GEOLOGICAL SURVEY FIELD NOTES OF EDWARD HITCHCOCK

1830-1835

Transcriptions of the original hand-written
manuscripts in the collections of the
Amherst College Archives and Special Collections,
Amherst, Massachusetts

Transcribed by
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2017-2020

Introduction

In June 1830 Edward Hitchcock (1793-1864) received a commission from the Commonwealth of Massachusetts to carry out a geological survey, the first of its kind to be authorized and funded by any state. Over the next four years Hitchcock traveled across the state, visiting nearly every city and town, and recording notes on rock types, formations, and the dips and strikes of strata. He also collected some 5000 rock and mineral specimens.

Hitchcock's report on that first survey was published in 1833, a 700-page volume with data, maps, and precise descriptions and analyses of all that he observed in the field. The primary purpose of the survey was economic, and his report includes details of mines, quarries, and factories in existence at that time as well as his thoughts on the prospects for future mineral extraction. He carried out a second survey in 1837-1840 focusing on soils and published another lengthy report in 1841.

It is doubtful whether Hitchcock's surveys provided much economic benefit for the state. The most important mineral resources of Massachusetts, granite and limestone, were already being extensively exploited at the time of his survey. Furthermore, most of the untapped mineral resources that Hitchcock believed to have the greatest potential—coal, bog iron, and gold, for example—never amounted to much. Nevertheless, that survey played an important role in the development of Hitchcock's thinking on geology, particularly regarding the effects of glaciation on the surficial geology of the region. Hitchcock's survey was also influential in other states; some fifteen initiated their own surveys within six years of the Massachusetts survey. Those state surveys led in 1840 to the formation of the Association of American Geologists, of which Hitchcock was the first chairman. The AAG eventually gave rise to the American Association for the Advancement of Science, the nation's most important scientific organization to this day.

The original hand-written field notes of Hitchcock's first geological survey are recorded in six notebooks, all of which are held in the Amherst Colleges Archives and Special Collections, Amherst, Massachusetts. I read those notes and transcribed them in 2017-2018 in the course of my research on Hitchcock.

My transcriptions of those notebooks are included in this document. Also included are transcriptions of Hitchcock's account books in which he recorded expenditures related to the survey. Not included are notes from his later surveys. Notebook 5 contains notes from a trip Edward and Orra Hitchcock made to Portland, Maine, in 1835, and thus are not technically part of his Massachusetts geological survey. He did publish a paper a year later based in part on those notes, "Sketch of the Geology of Portland Maine," *Boston Journal of Natural History* 1(1836):306-346.

Page numbers indicated are the numbers of the images in the order in which they appear on acdc.amherst.edu. Where the hand-written text is unreadable, I have inserted four question marks in brackets: [????]. My comments are also placed in brackets.

The notebooks are held in the Edward and Orra White Hitchcock Papers of the Amherst College Archives, Series 5-C. Locations of the original hand-written notes in the Archives are as follows:

Diary and observations, notebook 1830 Jul-Sep Box 11: folder 7 [Notes 1]

Diary and observations, notebook 1830 Oct-1831 Oct Box 11: folder 8 [Notes 2]

Diary and observations, notebook 1832 May-1833 Jan Box 11: folder 9 [Notes 3]

Diary and observations, notebook 1833 May, Sep-Nov; n.d. Box 11: folder 10 [Notes 4]

Diary and observations, notebook 1835 geological *[Notes 1*834-1835 Box 11: folder 11 [Notes 5]

Expenses, notebook 1830-1833 Box 11: folder 12

Expense records 1830-1833, 1837-1838, 1843-1844 Box 11: folder 13

All the above have been digitized by the Amherst College Archives and are available on line. To locate digitized material, go to acdc.amherst.edu and enter an appropriate search term such as "Geological Survey Notes."

I am indebted to Amherst College, the Archives, and particularly to Margaret Dakin and Michael Kelly of the Archives, for preserving the notes of Hitchcock's geological surveys and making them accessible to all. If you make use of this transcription, please be sure to cite your source including, of course, the Amherst College Archives and Special Collections.

Readers wanting to learn more about Edward Hitchcock may wish to read my biography, *All the Light Here Comes from Above: the Life and Legacy of Edward Hitchcock.* Also of interest may be my article, "Edward Hitchcock's Geological Survey of Massachusetts:1830-1833," *Earth Sciences History* 39(1) (2020): 91-119.

Sincerely,

Robert T. McMaster
March 19, 2021

[Geological Survey Notes 1 (1830)]

No. 1

Notes taken on a Geological Survey of Massachusetts
Commencing July 29th 1830

[This seems to be a list of contacts in various towns, possibly entered before leaving Amherst; Haywood is the only name mentioned later.]

South Brimfield or Wales–Enquire for Dr. Smith

Holland–Deacon Wallace–an intelligent man

Plumbago Mine–SW part of Sturbridge–Otis Mackentick keeps the public house–the superintendant is a mulatto

Southbridge–Mr. Felch is a literary man who goes about the country with a solar microscope–Mr. Dunbar

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Near the meetinghouse–digs a mine

Dudley–Mr. Lawton keeps the academy

Oxford–Ira Barton Esq. a Lawyer

Taunton–Samuel Crocker–superintendant of a manufactory

South Oxford–John Slater, a superintendant of the manufactories–he has brothers there also: the father lives at Pawtucket

Uxbridge–Esq. Taft Jr. or Esq. Thayer–also Dr. Robbins a naturalist

Mendon–Esq. Haywood *[See below]*

Millbury–Asa Waters Jr.

Grafton–Rev. Mr. Searl

Westboro–Rev. Mr. Rockwood

Dighton–Judge Baylies and Dr. Wood father and son

Westport river–Rev. Mr. Thing

[Notes 1, Page 2 right side]

July 29, 1830 Commenced my geological survey

From Amherst to Monson 25 miles. Rocks as on the map.

Lythrum salicaria–Origanum vulgare–Sonchus spinulosus grow in Monson.

Dr. White–also *Apocynum cannabinum Lin.*

Anthophyllite a large mass found in Monson in Mr. S. Cotton's cabinet. Red Camellon calcareous spar *[calcite]* occurs in granite at Three Rivers in Palmer.

Fine anthophyllite occurs in gneiss in Pelham.

Plants not in my catalogue

Achillea millefolium
Arethusa cynapium–Hartford
Anagallis arvensis –Hadley
Antirrhinum elatine– "
Arenaria rubra–Amherst
Cardamine teris?– "
Conchus echinatus–Wethersfield
Cuphea visosissima–Pittsfield

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Helenium autumnale–Pittsfield
Sisymbrium palustre–Wethersfield
Geranium canadense–Amherst
Trillium grandiflorum–Pelham
Verbena spina–Wethersfield
Populus angulata should be *P. candicans* Mc.
(Dr. White)
Cardamine virginica grows in Amherst
Convallaria trifolia–Pelham
Pogonia verticillata–Amherst
Potentilla palustris–Pittsfield
Phryma leptostachya–Amherst

Ribes nigro–Amherst
Cassia chamaecrita–Monson
Nysoppus septetoides–Amherst
Onosmodium hispidum–Monson
Bidens bipinnata–E. Windsor
Streptopus roseus–Amherst
Viola acuta–Amherst
Verbena angustifolia–Amherst

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A fine quarry of gneiss is worked in Monson a mile northwest of the meetinghouse. Not very fissile – columns go out 20 feet long

Feldspar well crystallized in similar granite at Palmer.

Talcose slate in Stafford lies east of the mica slate between that and the granite.

July 30. From Monson to the plumbago mine 14 miles through Wales and Holland. The mine is on the edge of Sturbridge–gneiss all the way–dip from 45 to 70° to the west –direction north to south. Usually schistose–sometimes nearly stratified–the parallel position of the mica being scarcely perceptible. At the west line of Wales we came upon the gneiss stratum–2 or 3 miles thick that is full of pyrope garnet.

Dr. Smith a man of intelligence in Wales–did not see him. There is a meetinghouse and a Mr. Shink a Baptist preacher half the time. Not long ago a congregational present half the time. A pleasant place.

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Two meetinghouses in Holland–Baptist and congregational the first occupied half the time by Elder Hustin.

Plumbago mine 2 miles north of the Connecticut line a bed whose greatest width is about 2 feet often dwindling down to nothing. Walls gneiss–of a dark color–not infrequently fine lamellar hornblende is found in connection with the ore. Bed has been traced nearly 100 rods–though lost part of the interval–dig in some places and the depth of 60 or 70 feet–drained chiefly by lateral cuts into the galley–can be drained by an adit–100 tons have been dredged since the present proprietor Mr. Tudor of Boston has been engaged in the direction. Five miles from the mine to Sturbridge–six to Southbridge. Adularia and fine green feldspar occur at the mine; also iron pyrites and yellow ochre a brown ochry substance that needs further examination. Tip of the gneiss at the mine 60° to 70° West direction North 30° East 15 or 20 rods opened at the north and another opening 40 or 50 rods farther south where occurs bog iron ore found in a lateral seam in the gneiss–roots pebbles etc. enveloped in the iron. Phosphate of lime in small quantities here. The dark color of the rock at this mine seems to proceed from brown hornblende which it contains.

From Brookfield south to Sturbridge to Stafford and also in Holland and Wales numerous beds of bog iron there at least opened in Sturbridge–the outermost to Brookfield and Stafford, Troy, the firmest at Stafford–one at Brookfield one at Hardwick. The one occurs in great quantities–more than sufficient for

the demand and it is said rapidly to form. The gneiss of the region contains much iron and this rock decomposes and the water carries the iron to the low lands and there deposits it.

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A Mr. Bond–Dr. Corey and Colonel Wheelock respectable men in Sturbridge–the two former have paid considerable attention to botany. At Colonel W's new house saw specimens of the Dudley granite which I say is gneiss though a fine building stone. Those quarries have been long wrought and extensively. Much of the gneiss of this region is very coarse and in small specimens could be mistaken for granite but care will detect the parallel position of my mica.

Call on Dr. Smith at Sutton

From the plumbago mine to Sturbridge 5 miles northeast. No real granite seen today. Bowlders of greenstone not uncommon.

July 31. The beds of iron ore in this region are all bog ore and seem to be deposited from the water which filtrates through the decomposed gneiss. This rock contains much pyrite which decomposes probably into sulfate and this is dissolved by the water and seems to be again decomposed so as to deposit the oxide.

Southbridge. Gneiss rock 2 miles south of the meetinghouse are extensive beds of bog iron ore none wrought. Near the meetinghouse Mr. Dunbar has opened a decomposing ledge of rock a variety of gneiss probably full of pyrites gradually changes into the sulphate. Beautiful nodules of green and translucent feldspar occur here which when wrought are handsome. Also asbestos–also ochers and clays of yellow brown and green color some of them used as paints. Probably copperas might be here manufactured. From Sturbridge to Southbridge 3 miles–I came 6 miles so as to see the bog ore.

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Gneiss from Southbridge to Dudley 6 miles–the strata still dipping west but becoming less and less even as low as 25° (by the eye).

Near Dudley meetinghouse on a farm of Esquire Grafton is an excavation in a peculiar argillaceous slate having a glazing of plumbago. The indications are favorable for anthracite or plumbago–the depth already explored is 12 feet.

2 miles north of the Dudley meetinghouse is a fine quarry of gneiss (called there granite) from which slabs only 4 or 5 inches thick and a dozen in length are easily split such pieces are delivered at Dudley meetinghouse for four cents per foot in length.

From Dudley to Slaterville or South Oxford the gneiss continues though rarely appearing at the surface diluvial action being very manifest. At the factories we meet with a peculiar variety of slaty quartz which seems to be associated with gneiss. There also the numerous bowlders of are gneiss are porphyritic. The quartz rock continues for two or three miles when as we go over the hill towards Sutton we meet again with gneiss but running almost exactly east and west and dipping to the North 30° to 35°. As we enter

Sutton West Village near the line we find the quartz rock again running and dipping as the gneiss–a mile farther we come to gneiss again the direction becoming more northerly.

[Cross-section]

From Dudley to Sutton 12 or 13 miles.

August 1. Sabbath in Sutton only congregational society in the center of the town and two Baptist and one episcopal society in other parts of the place. A few of Unitarian notions. Rather a pleasant place. Mr. Hill was a man of some distinction in the place. Esquire Sibley also but not religious. Dr. Bill Bullard a worthy man. Dr. Solon

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Smith devotes much attention to natural history particularly botany herpetology entomology and ornithology. His partner Dr. Tenney.

August 2. Visited purgatory. 3 1/2 miles southeast of Sutton meetinghouse. Found it a fissure nearly half a mile long in gneiss at right angles to the strata. Its direction being South 30° West. Huge blocks of the gneiss have fallen into the cavity most of the distance. At one place the deepest walls are perpendicular 70 feet and 47 feet apart at the bottom. The inclination of the strata below the horizon to the northeast is 25° the same as in the rocks in the vicinity. In other places in the same region the rocks are strangely broken into pieces probably the result of some mighty convulsions acting beneath in early times. Though at the Purgatory the strata appear to be merely separated and not otherwise disturbed. I met with a rattlesnake among these rocks but as he kindly warned me that I was invading his dominions I suffered him to retire into his den and he suffered me to leave his precincts in peace–mutually willing to be rid of one another's company. We lost our way in the woods and were obliged to return for a guide. One maybe found on the edge of the woods.

Proceeded to Uxbridge 10 miles directly from Sutton. The quartz rocks were gradually succeeded by perfectly characterized gneiss which continued uninterruptedly to Uxbridge–the dip remaining about 25° and the direction nearly east and west though inclining more and more to the south of east. In Uxbridge the gneiss would readily be mistaken for granite but the parallel position of the mica will distinguish it in all cases even when the stratification is lost. The gneiss is extensively quarried in

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Uxbridge–some of the blocks being 15 to 20 feet long–some of it is exported–large bowlders frequently afford the best prices.

From Uxbridge to Smithfield lime quarries is 15 miles. Gneiss continues though not as well characterized to Slaterville–when we find a sort of granite? or perhaps quartz rock in small quantities–then succeed talcose slate out of which are made whetstones for 2 miles–then gneiss. At length near the limestone quarries we come to primitive or transition greenstone with greenstone slate–dipping to the North East some masses of this rock even penetrate the limestone. This limestone is white partially crystallized–somewhat translucent and would make good statuary marble were it not so full of seams. Its stratification is extensively observed. About 20,000 casks holding 30 to 40 gallons of lime made in Smithfield annually–there being two principal quarries 2 miles apart. I visited Harris's or the one most

westerly. Distance from Providence 7 miles.

In Uxbridge saw Dr. Robbins who is associated with Dr. Willard. The preceptor is Mr. Williams who pays some attention to natural history–also saw Mr. Mcgregory cashier of the bank.

On the south limestone at Smithfield has the greenstone slate becoming chloritic and dips Northeast 45°.

August 3. From Smithfield lime quarries to Providence 8 miles. An alternation of granite and a slaty rock apparently composed of feldspar quartz and chlorite or jade. The granite is of the variety which has bluish quartz and the feldspar is sometimes nearly compact which decomposes readily on the surface– so exhibiting numerous contemporaneous veins. This granite extends to the northwest a considerable distance 2 1/2 miles from Providence. It is quarried extensively and the

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enormous pillars on the fronts of the arcade in Providence were thence obtained. The graywacke embraces the hills of Providence and passes a mile or two west of the city and so on to the south probably including a part of the west shore of Rhode Island. Around Providence also occurs a tertiary formation and detached hills and undoubtedly remnants of the great alluvial deposits of the southern states.

In passing from Providence to Warren the graywacke fine slate at others very coarse puddingstone occurs in loose masses but rarely in place. When seen in place it dips to the east nearly 45° judged by the eye.

At Newport Colonel Totten will be able to give information relative to the geology of Rhode Island. At Providence became acquainted with a Mr. Mason an intelligent merchant who is somewhat acquainted with geology. Saw also President Wayland Professor Cornell and Revd. Mr. Patterson Dr. Webb Judge Eddy and William T Grinnell men fond of natural history I did not see. Saw the collection of the Franklin Institute.

Coal has been found at Warwick Neck 13 miles south of Providence–dug in 1770. Informed by a Quaker gentleman–21 miles from Providence to stone bridge in Tiverton went 2 miles farther.

The coal formation or rather graywacke continues to Bristol appearing in place several times between Warren and Bristol dipping rather to the North from 10° to 20° stratification indistinct. At Bristol meetinghouse we strike sienitic granite resembling that in the vicinity of Northampton it sometimes becomes a little schistose and passes into a sort of greenstone slate. This rock occupies all the region east of Bristol to the bay including Mount Hope. On the east shore of the bay at Tiverton the same rock lines the coast.

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But in proceeding southerly a thin stratum mostly apparently of an argillaceous character is often seen mounting upon the granite at an angle as great as 45°. In going from Tiverton bridge 4 miles south we find a stratum half a mile wide or less of the coarse puddingstone and graywacke slate. Soil remarkably

good where this rock prevails–similar to Rhode Island opposite. Apple trees remarkably large.

In crossing the neck of land extending from Rhode Island to Tiverton the air was rendered fragrant by immense quantities of the *Gnaphalium polycephalanthum*. In Bristol on the sienitic granite grows (a syngenesial plant naturalized at Hardwick Mass.). At the lime quarries in Smithfield grows in great abundance the *Onopordom acanthium*. The strata of shale at the anthracite coal mines in Portsmouth dip a few degrees to the southwest.

Mr. Mason says that in Cumberland Rhode Island is a large massive magnetic iron ore and the bowlders of it are scattered over all the region south of it as far as Providence but none of it is found north of the locality.

The north end of Rhode Island is a good place to teach the geologist not to rely on bowlders for the character of the formations since there the bowlders are chiefly sienitic granite whereas the rocks in places is the shale associated with coal.

From Smithfield lime quarries to Providence 7 miles; from thence to Tiverton month 21 miles from thence to Four Corners 4 miles.

August 4. From Tiverton Four Corners to Little Compton one or two miles the graywacke and continuing then we strike a range of granite,

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gneiss and a bastard mica or Talcose slate. The primary rock evidently occupies the whole of the main land below this except when the gneiss occurs and the Talcose slate. The gneiss is singular in its character–dipping to the Southeast 35° and running Southwest and Northeast. The granite obviously occupies the southeast part of Rhode Island and two or three of the small islands in the vicinity. The bowlders of conglomerate and graywacke are mixed in great abundance with the other rocks to the very end of the island. Indeed they occur very commonly the whole distance of the road from Little Compton to New Bedford 20 miles.

From Tiverton Four Corners to Little Compton center is 5 miles. From thence to Dartmouth 17 miles the numerous bowlders are gneiss and granite the latter predominating greatly and being of the finer variety with the feldspar and usually a little beyond Westport Center and just within the western limits of Dartmouth rock appears in place and it is granite. The soil is usually poor and full of bowlder stones some of them enormously large. In Dartmouth it is more sandy. Land generally rather poor. The evidence of diluvial action is very decided all along the coast. I shall venture to call the rocks granite as far as Dartmouth or within 3 miles of New Bedford.

Became acquainted with a Mr. Brownsell in Little Compton who has a pleasant family and is very hospitable. He is the father of Bishop Brownsell. Deacon Abraham Bailey is another worthy man in that place the minister is the Mr. Payne. Revd. Mr. King preaches in Tiverton Four Corners and at Adamsville on the edge of Westport. Westport and Dartmouth exhibit spiritual devotation (or desolation?).

From Dartmouth to New Bedford 3 miles–bowlders of granite and gneiss abundant but no rock appears in place until we enter the town.

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At the Mansion House is a ledge of hornblende slate dipping to the North 20° West at an angle of 55°. The granite quarried here is from loose bowlders. No collection of minerals in town. Mr. Thomas at Green devotes some attention to the subject: but did not see him. Esquire Coffin an excellent man somewhat wealthy. His father-in- law Mr. Parker owns more shipping than any man in the states–117 vessels are owned here employed in the whaling business. Stern boat runs every day or two hence to Nantucket.

August 5. Made an excursion in New Bedford Harbor to examine the rocks–Palmers Island 1 mile and 1/4 from the wharf is composed of gneiss of the most decided character running east and west and dipping to the North 35°. Numerous veins of course granite with red feldspar traverse this gneiss of which I have taken drawings. Opposite the island at the fork on the Fairhaven side extensive ranges of gneiss of the same character are found. One of the veins of granite here is 10 feet wide.

In the streets of New Bedford in several places occur masses of granite on beds in a gneisseous rock approaching even to mica slate and hornblende slate. The gneiss here not infrequently becomes hornblende slate.

In passing from New Bedford along the coast we come at 6 mile distance to Mattapoisett Village where Mr. Lebanon and Asabel Cobb are associate ministers. Just before entering this village we crossed an extensive ledge of gneiss–approaching in general aspect to granite but distinctly schistose and stratified the dipping North 35°. From thence to Sippican another village in Rochester is 5 miles where another Mr. Cobb preaches. Thence to Rochester 3 miles where Mr. Bigelow is minister. The soil all the way from New Bedford is light and sandy and full

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of bowlders of granite and gneiss chiefly of the former. The feldspar is considerably red and some of the granite very beautiful. It is used for building. Extensive saltworks occur at Mattapoisett and Sippican and quite a number of vessels are harbored there employed in the coastal trade and used too in whaling.

From Rochester Center to Snipatuit is 5 miles. Mr. Plaisted congregational minister. Large pond at this last place–Saw no rocks in place; bowlders of granite gneiss and graywacke the latter not abundant. From Snipatuit in Rochester to the iron furnaces in Freetown 4 1/2 miles some sandy plains with one or two large ponds on our right. Bowlders not so numerous those of puddingstone and graywacke slate increasing. At the furnaces at one place 2 miles east of them granite appears in place in considerable quantity. From the furnaces to Assonet the principal Village in Freetown the country is rather more hilly and granite in situ appears once or twice: but some parts of the distance graywacke bowlders constitute more than half of those seen, some of them weighing tons. The diluvial current in this region must have swept with prodigious force from the north or northwest.

Granite being in gneiss in New Bedford Harbor

[Two Drawings]

[Notes 1, Page 14] [Drawings]

[Notes 1, Page 15] [Drawings]

[Notes 1, Page 16] [Drawings followed by text]

In Freetown is an iron furnace part of the ore is obtained from the same town and part from New Jersey. It is the bog iron and I was told that it occurred abundantly here in Dartmouth Rochester and Troy.

At Rochester Centre we were shown an immense mass of agate one and 1/2 foot diameter broken off from a large rock. It consists bands of limpid quartz considering others of the quartz colored red by iron or by jasper and sometimes a nucleus of softer matter in the center. Numerous masses of these 1 to 4 inches diameter are aggregated.

August 6. Eight miles from Freetown to Fall River in Troy. More than half the way (which lies along Taunton River) immense quantities and bowlders of transition puddingstone and graywacke occur in some places constituting nine tenths of loose rocks. Near the tops of the hills however loose blocks rarely

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much rounded are granite and no ledge of any other rock could be found. Indeed this is probably the only rock in place and it is a good caution to the geologist not to trust to bowlders for determining the subadjacent rocks. 100 rods east of Troy Center I observe the surfaces of the granite exhibiting grooves in a direction nearly North and South–evidently produced by the abrasion of hard substances dragged over them by determined action. Some of these puddingstone bowlders would weigh from 50 to 100 tons. I never saw such direct evidence of a diluvial current and powerful one too from the North in early times. I now doubt whether any graywacke occurs in place on the west borders of Tiverton and Little Compton.

The quarries at Fall River are numerous. The granite would generally be called sienitic–the feldspar is pale red though a part of it (or some embedded mineral–gneiss phosphate of lime) is green.

The feldspar predominates and the rocks works easily. Blocks 50 or 60 feet long have been split out e.g. the signpost at Newhall Tavern in the village. Most of the factories are built of this stone one of them 250 feet long another 200 etc. Large quantities are carried away for example the fort at Newport is built mostly of it.

Where Fall River empties into the Taunton a distinct slate occurs composed either of argillaceous matter or sand and fine plates of mica or of grains of bluish quartz and talc is seen dipping north at an angle of 45° and lying above the granite. This slate seems to be an older variety of graywacke or the newest variety of micas slate (See specimens). A fine grained variety of granite or primitive trap occurs in place 100 rods east of the village associated in unstratified ledges with other granites (See specimens).

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From Fall River to Swansea on the west side of the Taunton River is 5 miles. No granite appears on the west side north of Mount Hope and at Swansea Center immense ledges or outliers of puddingstone

dipping to the North 35° or 40° are seen stretching away to the north and east for miles–exhibiting the remnants of this formation which has been so powerfully abraded by some debacle of waters and proving that no granite exists on the west side of Taunton River at least below Somerset. In Dighton it is said to occur.

From Swansea to Rehoboth Village or centre 9 miles–most of the way without any ledges but full of bowlders of graywacke. From Rehoboth to Pawtucket 9 miles no ledges till near Seekonk meetinghouse where they have a small dip say 10° to the east and run nearly North and South. At Pawtucket are vast ledges of graywacke. On the west or Rhode Island side they have been extensively quarried for flagstones and here are exhibited fine alterations of the red and gray varieties of graywacke often traversed by quartz and feldspar veins. The layers of the slate are remarkably regular and smooth dipping to the east 70° and running south 20° West. Cross stratification is not uncommon here particularly in the red variety. The two varieties are often found in the same continuous layer of slate having no seam between them.

Reverend Mr. Hopkins congregational minister in Pawtucket and Reverend Mr. Vernon in Rehoboth. In Pawtucket are two towns of the same name, one in Rhode Island and the other in Massachusetts. The Common in

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Seekonk is enormously large being more than a mile long and nearly half a mile wide. The Episcopalians have a church in Pawtucket–the methodists one the Baptists one the Universalists one the free will Baptists two.

August 7. From Pawtucket to the iron mine 2 miles northeast of Cumberland meetinghouse 10 miles. At 2½ miles from Pawtucket we struck the first ledge of primitive rocks– viz. a kind of poorly characterized talc chlorite slate abounding in epidote and sometimes with small crystals of magnetic iron ore. Direction nearly north east and west dip about 40° east and this is common dip of the rocks in Cumberland. As we go farther out their direction becomes nearly north and south and this is their general direction. In proceeding towards the meetinghouse we strike in a mile or two quartz rock both that which consist almost entirely of greenstone, quartz and that composed of mica or talk chlorite mentioned above graduate into each other and alternate. One mile northeast of the meetinghouse on the road to Wrentham, we come to granite which extends in a northerly and easterly direction. It is of a fine grain and often becomes highly sienitic from an admixture of hornblende and some of it is very beautiful. A mile southeast of the iron mine we found beautiful purple fluorate of lime in a quartz vain traversing this granite also lead or galena the same vein.

As we approach the iron mine the bowlders of the ore become very numerous and sometimes large constituting a very considerable proportion of the stone walls. The ore is the magnetic oxide and constitutes a large hill–the quantity is immense. On the west side of the hill the ore is beautifully

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porphyritic–the embedded crystals being feldspar. Embedded nodules apparently of serpentine exist also in other portions of the ore and another embedded mineral deserves examination. Whether this enormous bed occurs in granite or talc chlorite slate it is impossible to determine as no rocks appear in

contact with it. The granite is abundant in the vicinity. We saw bowlders of the ore all the distance to Pawtucket and they extended to the coast. The mine is owned by General Leach of Easton and a large quantity of ore is blasted out.

Before we reached the primary rocks today in situ we met with bowlders of them very frequently to the south of their beds. But in the whole distance from Pawtucket to Cumberland four miles and thence to Mason's tavern in the east part of Cumberland we saw only one block of puddingstone though that weighed several tons. The proof from hence seems to be conclusive that the last diluvial current was from the north.

From the iron mine to Mason's Tavern 3 miles–the rocks are granite and talc chlorite slate with some other varieties scarcely desirable. Near Mason's Tavern a little north we strike a remarkable hill of white granular quartz–exhibiting a remarkable cavernous or tabular structure–the strata scarcely visible. Would not this rock make a good glass?

From Mason's Tavern we proceeded easterly towards Attleboro North Parish. The graywacke succeeds to the quartz rocks near the east line of Cumberland and often is seen in ledges through Attleborough–generally dipping to the east. But on approaching the center of the town we find the slate and the puddingstone so highly impregnated with red oxide and iron as to appear a real ore of iron, sometimes becoming even

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vesicular and amygdaloidal the embedded mineral being calcareous spar. May not some of this rock be valuable as iron ore? In Attleborough this red wacke and puddingstone dip to the west at a large angle say 50°. As we approach Taunton from the south part of Norton 21 miles from Mason's Tavern the graywacke assumes its ordinary character and all regions around Taunton is decidedly graywacke.

August 8. Preached for Mr. Maltby. Took breakfast with Mr. Ballou at the public house who had come to preach in Taunton.

August 9. Visited the manufacturing of Brittania ware under the superintendance of Mr. West–and that for calico printing of which Mr. Charles Richmond is a principal proprietor. He and Horatio Leonard Esq. Sheriff of Bristol County from Raynham stated that the bog iron ore of the vicinity is nearly exhausted and that the ore now used in the smelting furnaces is obtained chiefly from New Jersey. They state also that recently they (or Mr. Richmond) sent out some practical Englishman in search of coal in the vicinity but to no purpose. They say that coal was found sometime ago in Cumberland but is exhausted. Also in the north part of Middleborough or South Bridgewater. At the office of Judge Williams in Taunton we were shown some vegetable remains evidently of tropical plants allied to the palms from Taunton near the bridge at 3 miles west–they resemble the vegetable remains in the valley of the Wyoming. These belonged to Dr. Norris. I saw also in his small cabinet a specimen of anthophyllite from Cumberland Rhode Island.

From Taunton to Dighton the rock is graywacke huge bowlders of coarse puddingstone being scattered over the surface.

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From Dighton to Berkeley 3 miles the same rock prevails and near the meetinghouse it is in the in place dipping to the northwest.

At South Bridgewater inquire of Nathan Lazell who will inform concerning the coal there found.

From Berkeley to Middleborough Four Corners or the center of the town 10 miles–not a rock in place–soil sandy and full of pebbles–evidence of diluvial action everywhere–we pass a little north of the ponds. Nearly all the bowlders are graywacke and a few rods southwest from the four corners is a ledge of the same rocks. The boundary between the graywacke in the granite must be along the southern part of Middleborough or the north part of Freetown. But the whole of this region might properly be marked as diluvium.

