnant of ancient Africa that had smashed against the old North American continent and was then left dangling as the Atlantic Basin later broke open. The more recent repeated gouging by glaciers and burying by their debris would have been easier for the Puritans to fathom as God-given plagues for the sins of a wayward lost tribe of Israel. These events, however, created a favored place for their "City Upon a Hill," but one that stretched their ability to build upon it. The unique geologic conditions around Boston brought out the remarkable ingenuity of their descendants in overcoming obsta-

cles to create a remarkable list of engineering firsts. The unraveling of this geologic history and construction on the unstable ground over the past two hundred years chronicles a remarkable achievement. The following is a story of this geologic framework, how it affected settlement and the struggle to overcome the limitations it imposed and difficulties in construction.

This special issue is a revised and greatly expanded version of our paper, "Boston Geology: A Survey of Engineering Impacts," published in *Civil Engineering Practice* in 1989 and our paper, "Geology of Boston, Massachusetts," published in 1991 by the Association of Engineering Geologists. We acknowledge the late Clifford A. Kaye of the USGS, Henry Russell of PBQ&D, William E. Pitt of GEI, the late Stephen A. Alsup and K.E. Franz of S.A. Alsup Associates, and the late Edmund G. Johnson of Haley & Aldrich, Inc., who contributed to those publications. The descriptions of the bedrock geology of Boston were compiled in large part from the work of Kenneth G. Bell and Clifford A. Kaye.

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We extend our appreciation to BSCES for publishing these papers, to Gian Lombardo for his professional editorial and production work, and to James Lambrechts, Chair of *Civil Engineering Practice*'s Editorial Board and of the Wentworth Institute of Technology, for his tireless efforts in editing these papers and for his technical contributions to various sections.

Many remarkable achievements have been made in the fields of classical and engineering geology in the Boston metropolitan region over the past two hundred years that have resulted in a long list of engineering firsts for the nation. The challenge of the extremely complex geology beneath the city has been met in many original and innovative ways as Boston expanded. The success rests on careful field observations and adherence to disciplined scientific and engineering practices. The scientific and practical value of good geology has been shown time and again. Departures from this have led to setbacks, delays and unnecessary costs. Continuing success rests on maintaining highly qualified geologists and engineering geologists, and having access to the previous work in the area. A solution for the decline in field-based geology in New England schools has not been found, nor has maintaining the availability of reports on the work done in metropolitan Boston. The latter is urgent as valuable information is being continuously lost. The proper archiving and cataloging of this information would result in significant savings in planning, avoiding problems and preventing duplication of effort.

The future for building development in Boston and attendant supporting infrastructure is promising in spite of periodic economic slowdowns. The great past accomplishments in engineering geology, as in the Big Dig, will occur again. Each project will offer new challenges to engineering geologists and geotechnical engineers, but they will have a proud history of experience and achievements to draw upon.

—PATRICK J. BAROSH & DAVID WOODHOUSE