From Middleborough four corners to S. Bridgewater 8½ miles–1½ from the corner we strike granite in place on a low elevation. Beyond this granite and hornblende rocks are mixed with graywacke. As we approach Bridgewater the primary bowlders rather predominate. Upon the whole I conclude our course to have been not far from the dividing line of the granite and graywacke. The ponds in Middleborough contain bog ore which is accumulating but none is now got out not however I was informed because it is exhausted.

In Dighton I noticed a small mass of anthracite in a recently split fragment of puddingstone probably a single vegetable changed into that substance.

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The only ledge of rocks in South Bridgewater that seemed to be known was near the village and was puddingstone. Nathaniel Lazelle Jr. told us of coal found in Titicut (Middleborough) also in Bridgewater in one of two places and in West Bridgewater near Dr. Whitman's.

Gen. Leach says that the best and largest quantity of bog ore is in Easton. It occurs some in neighboring towns Norton Marshfield Bridgewater Sharon and Stoughton. He owns a rich and inexhaustible bed of hematite iron ore in Cranston Rhode Island. He has a blast furnace in Easton and there are furnaces. The Cumberland ore yields only about 30%. He owns one blast furnace in Foxboro. In Wareham are extensive ironworks. One blast furnace in Walpole supplied by the neighboring towns–by one in Cumberland. One blast furnace in Chelmsford and four air furnaces. Some of the ore obtained from that vicinity brought by water.

Lead and silver mines in Easton of no consequence nothing ever found. Doubtful also whether any coal occurs there.

Gen. Leach owns a mine of hematite (or argillaceous?) iron ore in Patapsco Maryland. The bog ore of the vicinity of Easton yields about 30%. He employs at Easton about 100 hands and four times for five times as many other places. At present there is hardly demand enough for iron to keep his works in operation.

From South to West Bridgewater 3 miles the granite and hornblende predominate but probably the rock in place is graywacke. In West Bridgewater Dr. Whitman's anthracite coal has been found in small

quantities in shale in digging 10 or 12 feet. The shale appears in the stream close by running east and west and dipping north about 30°.

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From West Bridgewater to Easton is 7 miles and the primitive bowlders predominate. We were told of hill near the line W. and South Easton where immense quantities of rock occur probably primitive. In one place in West Bridgewater we saw the puddingstone in place. Near Easton General Leach's furnace it is also in place and in proceeding westerly to Mansfield 5 miles we find graywacke strata dipping north east about 45°. The graywacke and bowlders become much more numerous the whole distance to Mansfield.

Mansfield to Foxboro 3 miles 2 miles graywacke–not in place–then we strike a ridge of granite which continues about 3 miles west of Foxboro meetinghouse and is most evidently a continuation of the Cumberland range of granite which runs north east through Foxboro and we could see a High Hill apparently of granite in Sharon (See No. 2)

No. 2

Some of the granite in Foxboro is beautifully sienitic and some of it most decidedly conglomerated. One of the bowlders approach very near to porphyry. In the granite we found numerous veins of trap–too soft for greenstone and too hard for wacke–the specimens need further examination. Some of this granite is very beautiful though it is not quarried in the region to any extent. Is it not the southern extremity of the Quincy granite! Certainly the coal formation that appears in Wrentham does not pass through this granite ridge as I can find and I made an excursion south from Wrentham for the purpose. Probably the Wrentham range of puddingstone and slate extend northerly to Walpole and thence to

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Dorchester and Roxbury though this point remains to be proved.

From Foxborough to Wrentham is 5 miles–the puddingstone appears in place 1½ miles northeast of the meetinghouse and probably extends westerly several miles.

August 11. From Wrentham to Franklin 1/2 mile for two or three miles the evidence of diluvial action is most obvious. Indeed I have never seen the surface so scooped out and piled up by water as here. At 3 miles we strike ledges all of sienitic which continues to Franklin. A part of these ledges are decidedly sienite. The horns greatly predominating.

From Franklin to Bellingham the granite continues in occasional ledges 5 miles.

From Bellingham to Mendon 5 miles we find granite and gneiss successively. The gneiss running north west and southeast and dipping southeast. At Mendon called on Esquire Haywood who exhibited to us a

well of mineral water tasting exactly like that in Shutesbury and exhibiting by tests abundance of muriate of lime and carbonic acid–probably the most abundant ingredient is muriate of lime. No use made of water except to raise bread.

From Mendon to the Blackstone River west 4 miles. Immediately west of the meetinghouse in Mendon we find quartz rock some of which seems to be associated with the granite and some of it a member of the gneiss formation. Before we reach the river the gneiss becomes very decided in its character running Northwest and Southeast dipping southeast from 20 to 30° in some cases very much resembling granite. Thus is it certain that the coal formation does not enter to Worcester unless it be on the north of Franklin which is not at all probable.

From the point where the Hartford Turnpike strikes the Blackstone

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to Upton is 6 miles–gneiss all the way.

Upton to Grafton 5 miles. Gneiss all the way–dip Northeast small shale thick –scarcely to be distinguished often from granite. Indeed it is probably granite in some cases.

Grafton to Millbury 6 miles. Gneiss all the way–but its characters are somewhat changed sometimes the feldspar is nearly wanting–usually the ingredients are arranged in zones or belts–the mica is black–and the quartz granular–evidently a rock of more recent origin than the gneiss of Upton and and sometimes hornblende is present in such quantities as to form hornblende slate. This distance carries us upon the valley of the Blackstone. Hence the Rhode Island coal formation does not enter in this direction to Worcester nor even six miles south of Worcester. Probably it is very limited.

From Millbury to Ward 3 miles. Gneiss nearly all the distance. At the meeting House Hill in Ward a peculiar sort of bastard mica slate–plumbaginous in its appearance appears in ledges running north and south and dipping west 70 or 80°. This change in the direction of the strata is totally unaccountable to me.

August 12. The mica slate mentioned above becomes sometimes exceedingly plumbaginous in its aspect and dark colored affording in directions of anthracite and is undoubtedly a continuation of the Worcester rock containing coal. It extends only a short distance south of Ward *[Auburn]* meetinghouse.

Went off a wild goose chase in pursuit of limestone in the western

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part of Ward and was shown when I got there a hill of gneiss. Proceeded from thence to Charlton by the turnpike from Worcester 12 miles from Ward. Rock scarcely seen in place till we reach Charlton where

an imperfect kind of gneiss occurs or rather quartz rock passing into gneiss. Thence to Brookfield by the way of the Mineral Spring and furnace in Brookfield. Rock gneiss running north to south dipping to the east from 20 to 40°. In some places the slates are so thick and the parallel position of the gradients is indistinct that the rock might easily be mistaken for granite particularly about 2 miles from Charlton. Still I am of the opinion that no genuine granite occurs on this route. Distance from Charlton to West Brookfield 18 miles.

The mineral Spring is a strong chalybeate and contains as I was told by the proprietor magnesia, soda, etc. Not a place of very much resort–tested by Dr. Graham.

The ore used at the Brookfield furnace is obtained chiefly from the vicinity where it occurs in low grounds and in ponds in great quantities and at present there seems no prospect of exhausting the ore. Found in South and West Brookfield, New Braintree, Hardwick, Spencer, etc.

One mile west of Ward meetinghouse on the Leicester Road is a fine example of powerful diluvial action–exhibiting conical cleavages and depressions by the action of water.

The direction of the strata from southeast and northwest to north and south seems to take place at Ward.

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August 13. From West Brookfield to Belchertown 16 miles. The hill a little west of Western *[Warren?]* meetinghouse is quartz rock or perhaps mica slate having a dip not more than 20° to the south west. Coy's Hill on the eastern border of Western or the center part of Ware is composed chiefly of porphyritic gneiss. Though in some places extremely resembling granite. West of this hornblende prevails very much in the gneiss becoming hornblende. Slate in many places and there a mixture of hornblende quartz and feldspar and mica. The depth of the rock west of Coy's Hill is commonly greater then farther east. About 5 miles from Belchertown we met with very fine pure hornblende rocks–and large masses of that variety of the mineral called anthophyllite. About four miles from Belchertown we find the sienitic granite in place and it continues to appear for 2 miles on the rocks covered by diluvium and the bowlders are mica slate gneiss and hornblende slate chiefly. This sienite is traversed abundantly by feldspar veins. It would make a beautiful building stone and probably large blocks might be found.

From Belchertown to Amherst it is unnecessary to take any notes.

In Belchertown one mile southeast of the meetinghouse I found a rock of actinolite schist the material being actinolite somewhat granular, mica, feldspar–not in situ.

Coming toward Mount Holyoke from Belchertown ½ mile from the mountain the dip of the sandstone is 55° southeast and the direction of the strata southwest. Close to the trap in the mountain itself the dip rises 58 or 60°.

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August 30th

Commenced a second geological tour.

From Amherst to Enfield–gneiss after 2 miles. Where we first strike the gneiss it has a dip perhaps of 30° to the west and this dip continues for two or 3 miles where the dip is easterly and only from 15 to 20°. The direction of the strata being North bearing a few degrees West. Within 2 miles of Enfield the dip increases and 1½ miles west of the village decided mica slate appears forming a hill. Next we strike the hornblende schist which continues to the village.

Amherst to Hardwick 20 miles. Enfield to (Hardwick) 10 miles. One mile east of Enfield Village the gneiss is very irregular so as readily to be mistaken for granite. The strata seem to be nearly perpendicular. A little south of the meetinghouse in Greenwich is a rocking stone of gneiss weighing 38 tons moveable with a lever–lies all gneiss.

The plain around the center of Greenwich is sandy and would seem to be tertiary although I am not confident of this.

From Greenwich to Hardwick the evidence of diluvial action is quite obvious. No genuine granite on the road today unless it was in bowlders.

At Hardwick the gneiss often becomes hornblende schist exhibiting a beautiful interstratification of genuine gneiss and hornblende slate.

August 31. From Hardwick to Spencer 17 miles–gneiss all the way dip about 20° west. In North Brookfield near the meeting house genuine granite appears in beds; here the feldspar of the gneiss almost disappears and the rock approximates to mica slate. Its strata

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are also very irregular and tortuous. The same is true of the bastard gneiss rocks as we approach Spencer. In North Brookfield and New Braintree also the gneiss is covered very much with iron rust and copperas resulting from the decomposition of sulfur of iron. Often the rock is thus entirely disintegrated. Half a mile north of the meetinghouse in the field is a bed of oxide of iron (red oxide? Or argillaceous? See specimens) of a foot or two in thickness. One mile north of the meetinghouse in N. Brookfield is a rock (also another of exactly the same kind 2½ or 3 miles north on the road to New Braintree) of garnets and laminated green minerals which I am doubtful about. But it has been employed for emery and a Mr. Smith has bought the rock for this purpose. Can the green mineral be corundum? (See specimens) Associated with the same is plumbago or molybdena (make a trial with the specimens). Enquire for a Mr. Howard connected with a machine shop in Worcester. He has ground and used the emery.

The old ironworks in Hardwick owned by Colonel Billings have stopped because he could not find encouragement to continue them. There is however a newer establishment in operation in the south part of the town but according to Colonel B's statement not in a very flourishing condition. The ore is obtained chiefly in New Braintree and Oakham where it is very abundant. The bed in the former place which I visited appeared to be from 2 to 4 feet thick and to be scarcely covered by soil. The situation of several of these beds which I have seen precludes the idea that they could have been formed by causes now in action that is since the surface of the earth assumed its present form.

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Spencer to Leicester 5 miles. A little east of the meetinghouse in Spencer genuine granite appears in beds in gneiss the dip being to the west but quite small and the strata are more contorted. One or two miles east of this point the strata dip about 20° to the east. But in passing to Worcester from Leicester the dip is west two or three miles west of Worcester we meet with the talco-micaceous rocks containing anthracite. Its direction is generally nearly north and south and its depth about 25° westerly. It does not extend far north of the town and east only to the Long Pond.

W. Lincoln, Esq., in Worcester has attended to mineralogy and has a good collection of specimens mostly foreign ones in the county lyceum. He showed me large masses of arsenical iron and some carbonate of iron from a mine one mile north of village exposed long ago for silver. The idocrase occurred near the village and some of the crystals were very large.

September 1st. Half a mile east of Worcester on the Boston Turnpike granite appears and constitutes most of the hill. On the east and northeast side we find the anthracites mica slate or quartz rocks containing the anthracite. On the east side of the hill north of the turnpike the direction of the strata is North 30° east and the dip 90°. At the rim the direction is North 70° West. The dip from 25 to 40°. Towards the top of the hill southwest of the mine 80 rods from it is granite in place. Hence the slate rocks evidently lean upon the granite on all sides–as underneath.

[Cross-section]

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The rock containing the Worcester anthracite is most decidedly primitive whether we call it micas slate or quartz rocks or talcose slate–into all of which it occasionally passes. I am rather disposed to call it bastard mica slate. The floor and bed of the river I do not regard as argillaceous slate–it is river slate lightly impregnated with anthracite or graphite or other carbonaceous matter. The mine is now abandoned. There is no connection whatever between this coal and that in Rhode Island: this is in a much older formation.

In the south part of Shrewsbury 4 miles from Worcester is a bed of peat apparently of good quality

recently discovered.

The Worcester granite comes nearest to being stratified of any I have seen.

To Westboro from the Tavern where I dined 6 miles–bowlders gneiss. Towards Westboro the rock in place was hornblende slate running east of North and strata dipping west from 50° to 70°. Near Westborough struck a ridge of granite. From Westborough to the Hopkinton Springs 3 miles. Gneiss all the way are from quartz beautifully stratified direction of strata nearly east and west and north about 30°. This gneiss generally has a reddish tinge not much wrought at the quarry.

Hopkinton Springs contains according to Dr. Gorham carbonic acid and carbonate of lime and iron. They are in the bottom of a swamp evidently abundant and abounding in iron ore and water exactly resembles those chalybeates so common in every part of the country.

From the springs to Hopkinton meetinghouse 5 miles–gneiss all the way–though it approaches in its character to granite. The bowlders scattered about the field are very large and numerous. Traces of diluvial action are very obvious in

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the lower valleys of this region. Two or three miles west of Worcester Village the conical hill and corresponding cavities are very numerous made up of diluvium. The same is true of the region three miles east of Worcester on the turnpike–also of the country a few miles west of Westborough.

September 2nd. From Hopkinton to Holliston 6 miles. Gneiss approaching to granite till within the boundaries of Holliston when we strike upon the sienitic granite. The varieties of the rocks are great. Sometimes it is a fine grained granite with not a particle of hornblende and scarcely any mica. Sometime nearly an equal admixture of feldspar and hornblende and sometimes the hornblende is almost pure or mixed with a green mineral not determined. Sometimes this hornblende rock is a little slaty. Common granite is associated with this sienite and between Midway and Medfield is a beautiful granite the quartz of a dark gray. Half a mile south of Medfield meeting house near Charles River I saw a large bowlder of red petrosilex very beautiful also a puddingstone. The feldspar in the granite of this region is usually though not always red. The granite not infrequently appears in places in low ridges. It is not much quarried though some would be fine for building. The traces of diluvial action in all this region are quite distinct.

From Holliston to Medway factory village 5 miles–same rocks from this place to Medfield Six Mile same rocks.

A little peat has been found in Hopkinton and in Medway: but not much worked.

On Charles River in Medfield I saw growing the large species of *Limnetis [a crustacean]* which I had supposed peculiar to salt marshes.

Carbonate lime occurs in the west part of Walpole near Daniel Kingsbury Esquires–owned by Daniel Adams Esquire of Medfield. One or two hundred hogsheads were built

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some years ago but it contained some bad lumps and did not sell so as to be profitable–the eastern lime now sells there at about $0.25 per bushel. Doubtless this limestone will make good lime for laying brick–some of it is indeed is mixed with impurities. They slate runs NE and SW dip NW about 45°. Within a few rods is sienitic granite.

Half a mile west of Walpole meetinghouse We come to a rock of a chocolate color distinctly stratified and somewhat schistose dipping Northwest about 50 or 60°. Immediately northwest only a few rods succeed distinct talcose plates having the same depth and direction. A few bowlders of puddingstone occur in the Walpole Valley and it is said that it is found in places a few miles south towards Wrentham and also in Dedham. But perhaps it will be best to colour a a strip 2 or 3 miles wide as diluvial: for in fact it is a strictly diluvial region.

In the east part of Sharon we strike a high ridge of granite the Foxborough Range–extending northeast. After this we enter an extensive plain on which Sharon is situated but it is nearly terminated on the south by a low range of hills. We turned south from the pond in Sharon and went over Snake Hill into the eastern part of Easton 1½ miles northeast of the meetinghouse–all the way we find granite. In short there appears to be a spur of the Foxboro granite extending east at least to the east part of Easton–so that the coal formation cannot extend northerly unless it be in the west part of North Bridgewater. Sharon plain may be colorized as diluvium.

From Walpole to Sharon four miles. From Sharon to Easton east part 9 miles.

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September 3. To N. Bridgewater 5 miles–granite all the way chiefly in bowlders–till we come near the village where we meet with the red slate found in Walpole and graywacke but not in place. Two miles east of the village however our graywacke is in place running nearly East–West. And dipping to the North. The bowlders on this from North to East Bridgewater are chiefly graywacke and there is no doubt that the rock exists in place and extends north through Abington. For North Bridgewater and East Bridgewater 7 miles from thence to Halifax through Hanson 8 miles not a rock in place. After leaving East Bridgewater bowlders almost in equal quantity of graywacke and granite. Diluvial action most manifest and perhaps it would be best to color a belt six or eight miles wide diluvial entering at least as far as Halifax meetinghouse East.

The question is settled that the graywacke does not pass from Rhode Island to Roxbury on the west of North Bridgewater.

The lead and silver mine in the northeast part of Easton is in red granite. Nothing has ever been found there of a metallic kind unless it was a little galena–we could not find a particle. The excavation is nearly

100 feet deep in a most unfavorable spot for a mine, the water now filling it nearly to the top. Two men were killed in making the pit–first wrought more than 40 years ago. The more modern company was got up by a man who had failed in business. It is an example of those quixotic

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schemes in mining which are so common in New England.

From Halifax to Wareham through Plympton (4 miles) and Carver 3 miles–thence 14 miles to Wareham meetinghouse. No rocks in place except 2 miles south of the center of Halifax where there projects a rock of porphyritic granite: the man who lives near the spot told us that in digging wells in the vicinity he penetrated argillaceous slate and then came to granite. The bowlders reached Plympton and composed almost equally of granite and graywacke. South of this the granite predominates and erelong becomes the only rock except here and there talcose or quartz masses. The granite is generally beautifully porphyritic the feldspar being red.

South of Carver the same predominates in for miles in some places no rock appears even in bowlders. But no evidence appears that this is a tertiary formation. Little doubt exists that south of Halifax all is primary.

In Carver are several iron furnaces and some pond ore but the ore is chiefly brought from New Jersey. Some peat is found in Halifax.

September 4. From Wareham to Sandwich 13 miles. 7 miles to the head of the bay the whole distance a dreary sandy plain scarcely a bowlder of rock. But in one place we thought we found the granite in place. At the head of the bay the hills exhibit striking evidence of diluvial action. From thence to Sandwich across hills of

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considerable elevation on which are immense bowlders granite and very numerous but no rocks in place yet there can be no doubt that granite is the rock in place.

Noticed the *Arbutus uva-ursi* in immense quantities on Wareham plains also several plants that I do not know (See specimens).

From Sandwich to Barnstable 12 miles diluvium all the way. In many places the bowlders are enormously large weighing 100 to 200 tons and very thick. Many of them appear to be gneiss having red feldspar. No transition or secondary rocks appear. The hills are of considerable elevation 100 to 200 feet I should judge and still higher in the interior whence they are mostly covered with wood: but I could not discover there any rocks in place. In short the face of the country and its geological changes appear to be precisely like those of Martha's Vineyard and the Elizabeth Islands. I doubt not but the same remark will apply to the whole of Cape Cod.

The white cedar (*Cupressus thyoides*) is abundant in the swamps of the Cape.

Four miles before reaching Barnstable is a remarkably picturesque view from the top of the hill–you have before you on the right a village of considerable extent and on the left a vast marsh covered with conical heaps of hay–and still more to the left sand hills strangely dilapidated by the winds and almost destitute of vegetation.

September 6. From Yarmouth to Eastham through Dennis, Brewster, and Orleans 19 miles. Diluvium all the way 1½ miles west of Brewster meetinghouse

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is a rocky place and a huge bowlder or a rock in place near the mills at the outlet of the pond (See sketch of the rock split into five or six masses.) I am inclined to believe it in place and a remnant of the granite that once existed in this region. Other huge bowlders are piled upon on another in huge disorder showing the enormous power of the diluvial current that has swept over this region. This is the most stony spot between Yarmouth and Eastham.

I presume Cape Cod to be the remains of a tertiary formation torn up by diluvial action and spread over a granite nucleus. Some of the bowlders are gneiss particularly as we go east and some of them are sienite and greenstone. We are told that beds of clay are not infrequent seven sufficiently pure to make brick–but as yet we have seen none. Perhaps loam is meant is meant. The roads in

[Drawing of rocks in Brewster]

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[Hand–drawn map of Cape Cod]

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[Drawing on the left]

many places are greatly improved by spreading this loam over them.

Downs or sand hills are not uncommon. They are most successfully resisted in their march by beach

grass and another plant which I do not know.

Peat is very abundant in almost every town on the Cape and the white cedar swamps. Hitherto it has not been much dug–but we perceive the inhabitants frequently getting it out. It must prove an invaluable treasure. The Honorable John Reid of Yarmouth says he employs it for manure and it does well. Indian corn grows better than almost any other crop on the Cape. The roads are not as bad as we expected to find them. The scenery made up of sand hills–marshes–saltworks and here and there are copse of low trees is

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picturesque though generally dreary. The houses appear better than we had anticipated and there is an appearance of comfort and even thrift which we had not expected. The inhabitants also appear obliging and civil everywhere. There is a great deficiency of guide boards and we are apt to get out of the way.

From Eastham to the north part of Truro through Wellfleet stopped at Colonel Smalley's near the lighthouse.

Eastham and Wellfleet are not very uneven and there are extensive tracts of woodland the yellow pine and the birch being the only trees that I noticed. But Truro is the most remarkable example of diluvial action that I ever saw. The whole town is scooped out and piled up in that peculiar manner which characterizes diluvium–the hills being from one to two hundred feet high and often very steep. The waters have acted on sand alone for no rocks appear in the diluvium and scarcely pebbles. The houses are usually in the valleys where the land is sometimes arable and as all the trees are cut off the landscape is most singular. Many of the marshes even in Truro contain peat. We left our wagon in Eastham although for 6 or 7 miles further the road was quite tolerable for wheels.

September 7.

From Truro at Esquire Small to Provincetown 7 miles–long ones road nearly all the way through and along the border of a salt marsh over which the sea flows at high water. Or rather there is no road except that made by the sea. The appearance of Provincetown is exceeding picturesque–as we ride along the beach below the houses

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first stand the windmills then the houses in a irregular order generally two or three rows and mixed with yards for drying fish and salt works. There are three meetinghouses, two Unitarian and one Methodist. Mr. Davis and Stone are the congregational ministers.

Back of the houses are the sand hills capped probably by beach grass and bayberry bush. A few trees of moderate dimensions appear back of the town and these are all I have seen. They are pine and oak. The long saltmarsh over which we passed I doubt not contains peat.

The lighthouse in Truro at Colonel and Esquire Small's 7 miles south of Provincetown stands on a bank of dark blue clay which is laid open on the Atlantic shore 150 to 200 feet high. There are some shades of yellow and others of a reddish color but they little resemble that on Martha's Vineyard the blue clay is very thick and the view from the top of the cliff is grand and magnificent and looking directly into the gulf produced by the wearing away of the bank one almost shrinks back. Colonel Small's farm the best in this part of the country owes its chief value to this clay which is found over the whole of it a few feet below the surface. This is a remnant of that extensive tertiary formation that was undoubtedly once broken up by diluvial action.

September 8. Came from Provincetown to Barnstable about 50 miles. I was told at Orleans that the beach in Chatham has extended into the ocean at the rate of 5 miles in 40 years. Generally the eastern side of the Cape is wearing away and the western side is gaining though not

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so fast as east is losing.

A curious deception was noticed by myself and two companions Mr. Hebard and Tappan in the sandy regions of the Cape particularly in Orleans. We seem even on level ground to be ascending in other words to be in a basin. We observed this mirage so frequently and it was so striking that it could not have been a mistake. Frequently the roads seem to have an ascent up to 3° before us and passing forward and looking back an elevation equally great appeared in that direction. This phenomenon seems to be of the nature what the sailors call looming but I cannot explain it and especially why it should appear in this rather than any other region.

September 9. Detained at Barnstable by severe rain.

September 10. From Barnstable to Falmouth 23 miles diluvial all the way most of the distance a dreary plain inhabited here by Indians. Saw here a new species of aster and syngenesial plant unknown to me.

September 11. Went to Gay Head from Falmouth and returned in an open boat 20 miles out and 30 returning. The cliff there is not more than 150 or 200 feet high. Found large quantities of argillaceous iron ore in the clay also lignite. The strata are less distinct here than in Chilmark east shore but the appearance is singularly fanciful. Immense bowlders of granite and gneiss lie along the shore. Some of them decidedly the conglomerate granite which I have noticed in various places. These bowlders are the largest I ever saw lying fairly above the surface. Found there crystals of selenite in the black clay. Cliffs of the clays appear in several places along the west shore of the Vineyard. No rocks in place on Elizabeth Islands or the promontory below Falmouth.

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Bog ore is found on Martha's Vineyard. Iron ore was obtained from the island during the last war.

September 13. From Falmouth to Plymouth 36 miles diluvium all the way. But in the west part of Falmouth and Sandwich the bowlders are so large and thick and so numerous and the hills so high that there can be no doubt that granite and gneiss are in place a little below the surface. All the south part of Plymouth must be marked as diluvial and indeed the marks of diluvial action are very manifest in the basin shaped cavities in the extensive oaks and pine plains of that part of the town. Within 6 miles of the town we meet with the hills 300 feet high covered with bowlders and perhaps there are some ledges upon them.

No rocks in place occur in Plymouth as nearly as I can find out. The rock on which our forefathers landed is a compact fine grained granite–the common rock of the town–half of it is drawn up into the village near the meetinghouse and the other half remains in its original position. The oldest gravestone in the burying ground dated 1699 is of the red slate we found in Walpole or perhaps more compact than that. From the burying ground we have a fine view of diluvial hills and cavities in the vicinity. It is a fine spot for studying this formation. In Carver occurs pond ore and bog ore but very little of either it seems used on account of the cheapness of the ore from New Jersey.

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September 14. From Plymouth to Scituate 20 miles to Kingston and Duxbury and Marshfield. All diluvium to a little beyond the Duxbury meetinghouse. There we come to a slaty rock in place running nearly east and west and dipping to North about 30°. Its characters are very obscure (See specimens). This continues not more than two or three miles when we strike granite for one or two miles. Then a region of sand and diluvium into the south part of Scituate. At Scituate hills of sand very high: the bowlders are chiefly granite though mixed with very much of the red rock that occurs in Walpole and occasionally we see a mass of puddingstone.

From Scituate 3 miles south of the harbor to Hanover Four Corners 7 miles–granite appearing frequently in place and exhibiting on its surface furrows or grooves running north and south the effect of diluvial action. From Hanover to Abington meetinghouse 7 miles. Half mile east of Hanover Square we strike the graywacke in place. From that point to within 2 miles of Abington the country is diluvial. Then we stripe the red slate rocks so often mentioned running east and west. Soon after we come to the greenish slaty rocks observed today in Duxbury. And finally the hill on which Abington meeting house stands is granite appearing however to extend only a little way south. Probably it extends north to to Weymouth.

September 15. From Abington to Randolph west parish 8 miles–granite all the way and in place. Some of it is beautifully porphyritic the feldspar being red. Near Randolph east meetinghouse the granite becomes real sienitic and sometimes even greenstone

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by the predominance of the hornblende. The same rock generally called sienite prevails abundantly to Stoughton 5 miles from Randolph. In the same continuous ledge on this route we found genuine granite with no hornblende and then decided sienite and even passing into greenstone. The granite generally occupies the lower part of ledge. There can hardly be a doubt but these rocks are mere varieties of one another. Indeed you will sometimes see them all in the same bowlder. From Stoughton to Canton 5 miles granite and sienite occur the whole distance with numerous and sometimes large bowlders of red graywacke and puddingstone. Here a beautiful porphyritic sienite occurs in bowlders and probably in place in Canton the feldspar crystals being the compact variety.

At Hanover Four Corners met with a Dr. Richards who seemed interested in science. At Randolph became acquainted with Dr. Alden an intelligent man. He says the Blue Hills extending from Canton to Quincy are chiefly granite though the red graywacke occurs along their base. The Blue Hills appear to be a continuation of the granite range formally noticed in Sharon. It is now decided I think that the graywacke does not find its way through this range of green its anywhere west of Abington. Perhaps it runs to the coast to the east of Abington.

Some peat is found in Stoughton and iron ore in large quantities in Sharon.

From Canton to Dedham by the way of Milton 9 miles passing by the west end of the Blue Hills. One mile west of Canton meetinghouse we strike red graywacke and then course puddingstone dipping to the

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North from 25 to 50°. The slate passes beneath the puddingstone. At the foot of the hill on the northwest side we found an abundance of rocks of a peculiar kind consisting of a variegated red and white base resembling compact feldspar thickly studded with small fragments of limpid quartz. It must be a variety of porphyry it seems to me. Doubtless a part of the Blue Hills is of this kind of rock–though I have reason to suppose a part is graywacke or puddingstone–These Hills must be thoroughly examined.

In passing from this point to Dedham granite or sienite appears chiefly in the fences–and 2 miles east of the village granite appears in place, some of it however is of a very peculiar kind consisting of a peculiar a dark colored feldspar and some quartz which has a fragmented aspect. Indeed I found it difficult to determine when the rock was graywacke or granite. It deserves further examination. From Dedham to Dover 6½ miles granite sienite and greenstone occurs everywhere in ledges. In the same ledge the three rocks often exist. Where the hornblende greatly prevails there is a decided tendency in the rock to stratification. The very beautiful granite in Dedham used for the columns in front of the Courthouse is from the southern extremity of Dover or the northern part of Medfield.

It is very doubtful whether the graywacke finds its way from Dedham to Dorchester. More probably it is cut off by a range of granite.

In all the towns we passed today it is a very frequent to see furrows on the surface of the granite rocks running from north to south showing a powerful diluvial action. We saw this in Abington, Randolph, Canton, Dedham and Dover. We uniformly found also bowlders south of the beds but rarely even a few

rods north. In Canton towards Stoughton enormous bowlders of bedding puddingstone

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Lie on the sienite for one or 2 miles.

September 16. From Dover to South Natick 3 miles–granite for the first two nearly then we cross a range of greenish petrosilex half a mile wide then we come upon a slaty rock dipping to the northwest 45°. At first it seems to be chlorite slate with small red spots but soon it changes to a slate resembling telcose slate broken up and recomposed. Some of it is red and decidedly fragmented. Again it is a course conglomerate cemented by talcose slate. Indeed the whole series appears to be graywacke and graywacke slate lying about the petrosilex. Is the petrosilex also transition. From South Natick to Sherborn is 4 miles and these two rocks (petrolsilex and graywacke particularly the latter) accompany us 2 miles the strata running in that direction. How far they extend northerly I do not know. That point must be examined again. One mile north of Sherborn meetinghouse we strike mica slate running north west and south east and dipping northwest at 45°. In this we noticed a bed of greenstone. The slate is only a quarter or half a mile thick when we come upon granite. Turning northwest we next proceeded to Framingham 5 miles. Granite was seen once or twice with bowlders of quartz rock imperfect green etc. Near Framingham meetinghouse one mile west we saw granite in place accompanied by granite rocks. Two miles west on the turnpike is a quarry of good granite containing hornblende the crystals of which have a parallel position. Granite is seen in place for about three miles towards Southborough. Then we come upon the granite rocks that are associated with gneiss dipping nearly north at a high angle.

Peat is found at Dover–also in Framingham in abundance; also

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some in Southborough.

From Southborough to Worcester through Northborough and Shrewsbury about 18 miles until we reach Wesson's Tavern on the turnpike which is 2½ miles from the east line of Westborough granite is the prevailing rock though in some places we find hornblende slate. Beyond this we find no granite in place but gneiss of different descriptions until we come to the pond dividing Shrewsbury from Worcester. After passing this we come upon the bastard mica slate containing the anthracite which at first runs nearly east and west dipping northerly and looking up to the granite on the hill east of Worcester. On the west side of this hill it dips west and runs nearly north and south as it does in all the west part of Worcester valley. Does not this rock enter northeasterly a considerable distance and finally graduate into gneiss?

September 18. Yes. On going to West Boylston 6 miles we find this slate all the way–and turning easterly it accompanies us to Boylston meetinghouse 2½ miles. This appears to be its eastern limit for here we come to gneiss alternating with this rock–half a mile east of the meetinghouse on the road to Berlin we

see the junction remarkably distinct the mica slate (for it is decidedly such here) lying uppermost. For about half the distance to Berlin from this place we travel nearly in the direction of the slate and seem to be about on the limits between the two rocks. For 2½ or 3 miles we cross extensive strata of gneiss which sometimes seems nearly changed into

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granite. This rock is quarried in Boylston southeast of the meetinghouse and is a fine stone. The strata of gneiss and micas slate after leaving Worcester to Berlin run generally northeast and dip from 20 to 90°. At Berlin they are perpendicular.

In Boylston the rock is covered by a coating of oxide of iron and probably copperas might be made from it.

The rocks all the way from Worcester to Berlin bear striking marks of diluvial water in the grooves on their surfaces and the direction of these grooves is always nearly north and south.

A little peat has been dug in Boylston.

The hill east of Worcester is composed of granite only in its highest and most northerly part. In passing at southeasterly we first come to the mica slate and there succeeds the gneiss which continues to Grafton and the dip of the strata is from 45° to 90°.

[Cross-section]

The indications of anthracite are strong on the Blackstone canal one mile south of the village.

One mile north of the village is an excavation in the slate rocks made many years ago in search of silver. The ores thrown out are arsenical and arsenical pyrites and carbonates of iron and galena? Good specimens can be obtained.

These ores are settled in bowlders south of the river especially on the land of Governor Lincoln 50 rods west of his house where seemed also

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the reservoir. W Lincoln Esquire familiarized me with specimens. Mr. Earl editor of the Spy is a good botanist. Dr. Butler a mineralogist also resides in Worcester. Dr. Green also attends some to the subject.

I found wacke in small crystals in Worcester in a dark argillaceous rock two miles southeast of the village.

From Berlin to Marlborough 6 miles gneiss all the way till we come to the village of Marlborough. We

strike hornblende slate in strata nearly perpendicular but when inclined at all leaning a few degrees easterly that is dipping west 80°. The grain of this rock is very fine in most places and is become in some places decided greenstone slate. From Marlborough to Concord 14 miles–this slate continuing all the distance or at least within 2 miles of Concord. We traveled just about in the direction of the strata. The bowlders are for the most part gneiss which comes probably from the north. From the bowlders we should not suspect the nature of the rocks in place.

A small quantity of peat has been dug in Marlborough. The manufacturer of Spanish brown mentioned in the *Massachusetts Gazetteer* never amounted to much. *[see Spofford, A Gazeteer of Massachusetts, p. 236; Spanish brown said to be manufactured in Marlborough in "considerable quantity from a fossil found here" (from a kind of earth or loam resembling bed ore); Spanish brown is defined as earth having a dark reddish brown color because of the presence of iron oxide and used as a pigment — compare spanish oxide.]*

September 20. From Concord to Andover through Bedford, Billerica, and Tewkesbury–20 miles. Gneiss rock sometimes passing into hornblende slate and sometimes into mica slate with protruding masses of granite exists all the way–though an extensive diluvial plain lies between Billerica and Andover. In the west part of

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Andover granite of the most decided character occurs in place. The strata of gneiss are generally about perpendicular. In most cases however the stratification is extremely indistinct even when the schistose structure is decided. The layers are extremely tortuous and irregular.

Between Bedford and Billerica near midway between the towns and close by the 16 milestone from Boston is a rock bearing the most striking marks of diluvial action of any rock that I have seen. Mrs. H. took a drawing of it.

In the center of Andover granite and that alone appears in several places. It is a very coarse kind for building. A finer kind of decent quality is obtained 4 miles east from the seminary.

September 23. From Andover to Boston 20 miles. For 3 miles the coarse granite continues. Then we come upon sienite for about two miles. After that we strike the greenstone about 13 miles from Boston this continues at least as far as Stoneham. It often passes into sienite. And sometimes is traversed by veins of feldspar. Sometimes it is highly impregnated with iron giving it a rusty appearance. Sometimes half the rock is sienite and half greenstone in the same ledge.

Marks of diluvial action appear in several places over the surface of the granite and sienite on this road and the usual grooves running north and south are present. The northeastern or northwestern faces of ledges are usually more worn with diluvial action then the southeast sides. Indeed I do not recollect an instance in which the south side shows any such action.

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I observed peat dug up in the south part of Reading.

The limestone in Stoneham is a mile southwest of the meetinghouse. It occurs in irregular beds or veins in greenstone though the rock generally in the vicinity is sienite. It is compact white and translucent on the edge. A mineral occurs in it which I take to be jade–also a green mineral whose name I do not know. Also two or three varieties of hornstone. This lime has not been used for any purpose during many years. Formerly it was burnt. Wood is now too high.

From Stoneham to Charlestown through Medford the greenstone continues to predominate. Indeed this is the only rock the whole distance to Boston in place. In Charlestown we see occasionally argillaceous slate in the stone walls.

September 24th From Boston to Randolph 14 miles through Roxbury, Dorchester, and Milton. Through all Roxbury and Dorchester occurs the puddingstone in thick slates dipping northeasterly from 15 to 30°. The strata are sometimes very thick and frequently there exists some sort of cross stratification. Directly east of Milton meetinghouse we strike a slaty rock evidently aggregated and mechanical–generally gray and sometimes red– sometimes talcose which is what I have called graywacke. Strata dip northerly 60 or 90°. This rock continues but a short distance when we strike a dark–coloured compact greenstone of no great thickness that succeeds sienite and when we get among the Blue Hills we find the predominant rock to be a sort of porphyry of a singular kind. After coming within 3 miles of Randolph we strike the red graywacke in ledges and it continues a mile or two. There

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is probably a tongue of this rock running along the southern side of the Blue Hills. Next surround sienite to Randolph.

Peat is dug in Milton.

September 25. From Randolph to the quarries of granite in Quincy through the west part of Braintree six or eight miles the sienite is sometimes approaching to greenstone for 4 or 5 miles. Then the rock in the walls becomes more porphyritic indeed we find several varieties of beautiful porphyry having a base of petrosilex and one rocks certainly of clinkstone judging from the sound when struck. The porphyry is not common in place.

The sienite at two different quarries differs but little though the feldspar is of different colours.

In some of the beds there is an appearance of very distinct stratification but upon the whole the rock must be considered as unstratified. I doubt whether the porphyry in place extends farther east than the quarries. I mean the monument quarries and Bunker Hill quarry. In passing from Randolph to the

monument we went east of all the red rock so common in this region.

Marks of diluvial action appear on the rocks near the monument though distinct furrows are not here observable.

In passing from the Quincy quarries to the west part of the Blue Hills we went into Milton where we struck a mile or two southeast of meetinghouse with argillaceous slate running east and west and dipping

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easterly at a great angle. This is doubtless a continuation of the Quincy argillite. Between the argillite and the Blue Hills we meet with a stratum of genuine greenstone. We passed diagonally through the valley in the mountains to its southwest extremity. The rock along the way is either real porphyry or halfway between sienite and porphyry. The feldspar in most specimens is only partly compact so the crystals of feldspar are very numerous. Small particles of smoky quartz are scattered through the rocks in the great abundance. As we ascend the west end of the mountain (about 900 feet) the rocks become more decided porphyry. Upon the whole I regard the great mass of this mountain particularly its western part to be porphyry. This formation extends to a large pond in Sharon south of the mountain. The other side of the pond range of red graywacke not less than 2 miles wide runs parallel to the Blue Hills as far as a large pond in the eastern part of Randolph.

September 27. From Randolph to Weymouth South (Mr. Tyler's parish) 5 miles–granite all the distance. From Weymouth to Hingham some 7 miles granite most of the way about 1 mile from the Cove we strike a remarkable rock being a conglomerate some part of it like that at Roxbury but composing other parts of porphyry and greenstone and amygdaloid. Indeed in some parts the rock appears just like greenstone. It is evidently one of the

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earliest of the mechanical rocks and allied to granite sienite and greenstone.

In passing from Hingham the whole 10 miles granite appears immediately on leaving the village and continues until within 200 rods of Nantasket Beach. Indeed I have never seen so much of the surface occupied by rocks and ledges. Greenstone is associated in this vicinity with the granite side by side and perhaps it would be proper to speak of it as in veins in the granite though it would be as proper in some cases to say that the granite veins are in the greenstone. The granite is generally sienitic though not commonly containing much hornblende.

Within 200 rods of Nantasket Beach we come upon the peculiar conglomerated rock found in Hingham. Just before entering upon the beach it becomes changed into a rock almost indescribable but probably

between the slate and graywacke.

The whole of the beach and Hull is diluvial–though at Hull the surface is covered by loose pieces of argillaceous slate. Rocks occur a little to the north of the cape which I could not visit.

At the south end of the promontory of Hull I found the argillaceous slate in place running each east and west and dipping North 60° or 70°. It is traversed by veins of chlorite and exhibits remarkable stripes of green gray white and purple.

The rock associated with puddingstone at the head of Nantasket Beach appears to be a remarkable variety of graywacke highly colored with epidote– exhibiting indeed the most brilliant variety of green and gray colors that I ever saw. Rock is not at all schistose but in many parts is divided by a kind of double set of strata–seams. The puddingstone

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connected with this rock does not seem to be stratified at all.

We passed from the head of Nantasket Beach to Cohasset 4 miles along the coast–granite all the way– the graywacke speedily disappearing in the ledges of sienitic granite traversed by huge veins of greenstone occupying nine-tenths of the surface, evidently having been powerfully created in early times by a flood of waters. I did not discover the petrosilex put down in this place by Dr. David. A very great variety of porphyries occur at Nantasket Beach worn smooth by the water–a fine place for making a collection.

From Cohasset to Scituate meeting houses 5 miles–the same rocks all the way the ledges becoming less numerous.

September 28. From Scituate to Hingham 9 miles–granite all the way though seldom appearing in ledges till we come to within about 2 miles of Hingham. Then we meet with some greenstone. About ½ mile north of the cove on Crown Point we strike red petrosilex in place–unstratified and combined with the irregular strange rocks that occur at the head of Nantasket Beach. The extent of the stratum is quite limited. On the Turnpike to Boston however after passing over amygdaloid for half a mile we come to gray white and red petrosilex for at least another half mile then succeed diluvium to Quincy meetinghouse headed through argillaceous slate occurs a little to the left extending even as far as Weymouth Landing (See the larger map).

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Porphyry occurs on Payne's Hill one mile south of Quincy meetinghouse–a continuation of the Blue Hill range.

Graywacke slate passing into argillite occurs a few rods west of President Adam’s house. The quarry of slate is half a mile north of the seat of Hon. Josiah Quincy and just beyond is puddingstone in Squantum.

From Neponset Bridge to Randolph about 9 miles diluvian the first two then we pass over the same road as described formerly.

September 29.

From Randolph to Milton meetinghouse seven or eight miles. From this meetinghouse I made an excursion of three or four miles circuit over Brush Hill and found the rocks to be sienite passing into porphyry in place and in bowlders red green and white petrosilex. From Milton meetinghouse we passed over to the Brush Hill Turnpike and struck near Neponset River the kind of slaty petrosilex and quartz dipping north and running east and west. Next succeeds beyond the bridge in Dorchester white petrosilex for a considerable distance–say half a mile then puddingstone alternating with graywacke slate scarcely different from the argillite. Puddingstone continues the remainder of the distance to Boston. In Roxbury opposite to General Dearborn's the quarries exhibit the different stratification of their rock very distinctly. That part of the graywacke formation which lies next to the porphyry from Hingham westward appears wholly unstratified.

General Dearborn says that Governor’s Island is the only one he knows of in Boston Harbor that has slate upon it. He has a fine large pedestal of the Brighton amygdaloid (porphyry?) polished. He says that half way rocks off the coast between Salem and Marblehead is a red porphyry the same is that at Malden. It admits of a fine polish. He has also a polished specimen of the Roxbury puddingstone which is elegant.

September 30. Surveyed Boston Harbor geologically and the following is the character of the islands.

Woody's
Governor’s
Independence
Thompson's
Spectacle
Peddocks
Gallops
George's
Lovel’s
Long Island
Great Brewster
Deer Island
South Shirley
And the greater part of moon Island.

All diluvial

The northeast point of Sloan Island is conglomerate graywacke

Hangmans Island–sienite

Rainsford Island–argillaceous slate

Middle and Outer Brewster
Boston Light
Egg Rock
Calf Island
Green's Island
} Flinty slate–or argillaceous slate, very hard

The slate on Rainsford Island is remarkable for the contortions of its strata–forming sometimes a complete oval in the space of a few feet in veins NE and SW and dips easterly though nearly perpendicular. Its dip and directions seem to be affected by its contiguity to the sienite on Hangman's Island. The slate on the Brewsters has a double stratification–sometimes as well as that on Rainsford Islands. In the former the slaty structure is very indistinct.

The encroachments of the ocean upon the diluvial coating of these islands is most manifest. And the wearing away is in nearly every case on the east or NE side. The rocks east of the Great Brewster were once doubtless covered with diluvium which has been worn away for 3 or 4 miles and the mural front presented by that island on the east bears evidence of the powerful action of the water while the long beach on its SW side appears to be merely an accumulation of the sand that has been worn away from the opposite side. The back side of Deer Island is defended against these encroachments by a wall erected by the government of the U. States.

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October 1st. From Boston through Roxbury 8 miles through Jamaica Plains. Puddingstone till the tavern in Spring Street when we strike upon a kind of flinty slate exactly like that which forms the Brewster Islands in Boston Harbour. Half a mile beyond this on the banks of Charles River I strike a peculiar feldspathic rock which occurred in Dedham and which seems to be intermediate between porphyry and sienite. This point is about 2 miles north of Dedham. In passing from this point directly to Needham I struck the petrosilex and soon after it became porphyritic and this porphyry occasionally slaty sometimes greenish or sometimes bluish but most commonly whitish extends to Mr. Noyes' Meetinghouse in the west part of Needham about 8 miles. Generally the base is only imperfectly compact feldspar. In Needham I saw peat

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in considerable quantities.

From Needham to Natick 3 miles granite and sienitic granite all the way. From thence into East Sudbury 3 miles granite and greenstone–thence to Newton Lower Falls through the south part Weston 8 miles–granite nearly all the way. At the falls however a slaty rock appears which is probably one of the oldest varieties of graywacke slate and it continued to Mr. Greenough's meetinghouse 2 miles northeast. Bowlders of pudding here begin to be seen. Sometimes also of porphyry.

October 2. From Mr. Greenough's meetinghouse in Newton to Angier's Corner in the same town five or six miles–I found bowlders of granite and greenstone almost entirely as far as to Charles River at Bemis factory. There I found graywacke slate cropping out running east and west and dipping north about 30°. I presume that Charles River in Newton is to be considered as the boundary of the graywacke formation although all the north part of the stone is covered with diluvium.

From Anger's Corner to Boston through Brighton and Brookline about 7 miles–graywacke all the way frequently in place. Generally coarse and conglomerated though sometimes slaty and pure. Bowlders of amygdaloid which consist of slaty graywacke he of a reddish aspect with nodules chiefly of quartz and epidote the latter sometimes crystallized.

October 5. From Charlestown to Marlborough 26 miles through East Cambridge, Cambridge, Watertown, Waltham, and East Sudbury. A tertiary formation

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Extends 2 or 3 miles beyond the Colleges. Then succeed diluvium till near Watertown where a graywacke slate crops out running northeast and southwest and the strata perpendicular. No rock appears in place after this until a mile beyond Waltham Village and we strike upon greenstone with sienite and sometimes granite and this formation extends to East Sudbury. Then succeeds diluvium for 2 miles — then fine grained granite to Marlborough within 1 mile of the village when we strike the hornblende slate already described. I think it would be correct to colour all the space between Cambridge tertiary and the Waltham greenstone as diluvium.

From Marlborough to Holden through Northborough and Shrewsbury 19 miles. The hornblende slate becoming more and more crystalline continuing nearly to Northborough meetinghouse then gneiss 3 miles beyond Shrewsbury–where commences the Worcester range of mica slate and continues about 3 miles after which gneiss the rest of the way.

October 5. From Holden to Barre through Rutland 15 miles. Gneiss most of the way though nice slate appears abundantly in the walls in the western part of Holden. On ascending the hill east of Barre meetinghouse talcose slate is seen cropping out. In the east part of Barre the gneiss is of that coarse variety which appears exceedingly like granite but cannot be considered truly such. In the valley between Rutland and Barre the soil appears loaded with oxide and iron as in Brookfield. Marks of diluvial action appear on the high hills of Rutland among which are the diluvial furrows running north

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and south or rather a little east of south and this is the case with all of them that I have seen.

From Barre to Dana 9 miles. The gneiss appears in huge ranges in the western part of Barre and occurs also a most remarkable rocking stone divided into two parts and appearing as if it must tumble down even upon the slightest concussion. It is nearly 10 feet high and irregular in shape and probably will weigh 30 to 40 tons.

From Dana to Amherst 16 or 17 miles through Prescott and Pelham. The hornblende slate range that passes through Monson appears in the western part of Dana. The porphyritic gneiss presses east of this.

In the western part of Rutland greenstone appears in place with granite or coarse variety of gneiss. At the junction of the appearance of the greenstone is altered (See specimens).

On the high hills of Rutland the strata of greenstone are almost horizontal gneiss are almost horizontal — dipping a little to the east. Several miles west they are perpendicular (In Dana?). Through Prescott and Pelham the dip is easterly at an angle 20 or 30°.

October 14

From Amherst to Shutesbury 9 miles — granite as far as Hill or Universalist Corner (interchangeable names) in Leverett. Thence gneiss though covered with diluvium. The northeast part of Amherst affords some good examples of diluvial hills and

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[Illustration of rocking stone in Barre on the road to Dana]

vallies.

From Shutesbury to Petersham gneiss all the way — no granite except occasionally very small veins–dip in Shutesbury 45° easterly–farther east it increases until it becomes almost perpendicular. In the west part of Petersham the dip suddenly changes and becomes westerly and not greater than 40 or 50°. In

ascending Petersham Hill on which the village stands hornblende enters largely into the composition of the rocks so that it becomes almost trap in its appearance. It appears in place in the street at Petersham near the meetinghouse and I could not determine its dip there. It shows marks of diluvial action–though the furrows on the abraded surface are less distinct than in some places.

October 15. From Petersham to Hubbardston 10 miles gneiss all the way for several miles beautifully porphyritic.

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I could not discover in it any seams of stratification: still the ingredients heavy a parallel position and it is decidedly gneiss. Towards Hubbardston the stratification is more distinct and the layers dip to the west at an angle of about 30°.

From Hubbardston Village 3 miles to the copperas mine. The bowlders all along are covered with oxide of iron and the rock is in a state of disintegration from the decomposition of the sulphuret of iron. The ore used at the mine is the common sulphuret in a gangue of imperfect gneiss. Usually it constitutes but a small part of the rock — the strata of this rock run nearly north and south and dip west about 30°. The ore is blasted and broken up into small pieces then piled up on a bed of clay and exposed to the rains and water also is poured on — after a while the heat generated by incipient decomposition is great enough very much to hasten the process. The lye is conveyed by a trough to a lead vat under which is built a fire for evaporation. When considerably rendered it is placed in other vats of wood and sticks are suspended in it around which the crystals form. Yellow ocher deposits in the vats as well as copperas. Would not this be prevented and a much larger amount of copperas be formed if sulphuric acid were added to the lye. The works are owned chiefly by Dr. Green of Worcester and about $4000 have been thus far expended.

The soil for several miles west of Hubbardston meetinghouse is highly charged with oxide and iron and the rocks are coated with it. It is the same range of rocks as seen at Brookfield New Braintree and etc. Doubtless bog iron ore may be found in Hubbardston etc. and copperas might be made almost anywhere in the same range.

I found pelions well characterized at the mine of copperas in Hubbardston. It exactly resembles that from _____ in Germany. See specimens.

From the copperas mine to Princeton through Hubbardston centre 10 miles. For about 5 miles beyond Hubbardston no rocks appear in place. As we come to a southern

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spur from the Wachusett we find the dip to be easterly although very small not more usually then 10° to 20° — often indeed nearly horizontal. The feldspar almost disappears from this rock and the mica of a dark colour very much predominates. Indeed it is sometimes real mica slate. The same rock forms a considerable part of the Wachusett. Near the top however we find mica slate alternating with gneiss and occasionally veins of granite. These rocks are very imperfectly stratified nor is it easy to discover the direction of dip: though I believe the former to be from northeast to southwest and the latter to be to the east but very small. Indeed more commonly the seams of stratification when they exist are horizontal. The marks of diluvial action on the top of the mountain are not striking — still the surface of

the rock has evidently been broken up considerably by the debacle of waters and on the western declivity the surfaces of the rocks are considerably worn and some furrows appear. All the high mountains that I have visited show less of diluvial action than the vallies and thus we should expect if the waters rose only "fifteen cubits."

October 16. From Princeton to Sterling 7 miles. Gneiss and mica slate alternating with veins and beds of granite occasionally–the dip rather east though the strata are nearly horizontal — occurs about half the distance then after passing over some distance of diluvium we strike the micaceous slate of the Worcester range. In the centre of the town this is abundant in place but it is so irregular that its dip is with difficulty determined — probably however it dips to the west.

One and a half miles southeast of the village are two excavations in the rock made 40 or 50 years ago in search of precious metals. Large quantities of the ore was thrown out and now lies in loose masses around the spot. The most abundant is carbonate of iron: but we found also sulphuret of iron (perhaps arsenical) and the red oxide of iron — probably the carbonate changed to this oxide by exposure

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also galena and a reddish foliated ore which I suspect to be blende but it needs examination. The carbonate of the oxide are penetrated by numerous veins and crystals of quartz. A beautiful chlorite occurs in this quartz gangue possibly prinelite. These ores exist in a bed in mica slate which dips west 60 or 70°. This is the general dip of the slate of this formation and its direction is several degrees east or northeast of North. A part of it is argillaceous — commencing in the east part of Sterling and extending east beyond Lancaster meetinghouse perhaps a mile south nearly to Boylston and running north to Harvard and Groton at least.

A little west of the mine in Sterling granite appears in ledges though perhaps it may be gneiss. This is worked some of it being of fine grain. The excursion to this mine took us 3 miles out of our way. We were accompanied by a son of Dr. Allen. He says the Sterling spodumene occurs on the road from Lancaster to Westminster. He also said that there is a quarry of argillaceous slate now wrought occasionally in the southeast part of Sterling. Mr. Phinner says that the quarry usually said to be in Shirley is in fact in the northeast part of Lancaster. Also that most of the marle of this region is in Lancaster.

Marle andalusite and pyrite it seems to me as they occur in the region are merely varieties of the same mineral.

From Sterling to Lancaster 4 miles. From thence to Bolton 4 miles. No rock appears on this road till we come to Mr. Wilder's meetinghouse 3 miles and then occurs a rock made up of mostly quartz in grains with perhaps a mixture of talc. Nearer to Bolton Village we cross strata of the plumbaginous mica slate of Worcester having northeast direction and dipping west from 60 to 90°.

Dr. Allen's son told me that in Hubbardston 2 miles northeast of the copperas

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mine is an extensive excavation formerly made in search of precious metals.

October 18. From Bolton centre to the lime quarry two miles northeast. Gneiss strata appear half a mile West 70 or 80° and running several degrees east of north. As we go eastward we find alternating strata of mica slate and granite in veins and beds. The south lime quarry is in gneiss–a bed of a few feet thickness having the normal dip 60° or 70° west. At the north or principal quarry granite appears on the south side of the bed and the adjoining strata are so disturbed that no uniform dip could be seen. This lime is much injured by the great abundance of simple minerals mixed with it among which are scapolite augite sphene petalite etc. Beautiful crystalized scapolite in gray quartz is abundant here at this time.

October 19. From Bolton to Boston through Stowe north part of Sudbury south part of Concord. Lincoln centre Waltham (Dr. Ripley's meetinghouse) and Cambridge — 30 miles. Gneiss and mica slate alternating continue to almost the centre of Stow–then hornblende schist succeeds. At the lower part Stow very coarse granite appears occasionally interrupted by sienite and greenstone when sienite becomes the prevailing rock in the south part of Concord and continues several miles when the greenstone predominates constituting high ledges through the whole of Waltham. Sienite however is always to be found in connection with it as is also granite and in this region the latter has the feldspar red and is of a fine grain. In short every variety of these rocks and every intermediate shade between them is found in almost any part of this region. The greenstone is not frequently slaty constituting genuine greenstone slate. The sienite is also occasionally porphyritic and that variety of porphyritic granite which has the embedded crystals of feldspar enormously large not infrequently

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two inches across and common in bowlders in Waltham — and indeed I never saw it in place anywhere.

The argillaceous slate first appears near the west line of Watertown in the stone walls and soon after in ledges just visible in the road running nearly east and west. This slate is of a light colour and very different from roofing slate and being much less fissile. Two miles from the University is a ledge of genuine graywacke slate dipping north 60 or 70° and running east and west. A considerable distance below this the bowlders are chiefly of greenstone sienite etc. and probably not more than a mile west of the colleges should be marked as tertiary. Very little if any of Brighton is tertiary.

October 20. Visited South Boston. Mr. Francis Alger showed me a quarry of argillaceous slate not half a mile from the bridge to Boston. It dips north at an angle of 50 to 60° running east and west.

It is traversed by cross seams of stratification so as to divide the slate into acute rhomboidal plates. It is traversed by numerous veins of quartz and carbonate of lime — as is the slate in Charlestown — evidently the same formation. It is doubtful whether any of South Boston ought to be colored as tertiary though the clay is pure enough to make brick: but it has evidently been disturbed by diluvial action. Dorchester Heights so — called as in South Boston and are diluvial: wells sunk in these hills very deep penetrated nothing but the diluvium.

October 21. From Boston to West Cambridge through Charlestown 7 miles. Just beyond the neck a little northeast of the insane hospital argillaceous slate is quarried running between northwest and west and dipping 50° to the southeast. It appears in several places on the road in passing over Winter and Prospect Hills. In one quarry the dip is west and only about 40°. At the next quarry a vein of trap intersects

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[Illustration]

Charlestown half mile north of the Palmer House. Dyke of greenstone in argillaceous slate – throwing up the latter.

…the slate as shown on the opposite page. At the junction of the rocks they pass insensibly into one another and the slate is divided by numerous fissures. Near the powder house a coarse greenstone appears in ledges. The greenstone hills approach within less than a mile West Cambridge meetinghouse and probably the slate with beds and dykes of greenstone continues to these hills.

From West Cambridge to Medford 2½ miles to Malden 2 miles. The petrosilex appears about on the west line of Medford and continues to rise in higher and higher ledges to Malden on the right of the road. It becomes genuine porphyry within 2 miles. At Malden the hills on the north are of considerable elevation. The petrosilex on the south side of the range is slaty and appears to be a recomposition of petrosilex abraded formerly. The strata dip to the North at a small angle.

From Malden to Saugus 5 miles. Porphyry and petrosilex all the way to within half mile of the

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Meetinghouse we meet with a coarse granite the feldspar red in extensive ledges. Soon the feldspar becomes white and northwest of the meetinghouse this variety…

[Illustration]

Porphyry bowlder on porphyry 10 or 12 feet in diameter

…occurs in extensive ledges. The jasper occurs east of the meetinghouse a few rods and constitutes a bed of several feet thickness and several rods long in length at least probably much more – and it appears to be associated with a variety of granite in which the feldspar is merely wanting though the actual junction of the two rocks is not visible. Some of this jasper is striped.

The conical hill just east of the meetinghouse in Saugus and between it and the jasper is made up of a most singular rock. It seems to be real graywacke — generally most beautifully amygdaloidal although to talk of this rock as real amygdaloid is idle as it is in respect to that at Brighton which this resembles. The embedded nodules in the Saugus rock appear to be quartz and must be contemporaneous with base.

From Saugus to Lynn 3 miles porphyry all the way.

October 22. From Lynn to Nahant 5 miles and returning 5 miles. The beach diluvial or alluvial. All the promontory is sienite traversed by veins of

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greenstone except the southeast extremity where we meet with flinty slate cut through by numerous

veins of greenstone more or less coarse from the width of 40 feet downwards. The strata of slate run nearly east and west dip to the north usually about 30 or 40°. The greenstone is often intruded laterally among the slate yet every little disturbance appears in the strata of the latter unless this inclination be thus considered. At the junction the two rocks appear as if it together forming a nameless compound having neither the characters are greenstone nor argillaceous slate. Sometimes veins of contact greenstone a rather small dimensions pass through both the slate and the other veins of greenstone. The same veins of greenstone are numerous in the sienite and in other veins of greenstone. On the north the greenstone passes into distinct sienite some of it at least is most distinctly stratified. The best place for seeing stratification is 50 rods northwest of the large Hotel. In some cases sienite or greenstone is interstratified

[Illustration]

Sienite and greenstone–Marblehead

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with the slate. Bowlders of porphyry are not infrequent on this promontory and the beach in different parts is covered with porphyry pebbles.

From Lynn to Marblehead four miles. Porphyry till after we cross brook in the east part of Lynn–then we strike sienite and greenstone and the latter particularly continues all the way in covers a large part of the surface not rising however into high hills but evidently very much abraded by diluvial action.

October 23. The promontory forming the south side of Marblehead Harbour is doubtless greenstone. Much of the greenstone of Marblehead is sienitic and much of it is traversed by veins of red feldspar passing into distinct granite. Often these veins are so numerous as to cut up the greenstone into angular and rounded fragments — a sample of which may be seen on the last pages.

From Marblehead to Salem 4½ miles and we went one mile round. Greenstone all the way. Two Danvers 1½ miles thence to Lynnfield Hotel in the south part of the town about 5 miles. Three miles from Salem we strike sienitic granite exactly almost resembling the Quincy granite and this continues to the Hotel above mentioned. In the west part of Danvers the bowlders of this rock are enormously large and cover the surface almost entirely along the Newburyport Turnpike.

[In pencil] Marks of diluvial action appear on the rocks in Marblehead. Particularly a rock about 15 rods southeast of the residence of Mr. Reid where the longitudinal furrows are quite distinct. Below the rock is very hard. It is close by a small white house.

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[In pencil] From Lynnfield to Boston by way of Lynn about 15 miles. The sienitic granite continues within less than a mile of Lynn Village and the Messr. Danas have doubtless extended the porphyry too far in a northeast direction. From Lynn to Boston through Malden we meet with not one rock in place nor could I see one in all Malden though some of the bowlders are very large and the hills very high. Probably rocks occur there though it will be safer to colour it as diluvial. The porphyry of this town appears to be peculiar and quite beautiful.

October 25. Mr. Solomon Willard is an architect in Boston who knows more than almost any other man of the rocks good for quarrying in the vicinity. He boards No. 369 Washington St. at the sign of the Lamb–and took me to a shop were small specimens of rocks can be smoothed and polished.

From Boston to Lexington through Charlestown about 13 miles. In Charlestown we found the novaculite–a very imperfect variety at the south end of Winter Hill. It is not schistose nor scarcely stratified at all and resembles greenstone very much. The tertiary formation cannot be considered as extended more than a mile on this road towards Concord. After which diluvium occupies the whole region till about 7 miles from Boston where we see the high ridge of greenstone

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that encircles Boston. In Lexington large quantities of peat are dug. It is that variety which is made up chiefly of fibres. It was dark before we reached Lexington and I could not see the works.

October 26. From Lexington to Leominster about 34 miles by way of Concord, Acton, Boxborough, Harvard and the north part of Lancaster. The greenstone and sienite continued to within a mile or two of Concord — in Concord is a coarse granite in place — 2 miles west of the Village distinct strata of gneiss appear running nearly northeast and dipping to the west almost 90°. This gneiss continues to Boxborough occasionally containing some hornblende and presenting veins and intruding masses of granite of a coarse texture. The limestone in Boxborough is a bed in distinct gneiss having the usual dip and inclination. The veins of red scapolite mixing through this limestone generally having two borders of green augite are extremely elegant. Limestone has not been wrought for three years. This limestone as well as that at Boston is highly fetid — good specimens of crystallized scapolite are now obtained there with much difficulty.

In Acton 1½ miles southwest of the meetinghouse is an old abandoned quarry of limestone in gneiss. I found little there interesting except compact scapolite and a few distinct crystals of ceylonite.

In west part of Boxborough the gneiss contains more hornblende in the strata almost exactly perpendicular. mica slate having the same general different and direction as the gneiss…

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…of this region commences about one mile west of the east line of Harvard and continues to within one mile of the meetinghouse–then succeeds a bed of granite several rods across then gneiss for more than half a mile — then nearly to the west line of Harvard an extensive range of that remarkable porphyritic granite bowlders of which I have several times found to the south of this place and in which the embedded crystals of feldspar are often 2 or 3 inches long. In the east part of Harvard succeeds argillaceous slate proper for gravestones. And in Lancaster it becomes proper for roofing. Quarries exist in Harvard and Lancaster. The dip and direction of the strata are as the rocks described above. I should judge that the slate is nearly 3 miles across it and then as far at least as Leominster succeeds the Worcester mica slate.

Abundance of peat is cut in Lexington. Also in considerable quantities in Billerica, Bedford, Waltham, Watertown, etc.

Granite is quarried in Leominster about one mile west of the meetinghouse. It is of quite a dark colour.

October 27. From Leominster to Templeton 17 miles. The mica slate crops out in the village of Leominster running east of north and dipping West at a high angle. On passing west two or 3 miles we find as we ascend the high hills large beds and veins of granite some of it quite fine and some very coarse. Disturbance of the strata of slate is very great by the intrusion of the granite though the case that I saw is very difficult to exhibit. Perhaps I shall attempt it on the next page. As we go on towards Westminster the granite predominates more and more until we reach the boundary of the…

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…town when a region of gneiss commences and continues to Templeton though it is rarely seen in place. In Gardner and in Templeton too the bowlders are of the same iron aspect as in Hubbardston which lies to the south.

[Illustration]

Huge mass of granite High Hill. A mica slate Templeton to Westminster the mica slates dips to the south and runs northwest. At B it dips west from 70° to 90° and runs a little east of north. This is the common dip and direction.

From Templeton to New Salem to Athol 18 miles–gneiss all the way–dipping west but nearly perpendicular in some places actually leaning to the west 2 or 3 miles east of Athol the rock so much resembles granite that it can with difficulty be distinguished veins of granite of a coarse kind become more frequent and in the south part of Worcester County.

The soapstone bed in New Salem is 1½ miles east of the meetinghouse on the farm of Daniel Andrews. It is a bed composed of steatite and black serpentine in distinct gneiss whose layers are nearly perpendicular leaning a few degrees to the east. It is a high hill and the surface is much broken into pieces. Mr. Andrews has dug into the hill from 10 to 20 feet and become discouraged. But in my…

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…opinion he has not given the bed a fair trial. Not improbably a good bed of steatite light may here be found by expanding 100 or 200 in examination.

October 28. From New Salem to Lock's Pond in Shutesbury 6 miles — gneiss all the way except that occasionally we see granite very coarse breaking through it. I saw also a very distinct and well characterized stratum of quartz rock 3 miles from New Salem. The strata on this route first become perpendicular and then lean to the west and the dip decreases rapidly so that ere we reach Lock's Pond it is not more than 45°. The direction of the strata also in many places runs northwest to southeast.

From Lock's Pond to Amherst 12 miles–gneiss till the centre of Leverett — then the granite begins to appear. The strata of gneiss run from northwest to southeast and the dip becomes less and less until at length the strata are nearly horizontal. Hornblende slate occupies a considerable part of the northern section of Leverett. Mica slate also appears in the stonewalls. A huge bowlder of coarse granite is seen a little north of Leverett meetinghouse. It must have come from a mile or two west.

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Marks of diluvial action are very obvious on the wacke like greenstone on the east side of North Sugarloaf in Deerfield — the furrows on the rocks being nearly north and south.

May 10, 1831

From Amherst to Northfield — 25 miles. There appears to be a narrow stratum of quartz rock from Amherst to Northfield between the puddingstone and the granite. The granite is generally in beds or irregular masses in bastard mica slate or gneiss. In Leverett the strata dip to the west at the mouth of Miller's River to the west. And my former section of rocks at this place seems to be correct except that the dip of the gneiss and the mica slate is not more than 30°. Diluvial furrows running north and south are very obvious on the puddingstone in Northfield street.

Northfield to Warwick 6 miles. Mica slate commences 1 mile from North village of a particular character which often splits into pieces 10 feet long and a foot square. Its dip is northwest about 30°. It gradually becomes converted to gneiss of imperfect character and both rocks contain beds and veins of coarse granite — not infrequently porphyritic — or graphite. It is difficult to say in respect to much of the porphyritic rock in this region whether it be gneiss or granite. In the centre of Warwick the rock is composed mostly of hornblende which is strangely contorted and displaced by large beds and veins of granite. In the southeast part of the town bog iron ore was formerly dug and a furnace erected but the whole is now abandoned.

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May 11. In Northfield the strata dipped in the northwest as we go towards Warwick the direction becomes more northerly and the debt becomes North Lee and east. From thence to Royalston the direction is nearly north and south in the deep east and generally from 60 to 80°.

From Warwick to Royalston 9 miles–the rocks for 5 miles are hornblende slate–mica slate and gneiss with beds and irregular masses of granite–the mica slate rather predominates. I observed also in east part of Warwick a stratum of several rods thick of decided quartz rocks distinctly stratified–the strata perpendicular. In Royalston the rock is chiefly gneiss full of sulphuret of iron decomposing.

Royalston to Winchendon 9 miles — chiefly gneiss and mica slate with rarely granite. Before reaching Winchendon the strata begin to dip to the west — gneiss quarried in the south part of Winchendon.

Winchendon to Ashburnham 8 miles — gneiss with sometimes mica slate — dip and direction as before — the rocks coated with oxide of iron and resembling that in Hubbardston from which copperas is

made. Soil poor immense quantities of the Norway pine and hemlock in the forests also many hackmatacks and spruce swamps full of sphagnum and other mosses. A fine grained granite in bowlders wrought in Ashburnham.

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Bog iron ore said to occur as I presume from the appearance of the rock it does in Ashburnham.

Ashburnham to Fitchburg 8 miles — gneiss nearly all the way– most of it dipping at a small angle westerly. At Fitchburg near the village is a mountain of fine grained granite which is quarried though not extensively on account of the paucity of the demand for it. The rock has more of an appearance of stratification than is usual with granite and the layers seem to be conformed to the shape of the hill so as to dip differently on different sides. Some of this granite is too coarse to be used for architectural purposes. Price of the granite dresses at the quarry above discussed about $0.40 per cubic foot.

Dr. Marshall showed me a fine beryl 1½ inch diameter found in Fitchburg.

The Worcester range of mica slate appears a few rods east of the village of Fitchburg dipping east at a small angle from 10 to 30° and thus continues to do beyond Lunenburg which is 5 miles beyond Fitchburg. This rock is mostly of a reddish hue and appears in many places very much like a sandstone; but it is sometimes traversed by granite veins. Is it not the quartz rock of McCulloch? Between Lunenburg and Shirley this rock dips at a small angle to the west becomes more argillaceous–in some places decided argillaceous site and contains tubercular masses of bluish quartz. From Lunenburg to Shirley 4 miles.

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May 12 Shirley to Littleton 10 miles–mostly level road over sandy plain covered with pines and shrub oak. About 4 miles struck the gneiss which continued occasionally to Littleton. Lime is dug in three places in Littleton at two places in the south part only half a mile from each other now abandoned and at a place in the east part of the town. This also is nearly abandoned. Scapolite augite actinolite and phosphate of lime occur here also sphene etc.

Littleton to Carlisle 6 miles direct (we went around 8 or 10) gneiss and beds and veins of granite — the latter generally great and fine grained — the gneiss runs about northeast and southwest and dips generally to the southeast from 60° to 90° occasionally leaning to the other way.

The cinnamon stone locality is on the road from Concord to Groton about 2 miles south of the meetinghouse in Carlisle–close by the house of Mr. Stephen Farrar. Probably more garnets can be found here but it will require some expense and labor.

From this locality to the centre of Carlisle 2 miles–thence to Billerica 6 miles–little rocks in place — gneiss and granite in the stone walls. About a mile from B. struck a large mass of coarse granite.

From Billerica to Middle Reading through Wilmington 10 miles– scarcely a rock all the way except near Reading say within 2 miles of Reading when we came upon sienitic granite and greenstone. In Wilmington was one ledge of granite and halfway to Reading one small ledge of hornblende slate or greenstone slate. The sienitic or greenstone here appears…

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…to be often slaty.

In Wilmington saw peat dug. It occurs also in Acton–and the swamps in the region must be full of it.

May 13. Reading to Salem 10 miles. Sienite or sienitic granite all the way. In Danvers it is quarried and exactly resembles the Quincy granite — not any hornblende in this rock. Blocks 20 feet long and easily got out. When entering Salem we strike ledges of decided greenstone.

Salem to Manchester 9 miles. Sienite all the way as the prevailing rock. Greenstone not infrequent especially in veins in sienite. The sienite has generally a dark or reddish aspect and the surface is decomposing to a considerable depth.

Manchester to Gloucester port 7 miles. Diorite and sienitic sienitic granite all the way. Thence to Squam 4 miles. Extensive quarry there employing 30 men — granite much like the Quincy though harder. Very large masses can be split out sometimes 60 feet long–price per foot not far from $0.45 when dressed well.

Squam to Sandy Bay near the end of the cape 5 miles — same rocks all the way. Near the latter place extensive quarries are opened in the sienite. At one of these the rock is distinctly stratified the layers from 2 inches to 2 feet thick. But the stratification does not extend far into the adjoining rocks.

In the west part of Gloucester on the road to quarry the bowlders are the most numerous of any place I have seen–and as the country is…

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…almost entirely destitute of trees the appearance is very singular and very desolate. To the northwest also on the coast is an extensive sand hill of purest white sand adding very much by contrast to the peculiarity of the landscape.

Bog iron ore occurs in Gloucester.

May 14. Sandy Bay to Gloucester Harbour 5 miles–all the way sienite–one or two varieties different from those before seen. A beauitiful porphyritic greenstone occurs at Sandy Bay in huge veins in sienite. The feldspar is almost transparent. A bronze colored feldspar peculiarly beautiful occurs in the sienite near Gloucester Harbour.

Gloucester Harbour and Essex 7 miles sienite all the way.

Essex to Hamilton 5 miles–sienite the whole distance.

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[Illustration]

Hamilton two Wenham 2 miles (Some peat cut in Hamilton). No rock in place these 2 miles.

Wenham to Topsfield 6 miles. Rock in place only once or twice then sienite. Much peat dug in Topsfield.

Topsfield to Ipswich 7 miles. Going north on the Newburyport Turnpike 3½ miles–greenstone appears in several places along this turnpike and at the northwest part of Ipswich rocks appear to be petrosilex and another porphyry. Here also I found a bowlder of greenstone beautifully porphyritic with crystals of black feldspar. I saw specimens also that resembled red slate of the graywacke formation.

Peat is cut in considerable quantity in Ipswich.

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May 16 Ipswich to Dummer Academy in Newbury 7 miles. Sienite and greenstone most of the way though some of the rock has a somewhat mechanical aspect the quartz existing in rounded grains. A little before reaching Parker River we come to red petrosilex in place–at the river we find a variety of graywacke slate dipping to the North about 45°. A little beyond occurs the coarse puddingstone such as is found in Roxbury — the red petrosilex forming a part of the mass. Next is seen a petrosilex in place — this continues till we pass a little beyond Byfield Academy when we again come upon sienite and greenstone of rather a mechanical character however. After a mile or two we find a greenish unstratified rock which for the present is nameless. It is the same that occurs in Saugus where it is amygdaloidal. Also in Hingham. This rock here is likewise sometimes amygdaloidal.

From Byfield Academy 4 miles sienite and greenstone most of the way. It is finer than most of the sienite and less crystallized. Sienite associated with the peculiar greenish rocks above described occurs on the north shore of the Merrimack opposite Newburyport.

An old abandoned lime pit occurs 2½ miles south of Newburyport. Here occurs precious and common serpentine satin spar–massive garnet–jade–hornstone–siliceous slate? And common asbestos also Dewelite. The limestone occurs in sienite or rather the southern bed is in the rock and the ore a few rods more northerly in greenstone.

Plum Island is entirely composed of sand except some beds of clay in the southern part. Beds of clay also occur in the eastern part…

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…of Ipswich.

Mr. Oakes of Ipswich showed me an interesting specimen in red granite, *from the falls of the Ammonoosuck 1½ miles down the river from E. A. Crawford's. White Mountains–close to the road–a single loose specimen.* It contains crystalline smoky quartz also reddish feldspar indistinct crystals and well characterized transparent terminated prisms of topaz! Showing the cleavage perpendicular to the axis most distinctly.

May 17. Newburyport to Boston 37 miles through Newbury, Rowley, Ipswich, Hamilton, Beverly, Salem, Lynn and Chelsea. Sienite to Salem except the petrosilex graywacke and puddingstone near the bridge

on the turnpike over the south branch of Parker River. In Beverly the granite of a good quality is quarried. In the north part of Salem the finer sienite traversed by numerous veins of coarse sienite or granite that it is assumes a brecciated appearance. In the south part of Salem greenstone appears and continues several miles.

The country is well cultivated on the route from Boston to Newburyport and the land appears well. The trees are too much cut down.

May 19. The red graywacke slate occurs along Parker's river not far from its mouth on the old road or eastern road to Boston. There also is found graywacke slate and petrosilex and quartz rock (at Thiant's Island). Greenstone is associated with greenstone the strata dip north at a great angle.

May 20 From Newburyport to Bradford 15 miles. For 3 miles sienite and granite. Then we strike a bastard kind of mica slate almost exactly like that which occupies the Worcester Valley. For most of the way it dips to the North and runs nearly east and west. The bowlders are thus slate and porphyritic greenstone gneiss and granite. Some of the rock might properly be called…

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…quartz rock. The people along the river are expecting to find coal in this slate but they never will unless it be anthracite of the Worcester kind.

May 21. From West Bradford through Haverhill and part of Plaistow and Amesbury and South Hampton in New Hampshire. Mica slate all the way of a character not much unlike that on the south side of the Merrimack. It contains much oxide of iron so as to be covered with an iron rust colour and a kind of breccia forms upon it.

At West Bradford saw a conglomerate well characterized in the bowlder near the Academy. It consists of granite and mica slate and cemented by oxide of iron.

Does the mica slate of this region connect with that at Worcester?

From South Hampton to Newburyport by way of Salisbury factory and Old Town. The slate apparently continues to the factories when we first strike upon granite of rather a coarse kind. From thence to Newburyport we find sienite with greenstone occasionally. No doubt but all the eastern part of Salisbury is sienite.

From Haverhill to Newburyport the way we came is over 20 miles.

Dr. Perkins says that arsenical iron occurs in the mica slate near the western part of Newburyport.

Newburyport to Andover through West Rowley and Boxford by a rather unfrequented route 22 miles. Sienite and greenstone as far west as Rowley meetinghouse. Then commenced mica slate which continued about to the east line…

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…of Andover where coarse grained granite appeared and continued almost without interruption to Andover South Parish. Occasionally I saw mica slate with this granite. The mica slate in Boxford runs nearly north east and southwest and dips to the northwest from 25 to 50°. It is full of sulphuret of iron which is decomposing and the outside of the rocks is covered with oxide.

May 23. Andover to Methuen 6 miles. Granite for about 2 miles then as we upon the Merrimack we strike the mica slate resembling that of Worcester direction of the strata nearly east and west and at the ridge dip from the 70 to 90° North. At the falls in Methuen the direction of the strata is nearly the same but the dip is not more than 20 to 30°. The slate here contains but little mica and is of a greenish hue. These falls are an interesting object and a fine view of them might be taken.

Methuen to Dracut 8 miles. We pass along the strata of slate (mica slate? Quartz rock?) sometimes becoming hornblende slate or a kind of gneissoid rocks — dipping northeasterly at a very high angle.

From Dracut to Lowell 2 miles the slate appears on the banks of the river on the north side and also at the west end of the village of Lowell. Chelmsford granite comes from Tyngsborough 6 miles north. A quarry however has been open just on the edge of Pelham 4 miles north of Lowell where blocks from 30 feet downward in length may be split out. Its quality is very superior.

Lowell to Chelmsford 4 miles. mica slate with large beds of coarse granite — dips and directions the same as before. At Chelmsford…

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…meetinghouse the strata are distinctly gneiss.

The principal lime quarry in Chelmsford is 1½ miles southwest of the meetinghouse in beds in gneiss dipping northwest 70 or 80°. The lime is crystalline and generally white and fetid and exactly resembles that at Bolton, Boxborough, etc. The minerals also are the same viz. actynolite scapolite white and lilac black serpentine and very beautiful amianthus.

Peat is cut in Chelmsford. We found near the lime quarry rose quartz.

Chelmsford to Westford 5 miles. mica slate most of the way with occasional beds of granite.

Found the andalusite in abundance on ascending the hill to Westford Village–in the stone walls. No doubt large quantities may be found. The large pillars in front of one of the banks in in Boston (called the Chelmsford granite) are from the northeast part of this town according to the statement of a merchant in Westford. He says also that all the granite wrought in Tyngsborough is obtained from bowlders.

May 24. Westford to Tyngsborough. 7 miles. Two miles north of Westford we strike the fine grained granite called the Chelmsford granite. This continues with alternations of mica slate to Tyngsborough generally in large bowlders only but in some cases in ledges. In the northeast corner of Westford is the principal quarry which is a ledge. The pillars for the United States Bank and the Market House of Boston were obtained from Chelmsford though a mile or two south from this quarry.

From Tyngsborough to Dunstable…

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3½ miles. mica slate and granite all the way. The slate at Tyngsborough resembles the bastard mica slate or rather perhaps quartz rock that appears abundantly farther down the Merrimack more than the slate in Westford which is of an older kind and more distinctly micaceous. From Tyngsborough to Dunstable the slate dips to the southeast and the granite beds and masses in it are coarser than the granite above described. Part of the way this slate becomes gneissoid–resembling that in the northern part of Dracut.

Dunstable to Groton 8 miles. Granite appears in Dunstable near the centre after which we met with no rock in place until within a mile of Groton meetinghouse. There we think mica slate or rather quartz rock a continuation of the Worcester range and resembling that at Worcester very much. It must run southwest and northeast and dips southeast about 45°. The country between Dunstable and Groton is mostly sandy much affected by diluvial action and exhibiting scarcely any bowlders except small pieces of slate. One mile north of Groton meetinghouse is a quarry of soapstone: considerable quantities are obtained and it appears very well though the specimens that I obtained contain considerable calcareous spar rendering them rather hard. Bog iron ore occurs in large quantities in the northern part of Groton. It is dug and used by General Leach at Chelmsford.

The quarry of soapstone is a bed 10 or 12 feet thick in the Worcester mica slate which runs northeast and southwest and dips not more than 30° to the southeast. I should judge that it might answer tolerably well…

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…though probably it will not bear the fire so well as if it were softer. Considerable labor has been expended in working it.

From Groton to Pepperell 5 miles. The slate does not appear to within 2 miles of Pepperell where we find it dipping northwest though nearly perpendicular.

In the west part of Pepperell a Mr. or Dr. Hale has dug an adit into a rock eight or ten rods in pursuit of some kind of ore but no one knows of his having obtained anything of value.

Pepperell to Townsend 6 miles. After about 2 miles the slate becomes argillaceous and soon we find it in ledges whose direction is not far from north and south and whose dip is east from 30 to 60°. This is sometimes wrought into gravestones. Towards its western limit it contains distinct beds of large size–and veins of coarse granite. Two miles from Townsend meetinghouse succeeds mica slate–dip and direction as the argillaceous slate and with protruding masses and beds of granite. And just before reaching the centre of the town well characterized gneiss makes its appearance having the same dip and direction.

* *[It is unclear where this reference goes]* A fine example of diluvial furrows in mica slate occurs one mile north of Westford meetinghouse on the road to Tyngsborough.

May 25. Townsend to Rindge NH through Ashby. Gneiss all the way except occasionally mica slate in a bed of gray fine granite near the line of the state. In the west part of Townsend the strata run north 30°

east and dip northwest about 25°. Further on the…

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…dip is not more than half as great. In Rindge the dip appears in some cases to be in the contrary direction though I would not speak with confidence without further examination.

Distance to Ashby 6 miles. Thence to Rindge 10 miles.

Rindge to Fitzwilliam 7 miles. Little Rock in place–some gneiss however in Rindge running north and south and dipping west 30 to 40° passing into mica slate. At Fitzwilliam occur large ledges of a fine gray granite which is wrought a good deal and carried 30 miles. It is a fine building stone.

Fitzwilliam to Richmond 7 miles. Granite and mica slate the letter very tortuous dipping east. Richmond to Winchester 6 miles the rock mostly mica slate with granite occasionally sometimes in large tubercular masses — the dip most of the way is west 30 or 40°. Winchendon to Northfield 7 miles — gneiss in thick layers more than half way dipping east 20 or 30°. Immense quantities of porphyritic gneiss or granite occur — found in place a mile or two north. As we ascend the hill towards Northfield mica slate and quartz rock occur having an easterly dip which increases until the strata become perpendicular. I did not see any granite between this mica slate and the puddingstone in Northfield Street.

The mica slate in Richmond is distinctly stratified in the direction at right angles to the layers of the slate and the slate several feet thick.

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May 26. Northfield to Bernardston through a part of Vernon — nine or ten miles. For about 2 miles west of the river mica slate and granite rocks occur running north and south nearly and dipping east from 20° to 60°. The quartz rock lies between the mica slate and argillite. No hornblende rock occurs here.

From Bernardston to Amherst 26 miles. Nothing new although we took Turners Falls in the way–except perhaps the decided marks of diluvial action on the old red sandstone rocks half a mile northeast of the village of Greenfield on the road to the Falls.

444 miles on this tour

May 30 Amherst to Ludlow through Belchertown 17½ miles. About 2½ miles beyond Belchertown struck sienitic granite — the same as occurs in the eastern part of Belchertown and it continues to Ludlow meetinghouse. It is traversed by innumerable veins generally of small dimensions of granite.

May 31. Went to East Windsor— Scantic parish and was disappointed of seeing the fossil bones found there by the incivility of the barbarian who owns them viz. Solomon Ellsworth. *[Dinosaur bones found there in 1818; originally thought to be human]* All the centre part of East Windsor and Enfield should be marked as new red sandstone. Indeed very little if any tertiary should be put down east of the Connecticut.

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June 1. The new red sandstone is quarried in very many places in Longmeadow and also in Wilbraham. It is a fine stone and enduring–easily wrought.

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August 29th 1831

Commenced another geological tour.

From Amherst to Whitingham Vermont through Sunderland, Deerfield, Greenfield, Colrain and corner of Heath 39 miles. When we fight first struck the mica slate in ascending the hill to Colrain the dip was east from 50° to 70° and the direction nearly north and south. In the western part of Colrain the dip is generally 90° sometimes even leaning to the east. The mica slate approaching argillite is the same as the range passing through Ashfield and the east part of Plainfield. In the south part of Whitingham we struck that peculiar variety of mica slate which contains talc…

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…and is generally called talcose slate. Chlorite slate also appears though not as I saw in place. Some of this talc chloritic slate contains hornblende crystals as in Hawley and Plainfield.

Micaceous limestone alternates with mica slate all the way from the foot of the mountains in the south part of Colrain to the Vermont line.

Below I shall attempt to delineate some veins of granite chiefly feldspar in gray micaceous limestone in the west part of Colrain.

[Illustration]

Vein about ¾ of an inch wide the bowlder 18 inches across.

Bowlders 3 feet across the veins from 1 to 2 inches wide not following any tortuosities in the rock.

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August 30 Whitingham to Wilmington 7 miles. The rock in Whitingham is chiefly mica slate — as we passed northerly however to Wilmington feldspar in greater or less quantity becomes an ingredient and the rock is gneiss whose direction is north 30° east and dip west from 30° to 70°. Probably in this gneiss occurs the limestone that is burnt there. That peculiar limestone containing green talc or chlorite and sulphuret of iron of which a large bowlder may be seen in Conway near Isaac Baker's is found in place in this town (Whitingham). Diluvial scratches not remarkably distinct are seen on the rocks between Whitingham and Wilmington.

Wilmington to Somerset 8 miles gneiss and mica slate most of the way generally running nearly north and south and dipping west at a high angle. In one case however at the base of a high hill direction is east and west and the dip southwest very small and in another case just north of Wilmington centre the dip is north. The iron ore at Somerset is in distinct talcose slate in beds extremely irregular in their width

the widest however not more than 10 feet. The strata are very tortuous and dip east from 20 to 30°. The ore is highly magnetic and takes up fragments of itself like iron filings forming native magnets. Mr. Wilbur states that this ore contains 78% of iron. It is smelted in a Bloomery Forge. A part of the ore appears to be from hematite and I should say that perhaps some argillaceous ore was among it.

But the native gold found in the vicinity of this iron is the most interesting. Over an extent of at least 800 acres no spot has been examined which did not yield more or less. In a bushel of dirt collected at different spots were found about three pennyweights value say three dollars. This dirt is the yellow soil immediately below the thin layer of black vegetable mould. How deep in the diluvial the gold may be found is not…

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…known as an attempt to find it below a few inches has not been made. The gold occurs in the quartz rock associated with the iron ore — the quartz being porous and containing some oxide of iron. Specimens of this kind exactly resemble the gold from Virginia and Carolina. Indeed one cannot but be struck with the resemblance in specimens of all kinds. The gold in the rocks at Somerset is globular — one of these nodules which Mr. Wilder gave me he found loose and broke he valued at $1.15. Some years ago a mass was found in Deerfield River which was sold for $68. The Somerset locality of gold and iron is on the east flanks of the Green Mountains and although near the middle of the town no settlements are made west of this spot until we get over the mountain. I am inclined to believe that the gold is associated with the iron and that when there is no iron there will be found no gold for always in washing the dirt iron sand remains when gold was present. And Mr. W informed me that a short distance north of the iron mines no iron record nor gold could be found in the soil. How far south the gold may be found remains to be shown. May we not expect to find it near the Hawley mine of iron since this is in talcose slate.

I ought to say perhaps that I myself picked out several small bits of gold from the soil before it was washed.

[August] 31st Somerset to Whitingham 15 miles — nothing new. Limestone in Whitingham lies about…

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…two miles southwest of the centre on a stream that empties into the Deerfield and this rock extends almost quite to the line of Rowe. I observed a bowlder several feet in diameter one mile west of the meetinghouse in Rowe. The only rock I found in connection with the limestone was telcose slate which with the limestone dips about 30° west. But the prevailing rock in the vicinity of the limestone is a bastard gneiss I found in the limestone actynolites–molybdene–bronze mica — mussite and common augite. The limestone is white granular and coarse. From Whitingham to Rowe 7 miles mica slate nearly to the line of Rowe. Here the strata run nearly east and west and dip south at a small angle. At length the strata wheel so as to run north and south near the centre of Rowe and dip south. In the north part of Rowe the land is very elevated higher than any land in the vicinity except Hoosak Mountain. Here are numerous striking examples of diluvial scratches and grooves–the furrows uniformly run nearly north and south. Similar scratches as seen near Rowe meetinghouse. The rock north part of Rowe is talco micaceous slate. Then succeeds a narrow strata of hornblende schist then decided talcose slate which continues to the Deerfield River in Zoar for 5 miles. One mile west of Rowe meetinghouse talc becomes remarkably pure and it is used for soapstone. There are two varieties, a dark green and white green

which alternate.

September 1. East line of Florida to the centre four miles mica slate and hornblende slate most of the way on ascending Hoosak Mountain we find talcose slate alternating with the mica slate the strata running…

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…a little west of north and dipping east from 70 to 90°. The rock has generally a ligniform appearance. A peculiar decomposing granite with greenish or brownish feldspar etc. occurs in bowlders in Florida and the Deerfield River. At the bridge in Deerfield River in Zoar is a block of rock 20 to 30 feet in diameter moved out of its bed by the force of the water.

From Rice's tannery halfway up the mountain to Adams North Village 7 miles. Mica slate the prevailing rock till we reach the foot of the large mountain on the west side then white granular limestone. The general dip of the mica slate and indeed of limestone is east from 20 to 90°. On the top of the mountain near the western side the strata are so wheeled about that the dip seems a short distance to be East though small but probably this is a local disturbance. Strata generally run a little west of north and sometimes nearly east and west. On the top of the Hoosak at its east margin not far from the turnpike are seen diluvial grooves and scratches having a direction west 20° North. Toward the west side of the hill also a few are seen having the same bearing. Large and very numerous bowlders of the peculiar granite with blue quartz so common in rolled masses in this region and also of granular quartz are found lining the steep escarpment of the Hoosak on the west even almost to the top. Some of them six or eight feet in diameter. The same appears commonly on top of the mountain and even several miles east of it. These facts indicate pretty clearly a diluvial current from the northwest.

Adams to Williamstown 5 miles–mica slate for a mile dipping…

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To the east at an angle from 20 to 30°. Then we strike a stratum of granular quartz. This exhibits a sort of double stratification in some parts of the bed dividing the rock into rhomboid prisms: but the direction of the dividing planes is different in different parts of the bed and can hardly be called regular stratification.

From Williamstown we went about two miles ascending the Taconic Range. The rock at first is a gray limestone then a bastard mica slate passing into argillaceous slate–and judging from the bowlders full of nodules of quartz. Diluvium covers the rocks in most places a the rich soil is produced. The dip of the limestone and slate is from 15 to 30°. Not a bowlder of the peculiar granite noticed in the morning did I see west of Adams.

September 2 from Williamstown to the edge of Pownal 3 miles and back again. Just over the line on the east bank of the Hoosic we found larger accumulations of diluvial gravel on the side of a mountain of mixed mica slate. The diluvium rising sometimes 100 feet. Large masses of this diluvium are consolidated forming distinct puddingstone and sandstone. The solid masses hanging over the road are moved from their original situation. My theory is that this diluvium containing considerable limestone in the water filtrating through it containing carbonate of lime has furnished a cement to hold together the

pebbles. These masses of rocks to be called alluvium or diluvium?

From Williamstown to the top of Saddle Mountain (Graylock) 9 miles. This mountain is composed of mica slate or rather in general of talco micaceous…

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…slate whose strata run nearly north and south and dip east for 15 to 40°. Several slides took place five or six years ago on the northeast side of the Hopper so called whose traces are still obvious–much more extensive slides must have occurred in former times from the appearance of the trees on the mountainside. Diluvium occurs on this mountain where ever it can find a lodgment. Though no foreign rocks are among it. The vegetable mould covers the greater part of the mountain so as to render it difficult to trace marks of diluvial action. On Bald Mountain however a branch of saddle mountain we saw grooves and furrows running nearly north and south. But as the strata run in nearly the same direction it is difficult to distinguish these furrows from the lines of stratification.

The view from the top of Saddle Mountain inspires one with an idea of vastness more than any view that I ever saw. You look down on the Hoosic and Taconic ranges and a sea of mountains stretches on every side to a vast extent. If you are in the valley on the north side of Ball Mountain it is one of the most imposing that I ever saw. One involuntarily begins to feel his foothold as if he were in danger of falling.

Foot of Saddle Mountain to New Ashford 5 miles — mica slate and talcose slate having the dip and direction common to the region all the way.

September 3. From New Ashford to Pittsfield through the west part of Lanesborough 15 miles. There are several varieties of marble at New Ashford white gray and clouded also the flexible which is not now wrought.

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Col. Tiler Kent is the principal owner and worker of the quarries in New Ashford. Mr. Herman the tavern keeper in the centre of the town is well acquainted with the quarries and can point out the place where the flexible marble is from. The strata of limestone here dip usually from 15 to 30°. Bastard mica slate is the rock that is associated here and generally with the limestone. This rock generally constitutes the highest hills while the limestone occurs chiefly in the valleys. On the opposite page is a sketch of a slab of marble standing against the fence near the centre of New Ashford.

[Illustration]

A slab of marble in New Ashford Mass

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September 5. Went out 4 miles from Pittsfield toward Springfield into Dalton and there found numerous bowlders of that curious quartz breccia that is cemented by brown hematite. Some of these are 6 or 8 feet diameter and probably were not removed far from the bed although I did not find the rock in situ. The return went out of our way making in all 10 miles to the localities all brickstone and quartz rock

used for flagging. Both occur in the same hill and in immense quantities. The flagging stone is very fine the strata vary from the thickness of one or two inches to one or two feet and the dip is toward the west not more than 10 to 15°. The brickstone dip is about as much in opposite direction and is succeeded beneath by a variety of quartz rock containing so much mica it might pass for mica slate. This brickstone is used considerably for grinding corn and provender and the stones sell for $70-$80. It resembles the foreign brickstone but it is much less tough. In the layers of the flagging stone I saw several veins of coarse graphic granite in which occurs red oxide and titanium.

From Pittsfield to Cheshire 14 miles by way of Lanesborough and the granular quartz disintegrate and used for manufacturing glass in Cheshire. In the east part of Lanesborough bowlders from 5 to 10 inches in diameter of brown hematite are abundant in the stone fences. Whence came they? The granular…

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…quartz occurs in a hill of 200 or 300 feet high and in large quantities. Much of it is so disintegrated as to become perfect sand. To what cause this disintegration is owing I cannot even conjecture. I should think it of an excellent quality for glassworks. It sells at the road one mile from the quarry at 6½ cents per bushel and is now carried to Keene New Hampshire.

September 5. Steatite occurs in Cheshire a little northeast of the decomposing bed of granular quartz. In how great quantities I do not know. This decomposing quartz appears two miles north of the bed on the stage road to Savoy. From Cheshire to Windsor through the west part of Savoy eight miles. In the east part of Cheshire we strike gneiss thrice more abundant in gradient–direction north and south dip east 20 to 30°. This continues to Windsor meetinghouse. Limestone occurs in Windsor only in bowlders as I should infer from all I could learn. The bowlders of quartz continue to the top of the hill at Windsor in large quantities constituting more than half of the stones in the fences. We saw none of this rock in place after leaving the easterly part of Cheshire. The stratum ought to be entered farther north than it is on Professor Dewey's map along the base of Hoosic Mountain. In one or two places in the north part of Windsor we saw diluvial scratches and grooves having a direction a few degrees north of west. There can be no doubt that the diluvial waters came from that direction in the western part of the state.

The steatite occurs in ledges…

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…in the northeast part of Windsor toward Savoy and I was told that it was found in that place also. Professor Dewey says also that serpentine is found northwest of Windsor meetinghouse on the road to Adams but I did not see it on the road that I came.

Windsor to Middlefield soapstone quarry through the eastern part of Peru and in parts of Worthington 10 miles. The gneiss continues till 3 miles northeast of Peru meetinghouse dipping east then succeeds mica slate which is in most places talcose. Layers are nearly perpendicular. In the west part of Worthington diluvial grooves appear running north 30° west. Between Middlefield soapstone quarry and the middle of the town these grooves are quite numerous and along the street south of the meetinghouse and run still nearer north and south. The talc and steatite at the quarry are abundant and good large quantities have been taken out. The east wall of the bed which is several rods wide is talcose slate. The west side is talcose hornblende slate. The Middlefield serpentine is 2½ miles south of the

middle of the town and has the hornblende slate on the west that I did not see the actual junction. It is nearly rods 80 rods wide and longer than this. It is very uniform in its appearance quite hard and is stratified, the strata dipping east 70 or 80°. From the stone quarry to the jasper lime is at least 6 miles. From the serpentine to Chester six more. In the western part of Chester we meet with porphyritic granite…

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…in bowlders and in place. Although it somewhat resembles porphyritic gneiss I could discover no schistose or stratified structure and conclude it genuine granite.

In Peru or near the north line of Middlefield we meet with a stratum of well characterized chlorite slate dip perpendicular direction north and south. Probably it is narrow here.

September 7. Chester to to Becket 14 miles up the Westfield River on the Stockbridge Turnpike. Mica slate with occasional intruding masses of granite all the way to the west line of Chester. The same kind as that occurring in Plainfield, Hawley, etc.–direction north and south dip generally east from 80 to 90° sometimes leaning east. Talcose slate in a narrow stratum succeeds the mica slate and alternating with the former we find hornblende slate — strata perpendicular–this graduates into gneiss near the east line of Becket which continues to the middle of the town with occasional beds of mica slate. The scenery along the Westfield in Chester is wild and sublime.

One mile south of Chester meetinghouse we found a mass of mica slate of bog iron enveloped in granite.

[Illustration]

Coarse granite

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Becket to Lee 11 miles gneiss all the way except 2 miles when we struck limestone dipping to the east 20 to 30° and associated with mica slate. The western part of the gneiss range graduates into hornblende slate retaining however the feldspar and often containing granular epidote. Between this hornblende slate and the limestone augite takes the place of hornblende and we have a rock composed of green augite and quartz or augite and feldspar most commonly the latter. This rock exhibits numerous contortions and is brown from decomposition on its surface. It exceedingly resembles a like compound associated with the limestone in the eastern part of the state at Bolton, Carlisle, etc. Indeed that formation throughout resembles that in the eastern part of Berkshire containing the lime.

Professor Dewey must be mistaken in not entering the gneiss farther west than he has done on his map. It certainly comes within 2 miles of Lee Centre. The bowlders of granular quartz do not appear much until we have come 4 or 5 miles from Becket. Along the valley below this the diluvial hills are very numerous and some of them quite large. Why are not the greater bowlders in this region rolled up as high upon Hoosic mountain as farther north? Is it not because the diluvial current father south seems to have been in direction more nearly from north to south.

Lee to Lenox 5 miles granular quartz appears in a ledge a little east of the village of Lee and a mile north

stratified quartz rock forming a hill on the right. It is composed of quartz and mica.

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The rest of the way to Lenox is a limestone country.

Lenox to Richmond iron furnace 7 or 8 miles. The principal bed of hematite iron in Lenox is a mile west of the courthouse not now wrought nor that in the village. The bed in Richmond containing the gibbsite is now being opened again by Mr. Gates the owner. He has on hand a quantity of the mineral which he sells. The other principal bed in Richmond is a 1½ miles southwest of this one. From this one bed (Mister Cone's) to West Stockbridge Village we lost our way and traveled 3 miles.

September 8. The varieties of marble in West Stockbridge are not much greater than in New Ashford and Lanesborough except a dark kind found in the west part of the town. The bed of hematite in this town is a very fine one and is now dug. The man who owns the land sells the ore for 37½ cents per ton.

West Stockbridge Village to Great Barrington 13 miles. Mica slate the first part of the way before getting to Barrington quartz rock appears abundantly. A fine variegated marble occurs a 1½ miles west of the Village. General Whiting gave me some specimens. I left a box at Beebe's Tavern to be forwarded by stage to Russell's Hotel in Pittsfield where I previously left two boxes.

Great Barrington to Sheffield 6 miles. Most of the way alluvial — of considerable width.

September 9. Sheffield to Canaan 11 miles. Sandy alluvium till past the river. Then we cross mica slate in the south east part of…

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…Sheffield then dolomite limestone and alternating with this 4 miles north of Canaan meetinghouse the scapolite rock. I doubt not but it extends into Sheffield with the dolomite limestone. The strata dip east and run generally nearly northwest. The best place for observing these sheets is east and northeast of Canaan meetinghouse. This scapolite is strongly intermixed with the lime and also with granite and sometimes with mica tremolite. We traced its strata east of Canaan meetinghouse as much as 3 miles making six or 7 miles of the whole. Bowlders of it are found all the way up the mountain northeast of Canaan on the road to Norfolk. Near the top of this mountain we saw diluvial furrows running almost exactly north and south. We saw no scapolite rocks higher up the mountain than say 200 feet–all above is mica slate running north and south and dipping east generally. Canaan to Norfolk 7 miles–mica slate to within a mile north of meetinghouse when gneiss commences. This continues to Colebrook 6 miles. Large bowlders of quartz rock occurred nearly the whole distance.

Diluvial grooves and scratches are very obvious on the gneiss within a few rods east of Norfolk meetinghouse.

From Colebrook to Middle Granville through the south part of Tolland 12 miles and a gneiss nearly all the way except that for two or three of last miles mica slate appears to predominate though it is difficult to distinguish between the two rocks. The strata are most commonly nearly perpendicular or sometimes dipping east and sometimes running in different directions than north and south. Rock contains an…

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…immense number of granite veins and protruding masses. I regret not having time to examine them with much care.

[Illustration of coarse granite veins 1 foot thick]

Granite veins in gneiss showing a shifting of the layers of gneiss.

Tolland South part

September 10. It is doubtful whether any soapstone occurs in Middle Granville except in bowlders or stones. In East Granville we found a bowlder of black serpentine occurring in Blandford–also others on the road to Westfield near the west line of Westfield. Westfield serpentines almost entirely like that found in Blandford. I saw two pieces smoothed and polished in the home of Mr. Cobb in Westfield.

From Middle Granville to Westfield 13 miles. Gneiss and hornblende slate and occasional beds of mica slate till near the west line of Westfield where we struck mica slate with very large protruding masses of coarse granite probably a continuation of the Southampton range or beds.

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Big bowlders of granite occur in Granville. In the east part of Middle Granville perpendicular strata of hornblende slate are cut off by an immense mass of granite. In East Granville one mile west of the meetinghouse is a fine example of diluvial grooves running 25° west of north.

In the west part of Westfield as soon as we got down the main hill we struck red sandstone and then crossed a plain between 2 and 3 miles wide which appears to be a tertiary formation.

Westfield to Northampton 17 miles. Tertiary almost 5 miles then we strike the red sandstone which continues with interruptions within two or three miles of Northampton and probably ought to be extended across the mountain on the map.

In the northeast part of Southampton I obtained a bowlder nearly a foot in diameter of the quartz breccia found in Berkshire that variety cemented by oxide of iron. It must have been drifted hither by a diluvial current.

Westhampton to Amherst 8 miles.

Whole distance gone over in this tour 333 miles.

The gold which we got from 6 quarts of dirt in Somerset weighs seven grains and the large pieces from the brook 29 grains.

Over the leaf may be seen a sketch of the line of sight of the layers of gneiss rock as exhibited in a bowlder of 6 or 8 feet across in Colebrook, Connecticut.

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September 19th 20th and 21st. From Amherst to Zoar to Florida through Hatfield, Williamsburg, Goshen, Plainfield, Hawley and Charlemont 45 miles. The mica slate extends to Plainfield meetinghouse where the telcose slate succeeds and continues to Florida. The dip of the strata is generally to the east but approaching 90°. Hornblende schist occasionally alternates with the talcose. The Hawley iron ore is in a bed varying from a few inches to several feet wide. The ores are the magnetic and the micaceous oxide. This mine is not at the junction of the talcose and mica slate but 2 or 3 miles west of the east margin of the talcose slate. Porous granite containing oxide of iron in abundant in the slate in Hawley Plainfield etc. and it promises well for gold though…

[Illustration]

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…I discovered none in the slight trials that I made. The the beryl appears a mile or two farther south than this point also north in Charlemont.

In Charlemont I found *Gentiana quinquefolia* with *crinita*.

In Zoar close on the banks of Deerfield River is an extensive bed of green and white steatite alternating with green serpentine. The green steatite is particularly firm and more compact than any I have seen in other localities. Serpentine is abundant. Talcose slate and mica slate are interstratified with these rocks and sometimes the serpentine and steatite are united in the same rock.

Abundance of bitter spar occurs with this steatite — also well characterized marmite and larger quantities of green asbestos.

Steatite I have learned occurs in the south part of Blandford also East Granville. Serpentines occurs here also probably in connection with the steatite.

From Zoar to Amherst to Charlemont Hawley Plainfield Ashfield Conway Deerfield and Sunderland 45 miles–going and returning–90 miles.

September 29. Found a bowlder stone near the Colleges in Amherst which exhibits the junction of the new red sandstone and granite. The specimen is about 6 inches across and they much worn by water. The granite is of the most divided character the feldspar red and abundant. The sandstone also was remarkably well characterized being rather coarse and indeed magnetic may be called..

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…conglomerate. The junction is well marked and no change appears in either rock near the line. It breaks no easier at the line of junction than in any other direction. This specimen proves that this granite was posterior to the sandstone–I suspect that the specimen came from Leverett east side of Mt. Toby where I have often noticed the granite very near the sandstone.

October 1. Went to the south part of Shutesbury to visit a bed of soapstone. It is in gneiss the gneiss appearing on both sides of it and a little distance. I could not see the soapstone in situ but from the amount of bowlders I doubt not its occurrence in that form. It is of a better quality than any I have seen in this quarter. It contains asbestos in broad veins. The gneiss in this region dips 20 to 25° west. At the quarries in Pelham granite veins are not uncommon.

Collected 40 or 50 specimens of rocks.

October 2. Collected 30 specimens of rocks in Amherst mostly granite and gneiss. Among them are three of the Pittsfield Brickstone from a mill. This quartz contains occasionally small foliated masses of feldspar and fragments of a mineral evidently not in its original gangue–which I suppose to be hornblende. These crystals appear to have been broken from some other place.

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The origin and formation of this singular rock appears to be inexplicable.

October 7. Went to Northampton to inquire about the Southampton mines. It is owned chiefly by Mr. Perkins of Boston and nearly $30,000 have been expended upon the adit. It is now abandoned.

The granite from Williamsburg is very fine used for facing stores in Northampton. Equal any in the state.

Got 10 specimens. 16 miles travel

October 16. Spent a day and a half in getting specimens of quartz chalcedony, serpentine, etc. in Pelham. Ascertained also that there is a quarry of soapstone in the southwest part of Wendell near Lock's Mills. The rock in Pelham is serpentine mixed with talc–the former black and the latter green.

Rocking stone in New Marlborough see History of Berkshire page 291.

Mr. Alexander says that there exists a large amount of black and red oxide of manganese a mile or two east of the centre of Winchester Vermont. Another extensive bed in Hinsdale. The bed of iron ore in Winchester (magnetic and micaceous oxide) lies in the southwest part of the town and exists in large quantities. He finds scapolite in Winchester in large quantities also large crystals of stenotype also pyrite.

Junior Burnham found beautiful yellow quartz in Pelham.

Junior Tuttle showed me fine sedimented…

[Notes 2, Page 59]

…asbestos from Barkhamsted, Connecticut.

Explosion from iron pyrites History Berkshire page 314.

Washington–a bed of fine sand for glass History of Berkshire page 346.

Hudson's Brook in Adams a waterfall History of Berkshire 430.

Omitted on the map bituminous limestone in West Springfield and Northampton
Serpentine at Newbury
Serpentine at Middlefield steatite quarry
Serpentine in Zoar
Serpentine in Windsor two places
Serpentine in Worthington
Serpentine in Plainfield
Serpentine in Pelham
Serpentine in Newport Rhode Island
Serpentine in Blandford and Westfield
Soapstone in Windsor with the serpentine
Soapstone in Savoy
Soapstone in Cheshire
Soapstone in Rowe
Soapstone in Zoar
Soapstone in Wendell
Soapstone in Shutesbury
Soapstone in Blandford
Soapstone just in the edge of Windsor
Soapstone in Windsor east side near the steatite manufactory
Soapstone in Hinsdale (Professor Dewey's letter)

October 28. M. Wilder Esquire of Lancaster informs me that large quantities of clay are brought from Martha's Vineyard for the manufacture of alum at Salem. Formerly they got it from Gay Head but now at Tisbury on the west shore where it is Lieutenant Jonathan Prescott and Nantucket

Henry Wilder Esquire Lancaster
Reverend Benjamin Kent Duxbury

[Notes 2, Page 60]

More fire from iron.

Mr. W says that the bones of animals and teeth are very abundant at Gay Head. They occur according to him in the diluvium above the clay beds. This diluvium being generally cemented by iron.

M. informs me that the stumps of trees are found at Holmes Hole under water in great quantities forming a sort of submarine forest. They occur also he says in the bay (bog?) west of Provincetown and at Nantucket Harbour there was dredged up peat and a cedar stump.

He says that real petrified shells were found probably in diluvium in Marshfield. Reverend Benjamin Kent of Duxbury will inform me about them. Shells also occur in Nantucket in the interior. Lieutenant Jonathan Prescott will give me information on the subject.

Is not the plious substance accompanying the Westford andalusite the Buchobrite? See Brooks Crystallography page 458.

In Mendon a shaft was sunk 40 years ago for finding the precious metals. Robinson's catalog page 54.

[Geological Survey Notes 3 (1832)]

[Notes 3, Page 1]

[Illustration]

Argillaceous slate–Guilford Vermont

[Notes 3, Page 2]

[Illustration]

Guilford, Vermont section

September 17th. Amherst to West Springfield 25 miles

The sandstone cropping out beneath the greenstone at Rock Ferry dips 20° east.

See at the end a sketch of the tops of the columns where they pass under the Connecticut River at this place which should receive the name of Titans Bridge.

On the opposite side of the river in the bed of a small brook east of Lyman's Tavern junction of the greenstone and sandstone is obvious. The former is intruded among the layers of the latter in almost every mode and sometimes overlies it. See sketch…

[Notes 3, Page 3]

…end of a protruding mass which seems to have forced up and bent the sandstone strata. The sandstone in the junction is visible in all this region to W. Springfield.

The limestone occurs in two places in West Springfield about 2 miles apart and probably is continuous. In the north quarry it consists of a single bed which has been opened at least 10 feet thick and the layers dip to the east about 15°. It is the fetid limestone as is also nearly all that at this south quarry. Probably what is called bituminous marlite occurs here (See specimens). Some of the specimens appear to be bituminous.

At the north quarry on land of a Mr. Meachem occur fine encrinites or pentacrinites.

The limestone at the south quarry exists in several beds none of which are as thick as those as those at the north quarry. Between some of these beds is a large protruding mass of greenstone. It seems to have acted somewhat on the limestone. Here is found also concreted carbonate of lime an inch or more wide.

September 18. West Springfield to south end of Mount Tom 15 miles up Westfield River. The layers of slate along this river dip almost uniformly east about 15 to 20°. But a mile from the village is a singular

curve as represented on the next page…

[Notes 3, Page 4]

[Illustration]

At this place coal occurs also nodules of calcareous substance internally divided prisms and irregular masses the interstices being filled with calcareous spar (??? Septaria Sudus Helmontica). These are abundant in many of the rocks but not so perfect anywhere else as at this curve. The rock here appears to be chiefly bituminous marlite or bituminous shale. A few distinct encrinites were found here.

The red shale predominates along this river but the gray alternates frequently and in one instance I saw the red pass laterally into the gray in the space of a few feet. Red slate contains numerous veins of satin spar from a mere lime to an inch in thickness. Common calcareous spar also traverse this and the bituminous shale. Not infrequently are strata of variegated sandstone interstratified with the red variety and exactly resembling that from Nova Scotia. Very commonly the red and gray slate are divided by cross seams of great regularity even not more than an inch or two apart. Sometimes a layer of the red slate…

[Notes 3, Page 5]

…from 2 to 6 inches thick is divided into short columns sometimes of four sides and sometimes more there being sometimes small interstices between them but not always. These layers are said by Esquire Lathrop to effervesce with acids. Indeed the rocks I should say were much more calcareous along this section than I have seen elsewhere and passing sometimes directly into limestone.

We found in the gray slate a most remarkable vegetable impression which extended at least 11 feet in length and 2 feet in breadth and probably this was not by any means its extent.

On the west side of the greenstone range south of Mount Tom are several quarries in the red sandstone where very good stone is obtained. Sometimes rock contains masses of yellow ochre. The rock is often gray.

September 19. On the top of Mount Tom are grooves running nearly north and south which appear at first view to be diluvial: but they probably result from the structure of the rock. Very numerous bowlders of sienite however occur on its southern declivity all the way to the summit although decreasing in size…

[Notes 3, Page 6]

…and number as we ascended. On the very top they are only a few inches in diameter.

The red micaceous slate crops out about 300 feet below the summit on the west side dipping east at an angle of 15 to 20°.

The Southampton lead mine runs not far from northeast and southwest. The gray sandstone in the adit can hardly be considered as slaty though very gray.

From Mt. Tom to Amherst by way of Southampton lead mine 23 miles. Distance the whole tour 63 miles.

*I found blende in the fetid limestone of West Springfield at Meacham's quarry.

September 24. To Whitman's ferry Sunderland and back 20 miles. The shale there lies as nearly horizontal as I can determine. Some of it effervesces slightly with nitric acid and is doubtless bituminous marlite and this variety abundant with ichthyolites.

November 14. To Deerfield Mountain and back 32 miles in search of Lincolnite, etc.

January 1833. To Boston and back on business relating to the survey 190 miles. In the valleys Worcester County particularly on the stage road through West Brookfield Spencer etc. diluvial hills of a conical shape are frequent.

[Notes 3, Page 7]

In West Brookfield I noticed somewhat of a terraced appearance.

In Spencer the gneiss is disintegrated so as to be easily removed by a shovel to the dip of 6 to 10 feet.

The bowlders in Brighton and Newton are a mixture of sienite, greenstone, granite, porphyry, and graywacke.

The trap veins in the conglomerate near Boston run about 10° west of south and 10° east of north.

Distance traveled on my geological tours

	Tour	Miles	Comments
X	1 tour	401	
X	2 tour	826	
X	3 tour	312	
X	4 tour	444	
X	5 tour	90	
X	6 tour	333	
X	7 tour	90	
X	8 tour	52	Several short trips
X	9 tour	96	
X	10 tour	52	
X	11 tour	491	

	12 tour	20	Possibly with Orra to Sunderland twice?
X	13 tour	24	
X	14 tour	165	
	15 tour	30	
X	16 tour	86	
	17 tour	24	
X	18 tour	17	
X	19 tour	63	
X	20 tour	20	
X	21 tour	32	
	22 tour	190	To Boston and back
	23 tour	190	To Boston and back
X	24 tour	177	May 1833
X	25 tour	186	May 1833
	26 tour	45	W Springfield &
	27 tour	94	Excursion to Worcester for geological objects
	TOTAL	4550	

[Notes 3, Page 8]

Amount of travel above 4456

Sept 1833 27th Excursion to Worcester for geological objects 94 miles

4550

[Notes 3, Page 9]

[Illustration]

Granite causeway– Holyoke–tops of the columns
Greenstone breaking through and overlying sandstone, Van Snyder Tavern, Northampton?

[Notes 3, Page 10]

September 17 Geological Tour	
Forage	0.125
Oats	0.125

September 18 Dinner and horse assistant $0.25	0.75
September 19 Supper breakfast and assistant $0.30	0.70
Dinner and oats (Assistant 0.125)	0.35
Bridge toll	0.125
Total	$2.175

[Illustration]

Riverboat

[Notes 3, Page 11]

[Inverted]

August 27 bridge toll	0.125
August 28 bridge toll	0.065
Corn	0.08
Boat at Gill	0.0125
Twine wrapping paper	0.06
August 29 Boatman at Turners Falls	$0.25
Quire of paper	$0.15
August 30th Meals lodging & horse	$1.50
Dinner and horse	0.875
August 31 Supper breakfast	1.50
Dinner and horse	1.00
Quire of paper	$0.14
September 1 Guide to the Glen	$0.25
Bridge toll	0.06
September 3 Dinner and oats	$0.33
September 4 Oats	0.125
Dinner and oats	1.06
September 5 bridge toll and paper	$0.19
September 6 Expenses for board in Deerfield	6.00

September 14 Postage of letters to Pittsfield and Williamstown	$0.20
Freight on barrel of minerals from New Bedford	$0.63
Expenses for transporting minerals from Deerfield	1.00

Geological Notes

August 27, 1832 Set out upon a tour in the valley of the Connecticut. To Deerfield 14 miles.

August 28. To Turners Falls 7 miles thence to the mouth of Miller's River and back 6 miles. The red micaceous slate where first it appears above the most easterly bed of greenstone dips easterly about 50° and runs north and south. The dip rarely descends more than 40° for a mile when we come to a peculiar indurated conglomerated sandstone which has every appearance of having been once partially fused so that the slate was melted in most parts and the direction of the layers changed. It is now nearly as hard as siliceous slate. Although no unstratified rock has protruded through this rock…

[Notes 3, Page 12]

…yet on the north shore the strata are of a spheroidal shape as if a protruding mass were not far beneath.

East of this point the river expands and no rock appears on the shores for nearly half a mile: then its layers assume a direction nearly east and west dipping from 20° to 30° south. This coarse and dip continue nearly to the mouth of Miller's River. Around that point however the slate is very suddenly bent upwards at its eastern edge so that indeed the very spot is visible on the south shore. The strata are not broken but simply bent several degrees and then a few rods they rise nearly to 90° and run a few degrees west of south. Then for some distance succeed a coarse puddingstone whose stratification is so obscure that I cannot determine the dip or direction. Not many rods beyond the conglomerate we come on the south shore to granite and granite gneiss. Hornblende sometimes prevails in this rock forming hornblende slate– sometimes it is distinct mica slate. These rocks dip from 30° to 40° west or rather between west and northwest. The annexed section will give a correct idea of the dip of the strata as above described. The strata in the central part running east and west call of course no dip can be exhibited. I am inclined to refer this southern dip to the ridge of greenstone that runs northeast from Turners Falls into Gill.

Half a mile east of Turners Falls the sandstone is divided by cross seams into parallelepipeds only…

[Illustration] A cross-section across the river from west to east

[Notes 3, Page 13]

…from half an inch to 2 inches thick giving the rock a peculiar appearance. When the slate first dips west near the mouth of Miller's River it is divided by seams into a kind of double wedge shaped masses very much resembling the masses of tobacco taken out of a keg.

In the gneiss east of Miller's River is a distinct vein of greenstone about 2 feet wide visible several rods.

For a considerable extent on the north bank of the Connecticut two quite distinct terraces are shown.

The upper one corresponding I should think with the sandy plain in the north part of Montague and the other about half as high.

The principal bed of clay in the tertiary formation on this river is not less than 30 feet thick in Long Hill south of Wapping and in the hill on which the village of Greenfield stands. The strata are horizontal or varying only to 2 or 3° occasionally.

August 29. The general dip of the slate between Turners Falls and the greenstone ridge is 40°. Red slate appears in patches in several places on the greenstone. I could find only one of the copper veins. This runs nearly north and south passing both into the greenstone and the slate. Its gangue is chiefly the toadstone though accompanied by barytes.

At the junction of the slate and the amygdaloid sometimes rounded masses of the latter is enveloped in broken masses of the former but more frequently the former is broken and mixed with the latter several feet from…

[Notes 3, Page 14]

…the junction.

The trap rock near the junction is all amygdaloidal and contains sometimes prehinte? or mesotype? and calcareous spar with a great deal of foliated chlorite. This rock decomposes easily and the ants (very numerous) have thrown out large quantities of it. This would make good puzzolana probably. Near the junction of this amygdaloid with the slate the former is distinctly stratified the strata being from 1 to 4 feet thick.

Iron sand occurs in granite in quite large quantities and very good on the Montague shore below the falls.

A vein of copper pyrites and variegated copper pyrites occurs on the smallest island in the dam. Its gangue is the gray sandstone forming a breccia and it crosses the strata nearly at right angles its direction being nearly north and south that is it dips to the west while the slate dips east though the direction of both coincides. In the seams of the same rock occur many very pretty lenticular crystals of carbonate of iron though it is not easy to detach large pieces on account of their upon the edge of the slate.

The greenstone extends not more than two or three miles northeasterly from Turners Falls. The southern and eastern parts of Gill are composed chiefly of coarse puddingstone or conglomerate rising six or seven hundred feet along the river. Near the top I noticed diluvial furrows.

About a 1½ miles north of Gill meetinghouse we struck the primary greenstone which in many places exhibits neither a schistose nor a stratified structure.

[Notes 3, Page 15]

In others however both are distinctly visible. The rock is chiefly hornblende a little feldspar being mixed with it and I have no doubt it ought to be described as a variety of hornblende slate. In one place a vein

of fetid white quartz traverses this greenstone and at its sides there are mixed crystals of feldspar.

West of the greenstone occurs a stratum of quartz rock distinctly characterized extended within about a mile east of Bernardston meetinghouse and this as well as the hornblende dip easterly at an angle as high as 50 or 60°.

The bowlders in Gill south part are sandstone conglomerate and an almost equal quantity of quartz rock hornblende and slate gneiss and granite. In the north part of town they are the same except no sandstone or conglomerate. In the south part of Bernardston on the road to Northfield commencing about a mile east of the center and extending at least a mile is perhaps the finest example of diluvial hills and valleys in the state. The gravel is composed of such rocks only as occur north of the spot.

On foot and riding today travelled about 14 miles.

August 30. Bernardston to Brattleborough 12 miles. The argillaceous slate does not exhibit as I can find a stratification at a different angle from the surface of layers although cross seams are not infrequent and sometimes they are parallel for some distance but they do not enter through the whole rock. The layers are generally nearly perpendicular though more commonly leaning east and west. The direction is usually several degrees and sometimes more than 45 degrees east of North. The drawings at the end of these notes will convey the best idea of a singular fracture to which the slate has been subject in its upper part since its elevation. In this case the layers of the…

[Notes 3, Page 16]

…slate are broken and not bent. But there is also exhibited a bending of layers in a lateral direction (See specimens) produced probably by the elevation of the slate and while they were in partially plastic state: for it is rare that they are cracked and this shows that this phenomenon is to be be referred to an earlier epoch than the other. What force it was that smote the top of this hill such a prodigious blow I am unable to imagine. It must have been directed from the east towards the west.

The granite in the argillaceous slate in Guilford extends not less than two or three miles. It has obviously been melted after its crystallization or else was cooled under peculiar circumstances so that much of it is little else apparently but compact feldspar. Perhaps some of this rock is novaculite. The slaty white rock (see specimens) occurs always I suspect in connection with granite or near it and is perhaps a variety of the argillaceous slate changed by heat.

I found an abundance of encrinites in the Bernardston limestone. Hence this is probably the encrinal limestone.

The bog iron ore at this quarry occurs in layers interstratified with the limestone.

[Notes 3, Page 17]

The old red limestone near the lime quarry is remarkably variegated. It is decomposed three or four feet deep. It dips about 10° west.

The banks of the Connecticut just below Brattleborough exhibit at least two distinct terraces.

The clay beds a little south of Brattleborough are inclined normally not less than 0 to 10°.

From Brattleborough to Bernardston through Algiers is 14 miles–27 miles the day's ride.

August 31. To Greenfield by Turners Falls 9 miles thence to Leyden at the Glen 5 miles. Chalcedony in the greenstone in Greenfield.

The sandstone at the west end of Greenfield street are variegated–also in several places on the Leyden road. The dip is generally as high as 20° east.

The Glen in Leyden is a fissure worn out by a large rock in argillaceous slate from 20 to 50 feet deep and 20 to 30 rods long. The rock exhibits numerous scenes of iron stratification and this helps the work of degradation. Two or three times the water falls several feet and the scene is quite wild.

[Notes 3, Page 18]

The contortions of the argillaceous slate at the Glen are often striking.

[Illustration]

This sketch is scarcely an exaggeration (See specimens). Quartz often forms one of these curved layers. Could this have been softened by heat and then bent?

Travel only 15 miles today.

September 1. Leyden to Conway 17 miles. An old grindstone forming a doorstep at Mr. Larabey's in Greenfield is full of what appear to be encrinites some of them more than a foot long. The rock is the red sandstone from Mr. Hoyt's quarry in Deerfield.

In Greenfield meadows are two terraces along the Green River both of which however are low. The upper one occupies…

[Illustration]

Map of falls. A above b 25 feet or so

[Notes 3, Page 19]

…most of the surface. Both these terraces correspond to those which show themselves near Green River bridge where are the marks of an ancient bed of Green River (See the sketch on the preceding page).

The layers of clay in Greenfield are generally horizontal.

At the saw mill half a mile south of the Glen in Leyden the brook has laid bare the junction of the argillaceous slate and the red sandstone. The latter is in unconformable position dipping nearly south about 20 to 30° while the former nearly north and south and stand nearly perpendicular. The sandstone here is a coarse conglomerate and is composed of white quartz and argillaceous slates as a cement

which has been changed to a bright red. At the junction the argillaceous slate is reddened for several inches. The conglomerate is obviously composed of the detritus of the slate and probably heat has converted the iron into a peroxide.

September 3. Conway to Charlemont 20 miles. The rocks at Shelburne Falls appear to be granite–gneiss– having an imperfect schistose structure but without stratification. Quartz predominates in this rock and hornblende slate is associated with it exhibiting numerous contortions though rather more of stratifications than the gneiss. It occurs a mile before we reach the falls and continues to the new bridge into Charlemont. On the way it is very distinct in its character…

[Notes 3, Page 20]

…and very perfectly stratified. Sometimes it dips east from 10 to 20° and sometimes west. I should think that the west dip predominated.

For a mile below Shelburne Falls a quantity of bowlders some of them very large is very great literally covering the bed of the river. The rock in place is full of seams and large blocks may be seen more or less moved from their original position.

Near the bridge in the east part of Charlemont to about 2 miles west of the meetinghouse the rock is mica slate and the layers of strata are nearly perpendicular generally however leaning a little to the east. Their direction is nearly north and south. Talcose slate however commences about 2 miles west of the centre of Charlemont.

No terraces appear on Deerfield River to the village 2 miles west of the meetinghouse where a small stream empties from the south. Here the mountains crowd close to the river forming a basin above the gorge and two terraces are very obvious above the present meadow which forms a third taking the bed of the river for the lowest point. They are not as high as those in Deerfield and Westfield but correspond to those in all other respects.

September 4. From Hawley to Heath 6 miles.

September 5. Heath to Colrain 7 miles mica slate all the way. Strata nearly perpendicular though leaning a few degrees to the east till…

[Notes 3, Page 21]

…we come to within 2 miles of Colrain when they begin to lean a little west.

20 rods south of the meetinghouse in Heath are several examples of diluvial scratches though not very striking.

Colrain to Deerfield 13 miles. Part of the trap Deerfield River cuts through the ridge is tuff and some of it is amygdaloid. The tuff abounds in this ridge and sometimes the columnar variety lies above it and sometimes below it traverses the other varieties in the form of veins.

September 6. Travelled 8 miles in Deerfield. Could not find the junction of sandstone and mica slate in Wisdom. The dip of the sandstone is about 15 or 20° in Wisdom. Encrinites abound in a slaty variety in

an abandoned quarry near the widow Jonathan Hoyt's. Those lying in the direction of the layers are compressed: those crossing the layers are cylindrical and sometimes an inch in diameter. Sometimes they are ramified.

September 7. Deerfield to Conway 8 miles.

At Long Hill in the clay beds is abundance of encrinites found in this tertiary formation. They occur also in Deerfield a little east of the Academy. In neither place are they much harder than the clay.

In the northeast part of Greenfield the upper part of the clay beds consists of this layer of clay separated by layers of loam or sandy clay. The bed of clay in…

[Notes 3, Page 22]

…Deerfield east of the Academy rises from 30 to 40 feet above the plain and it has been dug into 25 feet without reaching the bottom. At Long hill the clay cannot be less than 60 feet thick above the surface–but whether it extends deeper I know not.

At a clay bed a little east of the Academy is generally horizontal in its layers: but a stratum about 3 feet thick presents singular contortions a sketch of which is given over the next leaf. It extremely resembles certain beds of mica slate–how to explain this case I find very difficult.

September 8. Conway to Amherst by way of Whitman's ferry 18 miles. The meadows in Pine Nook are terraced–one rising above the meadows but not so high as the general level of the tertiary along the Connecticut River. Similar terraces occur in Sunderland opposite. Encrinites occur in considerable quantities in the trap rock near where it crosses Connecticut River. Traveled on this tour 65 miles.

[Illustration]

Contortions in mica slate–Conway

[Notes 3, Page 23]

September 11. From Amherst to Deerfield and back 30 miles. In going from the north part of Amherst to Connecticut River we pass over an extensive sandy plain and then descend to a second terrace–to a third which forms the present meadows and which cannot be less than 50 or 60 feet high. On the opposite side of the river I could find only two terraces–the meadows and the general level of the tertiary formation.

At the east foot of North Sugarloaf the layers of clay dip to the east from 5 to 10 degrees. In this clay we find quite a variety of organic remains of the encrinites tribe.

[Illustration]

Rock about 2½ feet diameter; granite veins in micaceous limestone west part of Colrain.

[Notes 3, Page 24]

Expenses Incurred upon a geological survey of the Commonwealth 1832

May 8th Fitting a leather bag for hammers	.375
May 11th Stage fare to Worcester	2.25
Breakfast dinner supper and lodging	1.375
May 12th Breakfast	0.375
Stage fare to Providence	1.50
Passage from Providence to Newport and dinner	1.50
Coach from steamboat	0.50
Boat to visit Ft. Adams	0.50
Shaving and crackers	0.13
May 14th Horse and chaise 5 miles Newport to ____rocks	1.25
May 5th Board for three days	2.75
Stage fare to New Bedford	2.25
May 17th board 1.5 days	1.50
Fare from N Bedford to Nantucket	2.00
Breakfast and dinner	0.50
May 19th Board for two days	2.00
Board for Mr. Belcher	2.00

[Possibly Nathan Belcher 34; see letter to Silliman 1834]

[Notes 3, Page 25]

May 19th Passage from Nantucket to Holmes Hole	1.50
Ditto for Mr. Belcher	1.50
Dinner for each of us	0.50
Ride to Chilmark 10 miles	2.50
May 21st from ___ to Gay Head for myself and Mr. Belcher	1.25
May 25th Board for three days	2.125
Dtto for Mr. Belcher	2.125
Barrel for minerals	0.25
To bag for specimens	0.10
Passage to N Bedford	1.25
Ditto for Mr. Belcher	1.25
Box and paper for minerals	0.62
Carting baggage and minerals	0.17
May 25th Let Mr Belcher have five dollars	5.00
Paid also his bill	0.56
May 28th Board four days	4.00
Working six articles	0.375
Stage fare N Bedford to Providence	3.00
To porter	0.26
June 1st Horse to Cambridge from Boston	1.00
Horse keeping and blacking boots	0.25
Bridge toll	0.08
Stage fare from Boston to Worcester	2.30
June 2nd Day's board	1.00

Horse and chaise to quarry in Worcester	0.50
Stage fare from Worcester to Amherst	2.25
Dinner	0.375
Carrying trunk	0.125
TOTAL EXPENSES	59.72
Paid for Mr. Belcher	14.56
My own expenses	45.12
June 15th postage of three letters to Duxbury, Taunton, and Philadelphia	0.43
Ditto of me from Philadelphia	0.1875
Ditto of excursion of one day with Mrs. H to take landscape Sugarloaf–expenses	0.50
June 21st Excursion of 2 days with Mrs. H. to take landscape	0.25
June 28th Paid for sawing out flexible marble	3.00
July 14th Paid freight of box of minerals to Boston	1.25
Letter to Newport	0.125
August 15th expenses during a day spent in collecting and drawing on Mt. Holyoke	0.825
Postage on letter to Philadelphia	0.19
September 14th Letter to Pittsfield and Williamstown	0.20
Freight on barrel of org. sem. From N Bedford	0.63

[Notes 3, Page 26]

March 11 183_ *[This appears to be an error; should read May 11, 1832.]*

[The last digit is missing in the notes but this should probably read 1832. These notes seem to be in roughly reverse order, starting with page 2 Sept 17th, page 6 Nov 14 and Jan 1833, page 11 Aug 27th, page 26 May 11th, page 32 May 23 (insert)]

Geological Notes.

May 11. Amherst to Worcester 45 miles. In several of the valleys of Worcester County diluvial action appears to have been very powerful and numerous conical elevations with their corresponding depressions appear not usually in the lowest part of the valley but after ascending one or two hundred feet. I noticed one in Enfield extremely irregular which might easily be mistaken for an artificial mound. (A similar one occurs in Deerfield at the Bars–foot of Long Hill one side of which is worn away so as to show its stratification).

Four miles west of Worcester towards Paxton the transition mica slate occurs dipping about 20° west.

[Notes 3, Page 27]

The Worcester granite is decidedly stratified in layers from 4 inches to 12 inches thick–not all schistose.

May 12. Worcester to Providence 40 miles. Gneiss all the way running northwest and southeast and dipping northeast nearly at an angle from 10 to 30°. Passed down the Blackstone River. The marks of diluvial action are decided. Some of the bowlders particularly in Uxbridge are very large–from 10 to 12 feet in diameter–are very numerous. In the south part of Uxbridge the diluvial ridges and cavities abound. In Smithfield just after passing Slatersville we struck upon a delicate kind of mica slate out of which whetstones are made. Its dip and direction are very irregular though the prevailing direction is southeast and northwest and dip east not more than 10°. This slate extends as much as 2 miles–then succeed gneiss again until within half mile of the lime quarry we strike the greenstone which has a dip and direction as though the dip is not less generally than 30°. It seems to be a variety of gneiss though it is associated with sienite into which it passes towards Providence. This rock and the greenstone seem to alternate and about 3 miles before reaching Providence the diluvial remains of a tertiary formation cover up most other rocks. This sand appears for eight or ten miles on both sides of Narragansett Bay below Providence. Occasionally however graywacke slate is seen on the east shore its the dip and direction are very irregular: but in the west shore its direction is about north and south

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and the dip of the layers east not more than 10° or 15°. Providence to Newport 30 miles.

The new fort at Newport is based on graywacke slate approaching argillaceous slate and often a little talcose. Sometimes it has an aspect somewhat mechanical or brecciated. It is traversed by numerous small bands of white quartz or white quartz mixed with flesh coloured feldspar. Near the fort it has a dip of 5 to 10° easterly and occasionally exhibits a cross stratification–the cross seams however not entering sometimes through the whole edge and seeming to be the result of desiccation merely. Near the fort a portion of the slate is converted into hornstone and jasper–the two minerals often exhibiting a brecciated appearance. Magnetic iron ore also exists in the same mass. Is it not evident that the operation of heat has converted the slate into hornstone and the magnetic oxide of iron into the red oxide which penetrated a portion of the hornstone converted it into Jasper? There is no doubt that granite underlies the slate and that too at a small depth since it appears on both sides of it at no great distance. From Newport to Fort Adams and back 5 miles.

Near the fort also on the east side appear two ledges of remarkable limestone one of them projecting from the shore into Newport Harbour and the other forming a small island in the midst of the harbour. It is entirely destitute of stratification and is surely or quite as hard as quartz having become very compact. It is of a white or bluish colour. There can be little doubt that its proximity to granite has produced the change in this rock above referred to.

May 13. I find the above limestone in a narrow and irregular bed in graywacke slate extending to a bed of serpentine on the south side of the harbour. The serpentine is usually black and compact in its grain and is…

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…accompanied by veins of neritic and talcose slate. It may be a vein at least for a part of its course for it appears at several places for a distance of more than a hundred rods and towards its southwestern extremity it seems to pass through siliceous slate.

Between the serpentine and the granite is a broad and irregular range of rocks which in some places exhibits a decidedly porphyritic in appearance–in others the base is reddish with an amygdaloidal appearance resembling exceedingly the Hingham amygdaloid. In other places it appears like hornstone and in others like compact feldspar. But in general it appears to be graywacke slate indurated or converted into siliceous slate the slaty structure being distinctly visible. The granite sends off veins several rods into the micaceous slate and in two of these places particularly on the coast the junction of the two rocks is distinctly visible they being chemically and most fixedly united so that the point of junction is scarcely visible. The granite is mostly feldspar and quartz and the feldspar in the vein is red.

Veins of feldspar or of graphic granite are common in the granite itself and frequently the vein is cut off by a lateral movement of one part of the granite containing it so that the two ends are several feet apart one 20 inches wide which has been slidden 7 feet and have halted.

This granite about south of the village of Newport cuts off the graywacke slate at right angles to the direction of its layers. For a few feet only the slate becomes siliceous.

Further north along the coast the slate is remarkably contorted and dips in various directions–generally running however either north and south or east and west. In one place the strata are beautifully…

[Notes 3, Page 30]

…mantle shaped being folded so as to form a paraboloid the longer axis dipping to the north from 10 to 15°.This rock is chiefly a dark coloured shale which contains occasionally thin buds of anthracite: also nodules of argillaceous iron ore and clay iron ore. In one place the strata are singularly disturbed in the vicinity of the coal a sketch of which I have taken and Col. Totten took another. His is the best. At this spot the shale contains an abundance of vegetable remains as gramine ferns and equisetaceae. Colonel T. informs me that these organic remains may be obtained in considerable quantities at Portsmouth. The beds of anthracite on this coast are only a few inches thick. In the war of the revolution the British soldiers after destroying all the wood upon the island made an attempt to obtain coal at this locality.

[Col. Joseph G. Totten (1788-1864)]

In the southeast part of the granite range is an excavation on the coast worn out by the waters called the Spouting cave. The water drives in during strong winds is often thrown into the air 30 feet above the surface of the rock and the fissure cannot be less than 20 feet deep. I could not discover that a vein of any softer kind of rock once occupied the place of this fissure.

In the southeast part of the island is a still more remarkable fissure called Purgatory in coarse puddingstone. It is 6 to 8 feet wide 60 or 70 feet deep and it is worn into the rock about 7 rods. The sides are almost exactly perpendicular. This rock is subject to numerous cross fissures and it is the wearing away of the portions of rock between two of these fissures that has produced this excavation.

In the southeastern part of the island are three very remarkable varieties of graywacke if they may be so

called. The one is the coarse puddingstone abovementioned the other a schistose and stratified rock composed chiefly of coarse grains of what appears to be black quartz cemented by mica or talc or both. This occurs in the most southeast point of the island. It dips at an…

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…angle not less than 80° to the east and runs north and south. I believe a little farther east on the east shore of the island the common gray slate of the island– halfway between graywacke and siliceous slate occurs.

Half a mile to the west of the peculiar quartz rocks above described as we pass along the beach we are struck with some remarkable and bold ledges 80 rods from the shore. These high bluffs appear with valleys between them which at their southern extremity are from 15 to 20 rods wide and so low as to be marshes through which small brooks run. These valleys however become narrower and narrower as one goes north until the ridges nearly or quite unite into one.

[Illustration]

The relative position of these rocks is as in the figure above. The direction of the strata or layers in the middle ridge is north and south and the dip west 60 or 70°. The sides of all the sizable ledges particularly the two most easterly ones are very steep. The puddingstone is divided by seams parallel to one another and perpendicular to the horizon as shown upon the figure above. The eastern ridge of conglomerate is the most remarkable. On its western side it has a slope dipping west 50 or 70°. Is also divided by thick seams into layers which are horizontal from 6 to 10 feet thick. These seem to be true strata seams. The pebbles are generally ellipsoid and cemented by a paste which is both micaceous and talcose and the longest diameter of the pebbles always corresponds with that of the schistose structure. These embedded varves vary in size from that of a pigeons egg to four…

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…five and six feet in the longest diameter. Nine tenths of them are granular quartz. The other various kinds of slate. The cross seams of this rock have divided the pebbles as completely as if cloven asunder by the sword of some Titan–and an end view of the rock thus divided presents a quite singular appearance.

This puddingstone is found in several other places to the west of these ridges. Sometimes it is traversed by veins of white quartz not less than a foot in diameter and from the principal vein smaller ones branch. The quartz divides the smallest as well as the largest pebbles in such cases and is chemically united to them.

The rock which occupies the western half of the middle ridge sketched above is a hard graywacke slate. The eastern side consists of a rock to me unknown. Specimens must be examined after to determine what are the simple minerals entering into its composition. In this rock I found a vein of mineral which is probably either tremolite or…

[Skip to page 40]

…zoisite. It is about 4 inches wide.

Colonel Totten informs me that on Conanicut Island the slate containing a great abundance of staurolite seems to be real clay slate. On Prudence Island it is full of that peculiar micaceous looking mineral so abundant in the bastard mica slate of Plainfield etc. Mass.

Bowlders of the porphyritic iron ore of Cumberland Rhode Island a few inches dimeter are not infrequent at the southern extremity of Newport. On the puddingstone near the southwest part of the town are a few diluvial scratches running north from 10 to 20° W though not very distinct.

I traveled today May 14 about 7 miles on foot two in a boat and 10 in a chaise.

May 15. From Newport to New Bedford 30 miles. The only slate along the road was about halfway to Tiverton Bridge running nearly northwest and southeast and dipping but a few degrees to the northeast. At Tiverton I say the peculiar black quartz rock which occurs on Rhode Island its southeast extremity and at Tiverton it rests upon the granite. Its extent is small. Then we strike ledges of granite for two or three miles–after which we strike only one ledge of rock in place (granite) and that is upon a stream I believe in Dartmouth. All the way however the region is full of bowlders almost all of granite some of them beautifully porphyritic the embedded crystals being flesh red and very large and the grain of the rock rather fine. Occasionally however bowlders of puddingstone from one to eight feet diameter are seen and sometimes quite numerous. As we approach New Bedford we occasionally see bowlders of gneiss.

May 16. Huge bowlders occur in New Bedford of a most beautiful porphyritic gneiss the crystals of feldspar being flesh coloured and about the size of hazelnuts.

Rev. Mr. Holmes informs me that in a pond in Carver are masses of stone which have traveled several feet and he thinks towards the shore. The tracks in the mud is distinct.

Mr. T. S. Greene has in his possession a mass of light coloured amber three or four inches across found at Nantucket.

Very beautiful graphic granite is found in New Bedford.

May 17. From New Bedford to Nantucket 60 miles. Lieutenant Prescott informs me that he found portions of cedar maple oak and beech trees some of them in an erect position 1/3 of a mile from the shore in Nantucket Harbour and 4 feet below the surface of the sand and about 8 feet…

[Notes 3, Page 42]

…below low water mark. He obtained peat also in the same place. He says that a current sets around the northern extremity of the island and thus he thinks conveys the sand into the harbour although the there is no evidence that the passage is filling up. A few years since during a violent gale a cliff on the southwest shore of the island was worn away 50 feet. He says that there are a few bowlders on the island of several tons weight. And that all the bowlders and pebbles are primary rocks. Mr. Coffin says that there are only about four very large bowlders say 60 feet diameter on the island. Peat swamps are very abundant. The surface exhibits strong marks of diluvial action though the sand is by no means as much piled and excavated as on Cape Cod. Lt. Prescott is of the opinion that the strata of clay here

dipped slightly toward the south. Shells are frequently found here in digging for wells.

May 18. Four specimens of Buccinum *[sea snail],* crepidula *[slipper shell],* natica *[sea snail]* etc. on the sandy cliffs a mile north of the town. The cliff and its upper part is from 50 to 90 feet high and the sands are more or less driven inward. The shells above mentioned occur in the excavations several feet deep which has been made by the winds and they are very much worn by water so as in many instances to be reduced to mere fragments. I am rather inclined to refer them to the diluvial current which has swept over the island though they may belong to the tertiary beds below. The clay beds are 30 or 40 feet below the top of the cliff. Lt. Prescott is of the opinion that these beds dip a few degrees towards the south and from all I could learn…

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…at the cliff above-mentioned I should be inclined to adopt this opinion though its situation is not favorable for determining this point. The clay is generally dark blue though sometimes white and resembles exceedingly the clays on the Vineyard. In this clay I found a zoophyte fossil (See specimens).

Bowlders of 3, 4, 5 and even 6 feet diameter are not infrequent among the sand. Generally they are of granite or of granular quartz.

Area of Nantucket Island according to Lieutenant Prescott 29,380 acres
Of Tuckernuck Island 1192 acres
Of Grand Island 3 acres
Of Muskeget Island 15 acres
Total 30,590 acres.

1050 acres are fresh pond: 750 peat swamps the layers being from 1 to 14 feet thick of good quality and used. Lt. Prescott says the bowlders are of granite and gneiss. Marine shells he says are found from 10 to 60 feet in depth all over the island. The mean rise and fall of the tide at Nantucket is three to four feet.

Lieutenant Prescott thinks that for several miles the east side of Nantucket has worn off three or four rods within 50 years. Smith's Point the southwestern extremity which is a low sand beach is liable to great variations. At the time that Mr. Barnes constructed his chart of this coast in 1772 this beach was nearly as at present. But since that time it has been shortened one or two miles and again lengthened out. On his chart which Lieutenant P. finds to be very accurate it is stated that 30 years before the entrance of Chatham Harbour was 2½ miles farther north than it then was–a sand beach having extended that distance in 30 miles.

Dr. Swift carried me to the south shore of the island–an excursion in the whole of 10 miles. The island shows much less of irregularity and diluvial action...

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…than I had supposed though bowlders are scattered all over it. Downs exist on the south shore only a few feet high however and almost fixed by the beach grass. A little out of town I noted the slight ascent of the plain on every side as I did on Cape Cod though less striking perhaps. The trembling of objects near the horizon indicates much inequality in the refraction of the atmosphere.

A well digger in Nantucket found a large quantity of shells 30 or 40 feet below the surface in digging a well–the mass seeming to have a dip to the north and resembling masses of shells which are now thrown up by the sea. These were sent in large quantities to Brown University and Harvard and were labeled. I obtained a specimen of *Strombus carica [conch]* which was got out 47 feet below the surface. The mass of shells above mentioned consisted of *Pectus linko [scallop], Mactra solidissima [clam]–Venus mercena* and *castanea [clams]–Crepidula fornicate [slipper shell]–Meirim carica [whelk?]– Solen ensis [razor clam]* and *Arca [ark clam].*

May 19. Nantucket to Chilmark by way of Holmes Hole about 50 miles. The captain of the Falmouth packet informed me that the stumps of cedar trees have been found on the north side of Cape Cod at Yarmouth extending more than 3 miles into the bay. I understand it to be Barnstable Bay. At low water part of this bay is bare and part covered with one or two feet of water. I could not learn any about a submarine forest at Holmes Hole. Though a pilot told me that on the west side of the harbour he had seen what looked like a swamp or marsh and another man said he believes some cedar stumps had been found formerly toward the lighthouse in shallow water. Mr. Allen of Chilmark tells me that cedar stumps have been found on the northwest shore of the Vineyard near Gay Head. He says also that peat is abundant…

[Notes 3, Page 45]

…on the Vineyard and is used considerably for fuel. Iron ore also occurs abundantly and is dug particularly in the northwest part of Chilmark. I found the argillaceous oxide abundantly on a cliff in the southeast part of Chilmark. White clay is done in various places in the interior of the island. The southeastern side of the island is generally much lower than the western where are hills of considerable altitude covered with huge bowlders. At Chilmark these bowlders are so numerous and large on many hills that I have little doubt that the hills beneath were composed of ledges of granite. I am the more confirmed in this opinion by finding in the cliff in the southeast part of the town such evidence of great disturbance in the supercretaceous rocks of this island. Very much of the clay here exhibits no schistose structure and in other cases it is so washed by veins on its surface as to obliterate the traces of such a structure. But in other cases the layers are quite obvious and as much distributed upheaved and contorted as the graywacke slate in the southeast part of Newport Rhode Island which I have had made a sketch. I had attempted to do the same with a few rods of the cliff in Chilmark and it needs only to be hardened to become genuine graywacke in appearance.

A rocking stone of several tons weight exists in Chilmark.

In crossing the shrub oak plain in Tisbury the oaks being uniformly almost from 3 to 5 feet high I noticed an apparent ascent on every side.

On the next page is a sketch of a cliff of clay and gravel in Chilmark. Sometimes the strata layers are saddle shaped thus

[Illustration]

Sometimes they dip northerly only a few degrees for several rods.

[Notes 3, Page 46]

[Illustration]

Cliffs in Chilmark Martha's Vineyard tertiary formation

May 21. Chilmark to Gay Head 7 miles. Diluvium all the way except here and there the subjacent clay and sand appears. The granite bowlders are so numerous in Chilmark that I can hardly doubt but they constitute the broken upper portion of a ledge.

The fossil bones at Gay Head are contained in a conglomerate the pebbles mostly of quartz and the cement chiefly ferruginous. It is usually not more than one or two feet in thickness and abounds in bones. These have been evidently somewhat disturbed since the animal died but I think not rolled much. Indeed in one cliff I saw a succession of vertebrae for 10 to 12 feet one or two occasionally wanting as was also the head that I think it must have died…

[Notes 3, Page 47]

…near or on the spot. Some of these vertebrae were not less than 9 inches across and nearly as much in the direction of the spine. Sometimes this conglomerate (I do not call it breccia for the fragments except the bones are all rounded) is so full of iron that it is little else but nodular argillaceous oxide of iron. Sometimes it is a coarse ferruginous red sandstone. His situation is very irregular in the cliffs. In one instance it forms an oblong basin the two sides at one extremity not being more than a rod apart. This is a section of this basin across its shortest diameter.

[Illustration]

In other cases this rock alternates with sand but generally it lies above the clay of the formation. It generally lies a little below the diluvium and has suffered from diluvial action but in one instance at least (see section) a stratum of clay lay above the conglomerate. It is often as hard as graywacke. The bones are sometimes almost entirely mineralized but generally only slightly so. Iron appears to be mineralized. The puddingstone abounds with balls of radiated pyrites. Very many of the bones are black and can hardly be distinguished from pebbles.

In the same cliffs we find spherical masses of what I call pea iron ore and associated with distinctly petrified shells I believe two genera, one of which is a *Venus*.

The layers of clay sand and conglomerate at this cliff seem to have a general dip nearly north though perhaps a little northeast from 20 to 45°. There is however in this respect a good deal of irregularity and not a little difficulty in determining the dip or amount of the powerful disintegration…

[Notes 3, Page 48]

…which is here going on. No spot could be more reposed to the buffeting of the elements.

May 22. I have found today several species of alcyonite in a stratum of green sand and ferruginous sand towards the north part of the cliff and hence this sand probably lies toward the upper part of the formation. In the ferruginous sand occur a venus and a tellina petrified; also in the green sand distinct

fossil crabs (cancer)–also a trunk and numerous vertebrae and some teeth. In the green sand occur rolled masses of a peculiar puddingstone which contains much bitumen and sometimes fossil zoophytes.

In the osseous conglomerate and also in the clay are masses of radiated pyrites often abundant from 1 to 3 or 4 inches diameter the surface being covered with the crystals.

May 23. I find that some of the beds of lignite at Gay Head are from 4 to 6 feet thick dipping northerly at an angle of 40 to 50°. Much of the bed however probably contains too much clay and sand to be …

[Notes 3, Page 32*] [Smaller booklet inserted]*

(May 23)

…burnt with facility.

At the foot of the cliff I found a mass of what I called graywacke slate on which are several most distinct impressions of leaves. This probably came from the continent. (Query–May not this be argillaceous oxide of iron?)

I find also that the slaty oxide of iron occurring here contains several most distinct impressions of the leaves of dicotyledonous plants. Also another most singular impression which I should take for the flower of a syngenesial plant were it lawful to call any impression a flower

[Notes 3, Page 33] Insert

Argillaceous iron ore very frequently forms around branches of trees converting them into lignite and leaving by decay a hollow through the nodules.

Most excellent examples of columnar argillaceous iron ore occur here. They (the columns) one or two inches diameter sometimes arranged side-by-side like the columns in a basaltic mountain. It constitutes the central part of nodules in the column the structure seems to have been produced by desiccation. When the nodule is spherical the cracks are irregular. But the mystery in both cases (which I cannot explain) is why the central parts of the mass should shrink and crack while the external part remains unaffected.

The quantity of argillaceous ore here is very great–I doubt not that 100 tons might may be collected without digging. Judging from the specific gravity it might be of good quality. It is a various colours from gray to red–occasionally by the abundant intermixture of the red oxide of iron. Sometimes the nodules of the argillaceous oxide are the red oxide. The scaly red side occurs here resembling red sandstone.

Found today a tellina? embedded in what I have suspected to be an abygnite–both of them in the green sand. Also another shell which is suspect to be isocardia.

Some of the bowlders at the foot of the cliffs are enormously large…

[Notes 3, Page 34] [Insert]

…one not less than 30 feet in one direction. The following is a sketch of a bowlder in this place with veins of granite of different epochs.

[Illustration of Bowlder]

1, 2, 3 granite veins contemporaneous, 4 a subsequent vein cutting the others

The argillaceous oxide of iron found at Gay Head is sometimes beautifully mammillary even becoming botryoidal. The same variety occurs in still larger quantities as I am informed by G. A. Greene in Chilmark west shore–4 miles east of Gay Head.

Sulphate of iron is frequently seen at Gay Head effervescing on the clays.

May 24. From Gay Head to New Bedford in an open boat in three hours with a wind–28 miles–

May 28. New Bedford to Boston by way of Fairhaven, Taunton, etc. 62 miles. For two or three miles up the river from Fairhaven a gneissoid rock prevails of a dark…

[Notes 3, Page 35] [Insert]

…aspect. At length it becomes porphyritic in granite the embedded feldspar being of a deep red and sometimes the crystals very large. Mica slate prevails along with the gneiss and some masses of granite having an agatized appearance similar to the agate rock in Rochester and probably connected with it. Where I saw the strata distinctly the course was not far from northeast and southwest and the dip largely northwest. The granite prevails frequently in place for eight or ten miles when we come to diluvium. In the most southerly of the Middleborough ponds are lots of ledges of rock, but I know not of what character. Yet not far from this place the graywacke commences and continues to Taunton. Indeed it continues two or three miles beyond the center of Easton where we strike the sienitic granite. This becomes almost greenstone in Sharon. It there is sometimes a liable to disintegration and sometimes assumes a slaty structure through a part of the mass.

On this sienite in Sharon I noticed one or two instances of diluvial grooves bearing a little east of south. Also…

[Notes 3, Page 36] [Insert]

…On the puddingstone in Dorchester though not very distinct.

Bowlders of sienitic granite are scattered all over the place around Taunton especially on the north increasing in number as we approach the rock in situ.

June 1. Boston to Worcester 40 miles. A little beyond Framingham the gneiss commences and for several miles the strata run nearly east and west dipping from 20° to 50° north. As we approach Worcester the direction becomes more and more northeast and southwest. Quartz rock and hornblende slate form a part of the series.

June 2. To the granite quarries in Worcester 2 miles and back again. This granite occupies the hill lying northeast of the village the quarries being on all the declivities and at the summits. Here is a distinct

stratification. But on examining the whole hill it appears that the strata dip from the apex on every side and envelop the hill like the coats of an onion. In some parts of the hill too this division of the rock into concentric layers entirely disappears. Hence I infer that this apparent stratification is not really such but results from some peculiarity in the mode of formation. In this granite are…

[Notes 3, Page 37] [Insert]

…several extensive seams crossing the strata. Seams at various angles and these appear to be mostly faults–this strata seams on the sides not corresponding with one another. Generally these seams have a direction between west and north and the sides of the rock that compose them appear as if one had been slidden over the other when in a plastic state, an appearance very common in the granite of New England.

Worcester to Amherst 45 miles–nothing new.

I was employed in geology on this tour only 16 day–the remainder of the time upon my own private concerns.

I have traveled during this excursion 491 miles.

June 6. I have ascertained that a part of the remains of one of the plants I found in a fossil state at Gay Head is converted into amber and another part into coal.

August 15. Found today at Rock Ferry Hadley the junction of sandstone and greenstone the former cropping out beneath the latter at an angle between 10 and 20°. The greenstone near the junction is generally amygdaloidal and contains veins of indurated clay or probably fine argillaceous slate. Sometimes the mica…

[Notes 3, Page 38] [Insert]

…is visible. The greenstone and clay are often curiously brecciated. A part of the greenstone near the junction is columnar and passes under the river the upper ends of the columns being very perfect and presenting the giant's causeway in miniature. The columnar and amygdaloidal trap alternates or is strangely intermixed. The columns of greenstone lean to the east from 20 to 30° and this in their general position in Holyoke.

About 1 mile south of the prospect house the columns are 30 or 40 feet long and from 1 to 4 feet diameter. Their lower portion is often worn away leaving the upper portion projecting often two tiers and in such case the lower extremities are converse or rather paraboloid and sometimes even lenticular. Portions cleave off from the bottoms of the columns resembling basins or bowls. I can not but think that this peculiar cleavage results from an original connectionary structure. All the columns at Holyoke are from 4 to 6 sided. When they branch up much smaller they are frequently three sided and rarely six sided.

The sandstone beneath the trap of Rock Ferry is in some places decidedly columnar so that at first view a person imagines…

[Notes 3, Page 39] [Insert]

…he is looking at greenstone–although this columnar structure is less perfect than that of the greenstone. The schistose varieties are not columnar. And near the high greenstone columns on the west front of Holyoke a slaty sandstone crops out immediately beneath the trap and then still lower down a gray sandstone which exhibits a columnar tendency. This variety of sandstone is grayer sometimes variegated and appears exceedingly like a rock that has been subject to high heat. In some places it has become considerably crystalline so that in hard specimens it might be mistaken for a fine granite.

[Geological Survey Notes 4 (1833)]

[Notes 4, Page 1]

Expenses of geological tour

May 2, 1833		
	Ferriage	0.125
	Oats	0.14
	Dinner and oats	0.395
May 3		
	Supper breakfast lodging and housekeeping	1.00
	Oats	0.73
	Dinner and hay	0.28
	Oats and turnpike gate	0.15
	Two other gates	0.08
May 4		
	For supper breakfasts housekeeping	0.81
May 6		
	Board and housekeeping two days	3.10
	Ferries and tollgates	0.375
	Dinner and oats	0.45
	Tollgates and minerals	0.20
May 7		
	Lodging breakfast and housekeeping	0.66
	Horse dinner and tollgate	0.50
May 8		
	Supper, lodging, toll, breakfast, dinner, horse	1.15
	Oats and bridge toll	0.19
	Total	$9.79

[Notes 4, Page 2]

[In pencil]

Goldfuss. Table 31 Fig. 8 & 9.
Scyphia resembles one of the Gay Head specimens.
Plate VII Fig. 2 & 3. Thomson. Philosophical Society of Philadelphia.

Somewhat resembles the Gorgonia from West Springfield

[Notes 4, Page 3]

May 7 *[This page seems to be out of place; it belongs after May 6 below]*

[Notes 4, Page 4]

May 2, 1833. Amherst to Windsor 35 miles.

In Goshen on the road to Cummington I took the dip of the mica slate with the clinometer of college and found it 30° north. This mica slate is at first a little west of the Baptist meetinghouse nearly east and west. As we dip nearly down the hill it gets around to southwest and northeast. And finally north and south and the strata lean a little to the west. Further west and nearly to the west line of Cummington they stand about perpendicular. Then they begin to lean to the west that is dip east at an angle of 70 to 80°. Such is the dip of the chlorite slate at the steatite locality. The serpentine at that place appears at the foot of the hill a little distance from the chlorite slate and is distinctly stratified and even has a decidedly schistose structure–the layers standing about perpendicular.

From this spot to Windsor the prevailing rock is talcose slate. But within a mile of the west meetinghouse we strike decided gneiss which continues to the meetinghouse. This and the talcose slate dipped easterly 70 to 80°.

For 3 miles east of the meetinghouse we found repeated examples of diluvial grooves on the rocks running exactly northwest and southeast. These being on such elevated land are fine examples.

Nearly one half of the stone walls in Windsor are made up of granular quartz bowlders.

[Notes 4, Page 5]

Dr. Wells informs us that he knows of no limestone in Windsor or in any of the mountain towns north or south except in bowlders and these are now getting to be rare.

May 3. Windsor to Cheshire 8 miles. Three miles northwest of Windsor found bed of serpentine on farm of Samuel Chapman. It appears only in large bowlders. It resembles that in Zoar and part of the mass is real steatite. The rock surrounding it is gneiss alternating with mica slate. This gneiss formation continues a mile farther northeast than this place. As we begin to descend the the steep hill into Cheshire we meet with quartz rock unstratified with gneiss and dipping north about 25 degrees for 600 or 800 feet. Part way down we strike limestone and granitic quartz in place. The dip and direction of the strata west of Windsor meetinghouse is extremely various–sometimes it dips west at a large angle and sometimes east more commonly perhaps the latter.

The shape of the valleys on the northeast side of Windsor is very favorable to the rolling up of bowlders by diluvial action and the high level at which we strike the quartz rocks takes away from the improbability that they might have been thus removed. Some of the quartz bowlders in Windsor are six or ten feet diameter.

Cheshire to Lanesboro 5 miles. Crossing a ridge of saddle mountain mica slate and micaceous limestone the rocks. At first the strata stand nearly perpendicular then they dip east from 60 to 80°. The layers are glazed and contorted very much and the rock abounds with quartz.

Lanesboro to Hancock 5 miles.

[Notes 4, Page 6]

Limestone and mica slate dipping east 30 to 60° and running north and south. I saw no clay slate. Half the stone walls in Hancock are graywacke. West of Hancock I saw no mica or slate in clay slate in place.

Hancock to Nassau (south part) 13 miles graywacke and graywacke slate all the way–rarely seen in place and generally no stratification visible. In Stephentown I saw this slate dipping west at a high angle. West of this the rock generally leans a little west often nearly perpendicular. (In the east part of Stephentown appears a blue compact limestone which dips east though its dip is indistinct.

Nassau to Troy 13 miles. Graywacke slate sometimes argillaceous–dip from 60 to 80° east. Sometimes it is gray and sometimes reddish. It disintegrates entirely and forms a fine material for roads.

From Stephentown to Troy the country is covered with the diluvium growing finer as we approach the Hudson and 5 or 6 miles from the river is presented one of the best examples I have seen of diluvial elevations and depressions. They are on a large scale.

May 4. Troy to Albany 6 miles graywacke slate.

May 6. Albany to Nassau 12 miles on the Pittsfield Road.

[Notes 4, Page 7]

(See over next leaf) maybe these two half pages are reversed?

of argillaceous and bastard mica slate to West Stockbridge. But in the east part of Chatham it is traversed by innumerable veins and masses of white quartz. The dip is usually east and it rather decreases as we go east until in West Stockbridge it is not generally more than 30° generally less. The high hill east of West Stockbridge is mica slate and I doubt exceedingly whether the limestone is interstratified with it. It is a fact however that in coming from New York into Massachusetts the limestone gradually becomes lighter in color until at length it is white.

In the valley of Stockbridge the limestone seems to have no connection with the mica slate on the west. But east of the village appears to pass insensibly into mica slate as the specimens show. There the limestone is externally of a very dark color and it is almost impossible to see in it any stratification. The same is true of the mica slate such as that which forms an eminence a little south of Stockbridge Village. The strata when are 10 feet thick. This dark limestone contains foreign minerals but at Lee South Village the white dolomite with tremolite comes into contact with the dark colored limestone and dips about 45° west. A mile farther east the strata stand perpendicularly.

It may be well to mark a narrow strip of alluvium in Stockbridge.

Argillaceous slate I have scarcely met with near the west line of the state and I greatly doubt whether such a stratum ought there to be represented.
(See the leaves forward)

[Notes 4, Page 8]

Clay of a tertiary formation for 5 or 6 miles much disturbed by diluvial action. The graywacke slate succeeds which is very irregular in its stratification and much contorted. The marks of diluvial action are very striking. The general dip of the layers of slate is 70 to 80° and even 90° east. In several places especially near Nassau I noticed diluvial grooves on the surface of the graywacke whose course is really northwest and southeast through somewhat between northwest and north.

Nassau to Lee 28 miles. Graywacke slate with the usual direction and dip until we come to Chatham where we meet with a dark limestone traversed by veins of calcareous spar. This continues with occasional alterations (see the leaf back)…

…mass in the west part of Chester that was probably was part of the serpentine not far from that rock hornblende slate occurs whose layers as well as those of the talcose slate on the east are nearly perpendicular. The serpentine is distinctly stratified and even schistose more decidedly so than any rock of the sort I have met with. The layers are perpendicular and run a few degrees east of north conforming both in dip and direction with the surrounding strata. This rock is certainly stratified and even slaty if mica slate is. The ledges at this spot are very precipitous and the rock is very much broken up and crumbled down.

For a mile or two south of the serpentine bed in Blandford bowlders of that rock are very numerous so much so that I was even led to suspect that they might proceed from a continuation of the ledges beneath…

[Notes 4, Page 9]

…diluvium: but the course in which these bowlders are strewed along does not exactly correspond with that supposition being a little east of south. Bowlders of serpentine are also numerous several miles south of the Middlefield bed though this happens to be down the stream.

The plants are rather peculiar on the serpentine ledge in Chester. Sassafras is abundant, *Prunus*, likewise *Arenaria, Saxifraga*, *Betula* (white birch). Few large trees grow upon it. *Convallaria bifolia* also is abundant and I noticed *Ilex canadensis*. The rock is rarely covered by lichens.

[Moved the following; see above]

[Notes 4, Page 2]

May 7. Lee to Blandford lime bed 18 miles. The limestone in Lee abounds in augite: next comes the augitic gneiss which is seen in bowlders six or seven miles but I did not see it in place. Diluvial action in this valley has been very powerful and the Berkshire granular quartz has been driven up and scattered in

Becket. Next to the augite gneiss succeeds hornblende slate which in one or two places appears and the layers are nearly perpendicular dipping at a high angle east say 70 or 80°. All the west part of Becket should be colored as hornblende slate. Should not this be connected with the hornblende slate of Tolland?

Gneiss succeeds gneiss and continues to the serpentine bed four miles northwest of Blandford Center. It rarely appears in place but sometimes has a high easterly dip. In Blandford it is granite gneiss exceedingly resembling granite. It would form a beautiful building stone the grain being very fine.

The bed of serpentine in Blandford on the northeast side of north meadow pound is about 30 rods wide rising into a hill of 30 or 40 feet high. In many parts of the bed it is distinctly stratified the strata conforming in dip and direction to those of the hornblende slate on the west viz. running nearly north and south and dipping east from 60° to 70°. What I call stratification might by some be regarded as a schistose structure and…

[Notes 4, Page 3]

…indeed it is often distinctly schistose as much so as mica slate. Yet although the strata seams are not so distinct as in some rocks yet they are quite as much so as in many of the primary stratified rocks. In this serpentine we found magnetic oxide of iron (chromate iron?) disseminated and in masses several inches diameter. On the west side of the serpentine we find hornblende slate frequently epidotic and dipping 60 or 70° east. On the east no rock appears in place but probably talcose slate succeeds there.

The bed of limestone in Blandford is one mile south of the serpentine and is only a rod in diameter above the surface. If I mistake not its layers here dip of about 45° south. No other rock lies in contact with it but the granite gneiss appears a few rods west of it as it does a little west of the serpentine and probably hornblende slate lies between the limestone and the gneiss as it does between the gneiss and the serpentine. This hornblende slate however alternates very distinctly with talcose slate on the west of the serpentine as may be seen 60 rods or hundred rods north of that rock. There also on the high hill may be seen very distinct alluvial grooves on the edges of talcose slate running north 22° west and south 22° east. The number of bowlders in the northeast part of Blandford and east part of Becket is immense.

Hornblende slate rises into high hills in the northern part of Blandford. Generally the layers of the slate are perpendicular sometimes as in the east part of Becket we perceive distinct horizontal divisions of the rock into layers from a foot to several feet thick.

Blandford to the Middlefield range of serpentine in the west part of Chester and back to Henry's Tavern 9 miles. In the west part of Chester and East Bank of a branch of Westfield River the south end of this range of serpentine rises not less than three or 400 feet above the river and on the east is succeeded by talcose slate which forms the mountain. (next sheet)

May 8. Chester west part to Amherst 30 miles. Along the south part of Chester mica slate is the principal rock sometimes leaning a few degrees east and sometimes a few degrees west and commonly perpendicular. Not until we get south of the center of the town do we see veins of granite. At Chester village and for half a mile north the strata of mica slate run nearly east and west and dip north about 45°. Granite abounds in the vicinity. As we ascend to Norwich granite veins and protruding masses are

very numerous and the mica slate is very much disturbed–some sketches of which I took. The granite is fine grained and this abounds through the whole town and should form a good building stone. A mile east of the meetinghouse in Norwich found large crystals (one 6 inches long and three across) of phosphate lime in the quartz rock passing into granite or rather in a nodule of quartz in mica slate.

In Mr. Tracy's nursery orchard is a mass of quartz gray granular rounded by attention (abrasion? alluvium?) and for the most part…

[Notes 4, Page 10]

… staying black at the surface. But the name of John Gilpin appears on it written coarsely except the last letters which are quite indistinct and these letters present the pure light gray of the quartz and they are slightly elevated above the general surface of the rocks as may be known by passing the fingers over the rock. Mica slate in the east part of Norwich is nearly perpendicular in its strata though frequently leaning a few degrees to the west.

Granite does not predominate until we get into Westhampton.

Whole distance traveled this tour 177 miles.

[Next seven pages may be an insert]

Geological Tour 1833

May 13. Amherst to Sturbridge 34 miles through Belchertown, Palmer, and Brimfield. After leaving Belchertown no gneiss appeared in place so that I could ascertain its dip till we came into the west part of Brimfield. There it dips west about 45°. From thence to Sturbridge the dip is the same way varying from 20 to 80° generally not far from 45°. From the bowlders in Palmer I judge that hornblende slate occurs there. The sienite bowlders extend nearly to Palmer Center. All the way from Belchertown to Brimfield the marks of diluvial action…

[Notes 4, Page 11]

… are very striking. From Brimfield to Sturbridge the soil has the aspect of iron rust and the gneiss is often the same colour and is disintegrating.

A mile east of Brimfield Village the gneiss contains adularia and pyrope.

May 14. Sturbridge to Charlton 7 miles. The gneiss both in the east part of Sturbridge and west part of Charlton dips west about 45°. It is of that dark kind which resembles mica slate.

May 15. Charlton to Woonsocket Falls Cumberland Rhode Island 32 miles. In the west part of Oxford the Worcester mica slate appears in considerable quantity in the stone walls. Gneiss also appears in place interstratified with quartz rock the dip in one place east not more than 10° in another west and larger. In Webster the mica slate is in place a few rods east of the village on the road to Douglas. It there dips to the west about 45° and becomes in some places decided quartz rock. In the east part of Webster we strike gneiss of a rather peculiar character. At first its dip and direction are difficult to determine though I rather believe that it runs nearly north and south and dips from 5 to 10° to the east. But soon it is seen

running nearly northwest and southeast and dipping northeast at a very constant angle of 25 to 30°. Thus it continues to Douglas wherever it is seen. In Burrillville and the west part of Smithfield its course veers around so much as to become nearly east and west…

[Notes 4, Page 12]

…the dip remaining the same. In the west part of Smithfield near Slatersville hornblende slate alternates in one instance with the gneiss and this latter rock seems to be passing into mica slate. Towards the eastern part of Smithfield we strike the talcose slate from which whetstones are made. This succeeds to a granite gneiss and seems to pass under it so that its direction is a little north of west and south of east and its dip northerly steady though rarely more than 15°. I think it ought to be marked as a strip on the map from near Woonsocket Falls southeasterly one or two miles.

At these falls a peculiar mica slate appears running south several degrees west and dipping east 70 or 80° corresponding I should think very nearly to the graywacke slate in Pawtucket.

May 16. Woonsocket Falls to Providence by way of Pawtucket 16 miles. After leaving the Falls we crossed for more than 2 miles a range of decided granite. Then succeeds a range of talcose chloride slate whose direction is 15 or 20° west of north and dip usually 20 to 30°. In this rock near Manville and opposite the centre of Cumberland occurs a bed of steatite and a large quantity of foliated talc as as decided chlorite slate. The steatite is full of rhomb spar and does not appear to exist in large quantities. Probably it will never be of much use. Two miles south of the spot the peculiar slate of this region passes into greenstone slate and…

[Notes 4, Page 13]

…this contains the limestone at Dexter's quarry about half a mile northeast of that quarry an extensive range of granite with a sienitic aspect is crossed. This slate abounds in epidote and some of it is decided chlorite slate. It is extremely difficult to determine its dip and direction but is divided by seams in various directions. I conclude however that its strata run south a few degrees west and southeast 30 or 40°. Query: Is not the whole of this slate merely graywacke that has been indurated by the agency of the adjoining granite?

This peculiar slate is the last rock that appears as we go easterly before we come upon decided graywacke.

I am informed that granite is quarried about 2 miles west of Providence but that the pillars of the Arcade were obtained 5 miles west. In both places Dr. Noble says that the rock is in place and is extensively wrought. I saw this range of granite in the west part of Cumberland and have no doubt but a continued stratum of the rock ought to be extended from Wrentham to Providence. The curious slate that has been described seems to alternate with the granite around the granite or rather the granite obtrudes through the slate in several places reckoning across the strata. I do not believe that any gneiss ought to be marked on the east side of the Blackstone in Cumberland but that granite quartz…

[Notes 4, Page 14]

…quartz rock and talcose micaceous slate should constitute the whole.

The talcose slate forming whetstones in Smithfield does not extend easterly so far as the Blackstone.

Providence to Attleborough East Parish 10 miles no rocks.

May 17. Attleborough to Worcester through Wrentham, Franklin, Bellingham, Mendon, Upton and Grafton 42 miles.

The red graywacke is abundant in bowlders in Attleborough. Some of it is coarse puddingstone. Little rock is in place in the town.

The coal mine in Wrentham is 2 miles north of the line. A dark shale or anthracitous slate contains it. No layers of much thickness have been penetrated: certainly not more than 18 inches thick. The slate dips north nearly 45°. The coal is much veined with quartz and slate and with sulphuret of iron in cubes. The rock does not appear at the surface but at about 10 feet below it. They have bored one place 180 feet.

Vegetable impressions ferns etc. occur here and the mineral appears to be talc.

A little north of the mine the red graywacke abounds and contains numerous veins of quartz as does the common graywacke in Attleborough.

Bowlders of sienite are mixed with those of graywacke in Attleborough but not one of the latter with those of the former half a mile north.

[Notes 4, Page 15]

Bowlders of red slate are abundant a little west of Wrentham Center brought probably from the north. No sienite in place appears till we get within the bounds of Franklin. Near the west line of Franklin bowlders of gneiss appear and occasionally the rock is in place. But little in place however appears till we get into Mendon. Two miles southeast of the center its strata run north and south and dip about 40° east. From Mendon to Upton gneiss is abundant in place and the general direction is northwest and southeast and the dip northeast about 25°. But this direction frequently changes within a few rods so as to become nearly north and south and sometimes approaching east and west. In Upton is much granitic gneiss apparently destitute of stratification: but the parallel direction of the Mica is often obvious when all other marks fail showing the rock to be gneiss. In Mendon a beautiful variety of gneiss or granite is wrought also in Northbridge.

From Grafton to Worcester no rock appears in place till we get within two or three miles of Worcester. Then the gneiss runs several degrees east of north and dips west at an angle of 70 to 80°. I saw in it a large vein of granite the first I saw in the gneiss east of Worcester. In Grafton south part the gneiss runs and dips as in Upton.

[Notes 4, Page 16]

May 18. Worcester to Amherst 45 miles. I saw no rocks in place till we reached the east part of New Braintree where and in the center and west part of the town the strata run mainly north and south and dip west at an angle rarely exceeding 30°. It is the same in Hardwick and until we get into Enfield where

the strata are nearly perpendicular. West of Enfield the rock dips to the east at a small angle from 10 to 30° except perhaps one ledge in the east part of Amherst. In one place in Pelham the direction is nearly northwest and southeast.

Whole distance traveled on this tour 186 miles.

[Geological Survey Notes 5 (1835]

[Notes of Edward and Orra's trip to Portland Maine, May, 1835]

[Notes 5, Pages 1-5 are unrelated]

[Notes 5, Page 5, left side]

[An unlabeled illustration, possibly unrelated]

Newburyport to Portsmouth

The rock seems to be syenite and greenstone.

Portsmouth to [????]

Till we get to York the rock is mostly slaty looking like graywacke slate never flinty slate — but erelong it passes into hornblende schist occasionally primary greenstone. In the east part of York we come to cleaved syenite some of it similar to that on Cape Ann though liable to decomposition. Thus far several miles alternates with hornblende schist. I suspect the porphyry is associated with the syenite. Through Wells the sand mostly covers…

[Notes 5, page 7]

…the rocks.

From Portsmouth to Casco rocks run Northwest and Southeast, dip large Northeast.

From Casco to Portland rocks argillaceous schistose and mica slate directed northeast and southwest, dip Northwest 70 to 80°.

May 9

Casco Bay

Horse Island rock apparently mica slate (but not hard) and dip southeast longer direction northeast and southwest for Bangs Island a little further out (White Rocks) direction northeast southwest dip Northwest large. Rock apparently quartz rocks divided by cross seams.

The rocks on the above island I find to be talcose micaceous slate.

On Jewel Island the rock is mica talcose micaceous slate plumbaginous mica slate. The strata run exactly northeast and southwest nearly perpendicular leaning however generally a little west. On the island several miles nearer to Portland they lean a little to the east. On this island there are at least three distinct strata of pyritiferous mica slate in a state of rapid decomposition and coated over with copperas and alum(?). On the northwest side of the island is a remarkable trap dyke between three and four feet

wide which runs in the direction of the strata across the whole island and is divided into columns somewhat regular lying across the direction of the dyke. It is said that this dyke extends to another island to the northeast eight or ten miles distant and SW to Cape Elizabeth 12 miles distant. At least two other dikes one of them…

[Notes 5, page 8]

…wider appear on Jewel Island. The action of the ocean on the shores of the islands has been very powerful and they are quite striking. There was also a bed of peat and a submarine forest there. It is said that on an island farther east a blue clay occurs containing shells.

In Diamond Cove on Hog Island the rock is talco-micaceous and also distinctly Plumbaginous. Here also is a kind of submarine forest of the peat bogs etc. seem to be gradually sliding down into the sea by the returning tide.

Diluvial grooves and scratches are very conspicuous and numerous on the peninsula of Portland, e.g., on the east shore near the south part of the city and near the northeast part also in Fore Street near its junction with Silver Street near Cumberland Street.

They uniformly run south from 10 to 15° East. The rock is talcose slate mica slate and quartz rock alternating and standing on its edge.

May 17 from Portland to extremity Cape Elizabeth 9 miles. Between the bridge and the new meetinghouse crossed a stratum less than a quarter of a mile thick of plumbaginous mica slate dip 90° direction northeast and southwest. Next for three or four miles crossed talcose slate sometimes passing into mica slate often imperfectly stratified. Then struck a stratum of hornblende schist (mostly primary greenstone) say half a mile. Then talcose slate to the lighthouses. Near that spot the rock is remarkable for splitting so as to resemble rails, slabs, and logs. Where it dips under the sea it appears primarily like larger logs traversed by numerous cross fissures. 80 rods northwest of the farther (most northerly) lighthouse is a vein of greenstone six or eight feet thick running in the direction of the strata and dipping about 60° northwest the columns lying across…

[Notes 5, page 9]

…the vein and perpendicular to the strata so that they dip southeast 30°. This vein does not run directly toward Jewel Island but east of it. Say 10 to 15° yet it may be the same vein as on that island. South of the lighthouse it appears in one or two places on the mainland and also crosses Richmond Island one mile south and probably extends to the mainland still farther south. Near the new meetinghouse 2 miles east of Portland are diluvial scratches running south 10° east.

May 18

Near the alms house one mile west of Portland are extensive clay beds containing the same organic relics as occur in similar beds in Massachusetts. A stratum of blue clay also occurs several feet below the top which the workmen told me contain seashells. The upper part of this clay for several feet has been broken up and mixed with loam. The lower part is in distinct layers which are horizontal. The southwest part of Portland may be marked as diluvial.

In going northwest from Portland we come within 2 miles to mica slate dipping southeast from 30 to 40° which contains veins…

[Illustration]

[Caption] Dip of the slate 28° southeast.
Trap dyke 6 inches thick
4 inches
3 inches
Trap dyke is talcose slate, Westbrook opposite Portland Maine

[Notes 5, page 10]

…and masses of granite. This continues nearly to Presumpscot River in Westbrook when we come upon divided gneiss and this continue 3 miles beyond the river as far as I went the strata dipping southeast even down to 20°.The strata are normally thick and somewhat uneven the rock scarcely schistose–used for building stone and flagging stones in Portland–though the latter comes chiefly from N. Yarmouth. This gneiss is traversed by numerous veins of a coarse granite and also by veins of greenstone from one to 4 or 5 feet thick. Sometimes the granite appears to have penetrated the greenstone or rather perhaps it is gneiss and not granite. In returning we came into Portland at the north end across the toll bridge. The gneiss or gneiss passing into mica slate continues till within half a mile of the bridge. Near the bridge (east of it) is a ledge of talcose slate dipping southeast more than 20° and numerous unstratified veins of a singular trap rock occur in it. One of these is shown two pages back which seems to have found its way into the slate without disturbing the layers.

On the back of Presumpscot River (generally 6 or 8 rods wide) is a remarkable slide that took place two separate times four or five years ago. The surface generally has sunk 15 to 20 feet and now lies very uneven. A blue clay underlies the soil which seems to be easily moved. The bank slices into the river driving it entirely out of its channel and compelling it to seek a new channel in a meadows. These slides I was told occurred when the weather was very dry. In the blue clay we found one specimen of a crab one of the *Maya* (broken) one of a small *Brella*, and very many of a small species of *Nucula* partially or entirely petrified. This shell appears to have been almost the only inhabitant of the waters in which this claim was deposited. Found also in the upper bed same nameless relic as occurs in clay in Massachusetts. All along that river may be marked by tertiary deposits.

Diluvial grooves on granite numerous in Westbrook especially near the shore towards Portland. At the bridge above referred to the greenstone dykes are finely scored.

[Notes 5, page 11]

Expenses tour from Amherst to Portland 1835

May 5	Expenses from Amherst to Boston	10.00
May 6	In Boston	1.56
___	From Boston to Newburyport	5.25
___	In Newburyport	0.75

May 6 To Portsmouth		3.00
May 6 At Portsmouth		1.25
____ Portsmouth to Portland		6.00
____ Dinner		0.75
May 8 Freight boxes		1.06
Lodging in Portland to		2.25
Received for lecture		31.25
May 15 "		6.25
May 16 "		5.50
May 22 "		14.27
May 26 "		11.00
"		34.25
Amount for tickets	TOTAL	103.12
Cost of room		24.00
[????] for drawings		2.00
Advertising tickets		7.50
	TOTAL	69.62

May 26 received the Portland mining company for services	55.00
May 26 Board for myself and wife 19 days	20.00
May 27 freight to Boston	0.75
May 28 2 Nights in Boston	3.12
Fare to Worcester	4.00
Breakfast	0.75
Fare to Amherst on stage	4.25
Dinner	0.75
Total expenses for the journey	64.39
Collections	33.50
Total dollars	97.89
Amount receive for tickets	103.12
Received of Portland mining company	55.00
total	58.12
	97.89
Saved	50.33

[Notes 5, page 12]

Portraits wanting to be framed are 11 by 33 inches

September 6, 1834 expenses of stage fare food and lodging in going from Amherst to Andover via Boston seven dollars.

[Geological Survey Notes 6 (1833)]

[Notes 6, *Page* 1

September 26		
Bridge toll		0.10
Dinner and oats and guide		0.53
Three quires paper		0.20
September 27		
Supper breakfast lodging		0.65
For minerals		0.375
Dinner		0.125
September 29		
Oats		0.13
Ferriage		0.10
	Total	2.21
Paid Dr. Wright for specimens of minerals		1.00
	Total	$3.21

[Notes 6, *Page* 2

September 26 Amherst to Goshen by the argentine locality 24 miles.

The lead vein in the west part of Hatfield runs north 22½° west through sienitic granite and is nearly perpendicular. The gangue sulphate of barytes the ore lead zinc and copper.

The argentine locality is in Westhampton nearly half a mile south of Williamsburg line and five or six rods west of the Northampton line.

The ends of perpendicular layers of mica slate and limestone appear as in the sketch in a following page. In the east part the layers are somewhat horizontal and undulating. The argentine lies between the slate and the granite and rather irregular masses. I cannot find that it penetrates the granite much although chemically united with it. Was it not produced by the action of the present granite upon the micaceous limestone?

Four or five rods easterly is an immense vein of brecciated quartz containing some galena. Its width I could not ascertain its length I traced not less than 30 or 40 rods. Its course in south 22½° west.

The above locality is on land of Ebenezer Warner of Williamsburg.

[Notes 6, *Page* 3

On the top of the high hill a mile west of Williamsburg meetinghouse in the course granite on the farm of the slate Edward Gere occur smoky quartz and plumose mica in abundance.

One mile south of Goshen meetinghouse is a border of mica slate whose circumference at that tongue of the ground is about six rods.

Dr. Wright finds find sapphire in Chesterfield north part–also beryls and he says that he knows of no evidence of a vein of galena in that town.

September 27. Goshen to Chesterfield and Cummington back to Goshen 20 miles. Spent the day in collecting minerals.

A very little carbonate of copper occurs in Chesterfield the origin of Mr. Nash's vein of copper on his map.

September 28 Goshen to Conway through Williamsburg 24 miles. In the west part of Whately made drawings of three case of granite veins in mica slate (see two leaves forward) probably A. Nash's red oxide of lead is an oxide of zinc or iron.

September 29. Galena vein north part of Whately runs north and south and is about 6 feet wide in granite. The small quartz veins in the vicinity are quite numerous. It contains blende as well as galena.

The vein in Conway is several feet wide and mica slate appears on one side. It contains red iron which is scattered about…

[Notes 6, *Page* 4

…the surface. Most of the gangue is agate breccia of all colours. The vein runs north 21½° east.

From Conway to Amherst 18 miles which distances trip 86 miles.

The mica slate strata in Whately before we come upon the sienite dips to the east at a high angle from 70 to 90° and their direction is considerably east of north. See a sketch of contortions on a subsequent page

[Illustration] Granite slate and argentine

[Notes 6, *Page* 5

[Illustration]

Whately west part

[Notes 6, *Page* 6

[Illustration]

Whately west part; contortions in mica slate Whately road to Hatfield west part

[Notes 6, *Page* 7

September 29. To Leverett and back again twice for specimens 24 miles.

October 6. To Mount Toby and Leverett and back 17 miles. In passing up a brook on the east steep side of Toby the mica slate and granite continued 200 or 300 feet with the puddingstone dipping very slightly to the east as is common in this mountain. On Roaring Brook a mile north the puddingstone continues to the foot of the hill and forms a precipice of great height the rock even overhanging. The water has worn a deep chasm in the rock for several hundred feet in height and the scenery was truly wild and sublime. The eastern slope of Toby is covered with bowlders of gneiss and granite from Leverett [????].

October 10 Amherst to Whately and back through Deerfield 24 miles. In the sienite two miles south of Whately meetinghouse I found numerous veins of quartz some of them one or two feet wide and several rods long. Also one vein two or three feet wide of compact feldspar–numerous veins of granite from a foot to a mere line thick. Many of them are composed of feldspar almost alone sometimes red and sometimes white. Sometimes the granite of these veins is very fine and at others very coarse. Also very numerous veins of epidote rarely more than a mere line in thickness: yet this seems to have provided the greatest disturbance and they generally run northeast and southwest the same direction as the stratified rocks in the region.

[Notes 6, *Page* 8

In this direction a large part of the sienite is divided by parallel seams for a few inches to several inches apart giving the distinct appearance of stratification. The other veins follow no uniform direction.

This sienite abounds with rounded masses of mica slate gneiss? Hornblende slate quartz rock and talcose slate. These vary from 2 feet to 1 inch in diameter and often project an inch or two above the surface of the rock and sometimes are so abundant as to give the rock the appearance of a conglomerate. These fragments are in various states of change into porphyritic.

As the sienite wears away at the surface there remains in relief numerous *veins of aggregation* or contemporaneous veins which are merely harder portions of the rock not infrequently their central part is verified by an epidote vein. These veins of aggregation cross one another in every direction though one does not cut off another.

The hornblende slate northwest of the meetinghouse runs nearly northeast and southwest and the layers are perpendicular. Often it almost loses its schistose character and becomes greenstone. In one case it takes into its composition compact feldspar but the schistose structure remains.

Two cases of granite and epidote…

[Notes 6, *Page* 9

…veins are given over the next leaf but one.

[Notes 6, *Page* 10

[Illustration]

Whately south part, Whately south part

[Notes 6, *Page* 11

November 2. Amherst to Westfield 25 miles through Southampton. The range of sandstone is 3 or 4 miles broad in Southampton and occupies nearly all the space between Westfield Village and the west line of the town. General dip east about 10° in the west part of Westfield has ever its dip a few degrees in the contrary direction and resembles a fine granite .

November 3. The Westfield serpentine lies 4 miles west of the Village at the commencement of mica slate and granite. It is the south side of a bank of the Westfield and extends across this river into Russell. It is almost 4 rods wide at the south end. It is a mixture of black serpentine and sometimes lime and sometimes white and green crystolite.

[Notes 6, *Page* 12

Mica slate appears on the west side of the bed dipping nearly 90° to the west and this is the general dip of the strata to Blandford though there is much irregularity owing to the huge beds and veins of granite. East side of the serpentine is a granite bed or vein scarcely if it all separated from the serpentine. The petalite is in a vein a foot wide crossing the serpentine. The latter rock is distinctly stratified at Westfield and at Blandford. Limestone is mixed with the Westfield serpentine or rather the serpentine is curiously disseminated in the limestone forming perhaps verde antiqua. The serpentine appears on the north side of the small river which is a branch of the Westfield and this is in Russell. It is probably a continuation of the same bed.

Westfield to Blandford 3 miles out-of-the-way 13 miles.

Blandford to Cummington 23 miles

Cummington to Windsor and back again 11 miles

Cummington to Amherst 24 miles

On Westfield River two or three miles west of the village is a curious terrace appearance on the banks. The upper terrace corresponds I believe with the tertiary formation along the Connecticut. This is worn away from half to a mile wide along the river and the remains of the second terrace 50 or 60 feet below the first appears everywhere at the same height. The present alluvial bottom over which the…

[Notes 6, *Page* 13

…river flows is 30 or 40 feet below the second terrace. A similar and corresponding set of terraces appear on the fourth branch of the Westfield near the serpentine locality though far less striking. On passing up the Westfield also two to three miles above the first terraces and going through the gorge in the mica slate mountains we come to another set of terraces the same in number at a level considerably higher than the first.

The Westfield River seems once to have overflowed the highest of the terraces and to have deposited them for they consist obviously of alluvial or diluvial matter not in regular layers or strata. After a time this barrier (probably the greenstone mountain which is a continuation of Mt. Tom) seems to have been suddenly lowered by some catastrophe so as to sink the level of the stream many feet. The stream now tore away most of the first terrace and formed another by floods. A second time the barrier seems to have suddenly sunk and brought down the stream to its present level. It is now forming a third terrace by its inundations.

To Blandford we find mica slate–sometimes as in the east part of Blandford distinct gneiss with huge beds and veins of granite. The dip is generally east 70 to 80° and the direction north and south. The strata however are often greatly disturbed by the granite. On the next page may be seen a profile view of a ledge of mica slate and granite in Russell. In that town veins excellent prismatic and variegated mica.

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[Illustration]

Mica slate strata perpendicular–whole surface 20 sq. ft. Granite

Profile of junction of granite and mica slate in Russell.

The rock in Blandford is mostly mica slate frequently here as well as in Russell passing into hornblende slate. Two miles southwest of the center of Blandford is a bed of fine soapstone remarkably pure. It is 2 or 3 rods wide enclosed by mica slate and granite–the granite on the west and being a huge vein or bed–it has not been extensively wrought.

40 rods east of the soapstone is an extensive bed of stratified serpentine in mica slate. It is several rods wide.

I have reason to believe that in the southeast part of the town is another bed of serpentine and shall so mark it on the map. Two beds of soapstone occur in Granville, one northwest and the other southwest of the center. Formerly wrought.

Large masses of rose quartz some of it beautiful occur in the north part of Blandford School also in quartz sometimes radiated. Diaspore? Also

From Blandford to Cummington the mica slate layers and strata lean a few degrees to the east. In the western part of Cummington…

[Notes 6, *Page* 15

…they begin to lean to the west.

The manganese in Plainfield is in beds in talcose slate. This slate commences about 2 miles west of the meetinghouse. The manganese is the gray and siliceous oxide and none of the bed appear to be more than three or four feet wide. It is chiefly the red oxide I presume although this is covered over with the black. Perhaps the bowlders at the meetinghouse in Cummington proceeded from this place but I doubt

it.

The steatite in Windsor is 1½ miles southwest from the manganese. It seems to consist chiefly of talc and is two or three rods wide. The steatite in Windsor seems to consist chiefly of slate and is two or 3 rods wide. It is said to be too soft but I apprehend that if wrought to considerable depth it would be found tolerably good. Bitter spar abounds in it and the talc is sometimes quite delicate. The bed lies near the junction of the talcose and chlorite slates.

On the opposite side of the river not 20 rods from the steatite occurs a bed of serpentine and a mountain of chlorite slate. The bed does not show itself much being hid by the diluvium. On the edges of the chlorite slate generally embedded in veins of graphic granite occur numerous fine crystals of red oxide titanium but it is next to impossible to get them out unbroken. Actinolite occurs with the steatite in tolerably good crystals.

In Chesterfield southwest part of the town occurs spodumene of huge size. Dr. Dwight showed me a specimen containing a prism broken off at each end yet 21 inches long. He also…

[Notes 6, *Page* 16

showed me an irregular crystal of beryl a foot in diameter.

A porphyritic mica slate in Chesterfield and Goshen is quite common. The mineral that has decomposed sometimes appears in foliated masses with a brilliant surface but I do not know it.

Plumose mica occurs most abundantly a mile west of Williamsburg meetinghouse on the farm of Edward Gere.

Limestone nearly white occurs in the east part of Williamsburg and closed in mica slate in a bowlder.

A huge rock composed chiefly of augite occurs a mile southeast of the village in the same town.

The mica slate in the northwest part of Goshen runs east and west and dips 25° north. May not this be occasioned by the great protrusion of granite to the southeast. The direction changes more and more to the north and south as we go east and the dip is east. Probably all the strata northeast of this have an easterly dip.

The sandstone in Hatfield Street dips to the west about 5 or 10°. In School Meadow on the river bank it appears running east and west and dipping north.

Remarkable example of diluvial grooves in the high hill on which Blandford meetinghouse stands–half a mile north of the meetinghouse–directions of the grooves nearly north and south.

[Notes 6, *Page* 17

November 18. Amherst to Bernardston through Deerfield 25 miles. In Deerfield Meadows–on their margin are two distinct terraces like those in Westfield–the upper one corresponding to the general level of the tertiary formation along the Connecticut the other not half as high. In some places there are

traces of a third (e.g. on Pine Hill Dfld. North Meadow) not more than 10 feet above that just named.

Greenfield Meadows appear to be the level that was found by Green River before it burst its bank near the mills in the south part of Greenfield. The bursting of this sunk the bed of the river to its present level.

At the north end of Federal Street and northeast of this on the road are decisive traces of diluvial action on the sandstone the grooves being north and south.

The diluvium in the north part of Greenfield is composed of detritus from the argillaceous slate although the sandstone extends 2 miles north of the center of Bernardston. Some bowlders of granite of a fine grain are scattered over the this region–probably brought down from Guilford where I have seen it in place. A long block lies a little below Turners Falls on the north bank and is of an excellent quality.

The argillaceous slate is quarried in Bernardston west of the center 2 miles chiefly for gravestones.

The prystone copper in Gill is in the southernmost island in Turners Falls and is…

[Notes 6, *Page* 18

…probably a bed a few inches wide.

November 19. Bernardston to Amherst 27 miles by the way of Turners Falls and through Greenfield. Collected numerous specimens.

The beds of iron and limestone in Bernardston I shall describe at once in the first part of my report.

[Geological Survey Accounts of Expenses (1830-1844)]

[Expenses 1–1830]

Commonwealth of Massachusetts to Edward Hitchcock D

1830

July

For articles of apparatus and prepared for executing a geological survey of the state viz.	
A pocket compass	3.00
A clinometer	1.25
A tape measure	2.50
Small boxes for carrying apparatus and chemicals	1.50
Fitting up boxes in the carriage for transporting specimens	3.00
Linen bag for carrying the same	0.30
Incidental expenses and preparing for the survey	2.125
Repairing harness	1.35
Total	15.025
November	
Postage on letters relating to the survey	1.04
Traveling expenses of an (Assistant during 68 days, .53 per day	35.98
" for myself and horse during the same time (1.44 per day)	97.69
" Boat fare for examining islands along the coast	8.07
" Boxes and paper for packing minerals in their transportation	9.605
" Horse and carriage 68 days for transporting myself (Assistant and minerals at 1.50 per day	102.00
December personal services for 84 days viz. from July25th to August 14 from August 30 to October 30 and 2 Days in December at 5.00 per day	420.00
" For copying and coloring geological maps in the state	10.36
" For Hailes? map of Boston and its vicinity of	2.50
Sum total	699.77
Received by an order on the treasury of the state	400.00
Balance	299.77
Add 1.00 more per day for personal services	84.00
Received the above balance	383.77

E Hitchcock

[**Expenses 2 1830-1831]**

Amount of my expense charges and receipts in my geological survey of Massachusetts

Commonwealth of Massachusetts to Edward Hitchcock D

1830		
July For articles of apparatus for the survey viz.		
A pocket compass		13.67
Clinometer		1.25
Tape measure		2.50
Small boxes for apparatus		1.50
" in carriage for specimens		3.00
Bag for "		0.30
Incidental expenses and preparing apparatus		2.125
Traveling expenses for myself and a horse		
between July 1830 and June 1831 viz. for 85 days		125.375
" for an assistant during that same time		47.125
Personal services between July 1, 1830 and June 1, 1831 viz. before		
101 days at 6.00 per day		606.00
Hire of a horse and wagon between July 1 1830 and June 1, 1831		
viz. 85 days at a 1.50 per day		127.50
Mending harness during the same time		2.10
Postage on letters during the same time		3.34
Paper and boxes for packing minerals and freight on the		
transportation between 3000 and 4000 specimens		16.68
Projecting and coloring four maps of Essex County		10.56
Boat fare for visiting islands along the coast		8.07
	Total	960.42
Received at various times during 1830 & 1831 by orders on the		
treasury of the Commonwealth of Massachusetts		960.42

E Hitchcock

[Expenses 4 1830]

Expenses incurred by surveying the state of Massachusetts geologically commencing July 1830

July 1st Clinometer	1.25
Pocket compass	3.00
Hammer	0.60
Tape measure	2.50
Note covers	0.125
July 20th	
Wagon	62.00
Harness for ditto	13.00
Repairing wagon	3.00
Linen bag	0.30
Toll and for looking up a wagon	2.00
Boxes for caring small articles	1.50
July 29th	
Fly defender for horse	0.75
July 30th	
Tavern expenses at Monson of which assistant 0.29	1.16
Dinner and horsebaiting	0.50
Paid for specimens of plumbago	0.40

[Expenses 5 1830]

July 31st For housekeeping and lodging Sturbridge (Assistant 0.125)	0.63
Horsebaiting and oats	0.31
Dinner (0.25) and baiting for horse	0.76
August 2nd Expenses over the Sabbath (Assistant 0.90)	2.60
Two dinners 0.50 horse 0.20	0.70
Paid for a guide to purgatory	0.125
August 3rd For lodging and supper and horsekeeping (Assistant 0.30)	1.06
For breakfast and horsekeeping at Providence (Assistant 0.25)	0.87
Toll bridges	0.16
Dinner and horse	0.85
Shoeing a horse	0.20
Toll at Bristol ferry and Rocky Bridge	0.75
August 4th Supper and lodging (Assistant 0.25)	0.60
Dinner and horse	0.68
August 5th Morning Bill (Assistant 0.87)	2.25
Passage to examine New Bedford Harbor (Assistant 0.375)	0.75
Bridge toll	0.12
Dinner (Assistant 0.31)	0.87
Hay for horse	0.06
August 6th Lodging supper and breakfast (Assistant 0.50)	1.54
Shoeing horse and mending hardness	0.40
Dinner and horsebaiting and oats (Assistant 0.375)	1.00
Toll at ferry	0.25
Supper and 4 quarts oats (Assistant 0.10)	0.36
Box for minerals	0.125
August 7th Lodging horsekeeping and breakfast (Assistant 0.375)	1.57
Dinner 0.50 horse0.20	0.70
For storage of minerals 0.10 Supper 0.34	0.44
August 9th For keeping over the Sabbath in Taunton (Assistant 1.25)	3.38
Bridge toll	0.125
Dinner (Assistant 0.25)	0.56
August 10th Lodging supper and breakfast (Assistant 0.525)	1.81
Oats, quire wrapping, letter postage to Worcester	0.35
Dinner (Assistant 0.25	0.66
August 11th Supper breakfast and lodging (Assistant 0.39)	1.125
Oats	0.125

Dinner and oats (Assistant 0.25)	0.66
August 12th Lodging supper breakfast (Assistant 0.50)	1.41
Oats and hay at noon	0.10
August 13th Supper breakfast lodging and horseshoeing (Assistant 0.50)	1.65
Dinner and Oats (Assistant 0.375)	0.92
August 20th For mending harness	0.40
Freight of box of minerals	0.75

[NEW EXPENSES 3 1830]

Commonwealth of Massachusetts to Edward Hitchcock

1830 July	
Clinometer	$1.25
Pocket compass	3.00
Hammer	$0.50
Tape measure	$2.50
Boxes in wagon for specimens	3.00
Linen bag for ditto	$0.30
Note covers	0.125
Boxes for apparatus and chemicals	1.50
Necessary expenses in making preparation for a geological survey in toll two dinners etc. 2.00	$14.27
Necessary expenses for myself and assistant and horsekeeping for 15 days from July 29th to August 13th	$35.525
Horse wagon 16 days at 1.50 per day viz. from July 29th to August 13th	$24.00
Personal services for 20 days viz. from July 25th to August 14th at five dollars per day	$100.00
Necessary expenses for myself assistant and horse for 37 days from August 30th to October 5th	$57.40
Ditto Mr. Hebard's expenses not included	$14.06
For boat to Gay Head from Falmouth and to survey Boston Harbor	$8.82
Horse and wagon 37 days from August 30th to October 5th	$55.50
Personal services for 37 days from August 30th to October 5th at 5.00 per day	$85.00
Expenses of myself and assistant from October 12th to 29th 15 days of travel	$31.50
Horse & wagon for myself and assistant 15 days viz. from October 14th to October 28th	$22.50
Personal services 25 days viz. from October 5th to October 30th at 5.00/day	$125.00

Drawing paper format $0.36, postage of letters $0.70, transportation

of specimens 4.89		$5.95

[NEW PAGE]

Expenses of my assistant first tour		$8.70
Ditto second tour		$19.305
Ditto third tour		$7.97
Ditto for the whole time 68 days		$35.98
	Or $0.53 per day	
Mending harness		2.10
Letter postage two		$0.34
Freight minerals paper etc.		$16.68
Map of Essex County		$0.20
Paper and coloring		$10.36
Boat fare		8.07

[Expenses 6 1830]

August 20th Silver pen	0.25
Postage of letter to Governor L.	0.125

August 30th

Commenced a new tour

For 4 quarts of oats	0.125
For two quires wrapping paper	0.17
August 31st Supper and lodging and horsekeeping (Mr. Tappan 0.375)	1.10
" Breakfast (Mr. T 0.25)	0.62
" Dinner (Mr. T. 0.31)	0.75
" 4 quarts oats	0.125
September 1st Supper breakfast lodging horsekeeping (Mr. T. 1.00)	2.50
" Dinner and oats	0.35
" 2 quarts oats and turnpike gate	0.14
September 2nd Supper breakfast housekeeping (Mr. Tappan 1.02)	1.93
Dinner (Mr. T 0.45)	0.94
Turnpike and 2 quarts oats	0.16
September 3rd Supper lodging breakfast (Mr. T 0.875)	1.75
" Box and freight of minerals	0.375
" Dinner and horsekeeping (Mr. T. 0.375)	0.75
" 4 quarts oats (Mr. T. 0.06)	0.125
September 4th Supper breakfast and horsekeeping (Mr. Tappan 1.21)	2.42
" 8 quarts oats (Mr. T 0.125)	0.25
" 4 quarts oats and dinner (Mr. T 0.25)	0.57
September 6th Over the Sabbath (Mr. Tappan 2.00)	4.00
" Oats (Mr. T. 0.16)	0.32
September 7th Supper lodging etc. (Mr. T. 0.50)	1.00
" Breakfast etc. (Mr. T 0.50)	1.00
September 8th Expenses for dinner supper lodging breakfast etc. (Mr. T 0.75)	1.33
For dinner on the 6th (Mr. T 0.375)	0.750
For dinner and oats today (Mr. T. 0.50)	1.00
Paid for Mr. Hebard *[crossed out?]*	0.25
For washing articles	0.32

September 10th For board etc. 2 days (Mr. T. 2.00)	5.00
Dinner (Mr. T. 0.50)	1.00
September 11th Passage to Gay Head (Mr. T 1.50)	3.00
(I paid for Mr. Hebard)	1.50
September 13th Keeping over the Sabbath Mr. T 2.12 4.12 and 1/2	
Breakfast	0.50
Dinner (Mr. T. .0375)	0.75
September 14th Supper lodging etc. (Mr. T. 1.78)	3.00
For breaking off a specimen of the Pilgrim rock	0.12

[Expenses 7 1830]

September 14th dinner and oats	0.50
September 15th Supper lodging in horsekeeping	0.68
" Breakfast and oats	0.37
" Box for minerals	0.25
" Dinner and oats	0.45
September 16th Lodging breakfast horsekeeping	0.87
Turnpike gate	0.12
Dinner etc.	0.50
Two quires of wrapping paper and box for minerals	0.25
September 17th Mending harness and paper	0.25
September 18th Two days board (Mrs. H. 0.625)	3.37
Washing articles	0.50
" Dinner (Mrs. H. 0625)	3.37
September 20th Board over the Sabbath (Mrs. H. 1.08)	3.17
" 4 quarts of oats	0.125
" Mending harness	0.25
September 22nd Getting a new breast collar for harness	3.00
September 23rd Horsekeeping three days	2.25
Tollgates	0.19
Dinner and washing wagon	1.00
Map of Boston and vicinity	2.50
September 24th Horsekeeping overnight	0.75
Tollgate	0.08
September 25th Expenses today	1.78
September 27th Washing	0.25
Mending harness and wrapping paper	0.375
Dinner and shoeing horse (Assistant 0.37)	1.00
September 28th Lodging breakfast (Assistant 0.375)	1.25
" Breakfast (Assistant 0.25)	0.75
Dinner (Assistant 0.31)	0.75
Mending harness	0.375
Tollgate	0.10
Box for minerals and toll papers etc.	0.45
Tollgates	0.20
September 30th For boat and boatman to survey Boston Harbor	4.32

" Supper lodging and two days horsekeeping in Boston (Assistant 0.50)	2.25
October 1st Dinner and two 4 quarts of oats	0.33
Tolls etc.	0.15
October 2nd Horsekeeping one night	0.56
Breakfast and oats	0.31
Horsekeeping toll etc.	0.55
October 4th Horsekeeping 2 days	1.00
" Dinner oats (Assistant 0.25)	0.68
October 5th Supper breakfast horsekeeping (Assistant 0.62)	01.75
" Oats	0.125
" Dinner and horse	0.75
October 12th For repairing harness	1.25
" For toll and oats search of an assistant	0.43

[Expenses 8 1830]

October 14th Started anew on a tour eastward	
" Mending harness	0.50
" Two quires wrapping paper	0.16
Dinner and oats (Assistant 0.22)	0.57
October 15th Supper lodging breakfast and horsekeeping (Assistant 0.46)	1.32
Dinner oats etc. (Assistant 0.25)	0.68
Guide to Wachusett and horsebaiting	0.24
October 16th Supper breakfast lodging and horsekeeping (Assistant 0.54)	1.45
" Dinner and oats (Assistant 0.20)	0.47
October 18th Keeping over the Sabbath 10 meals etc. (Assistant 1.50)	4.00
" Mending harness	0.10
" Box for minerals animal to break rocks	0.41
October 19th Dinner supper breakfast lodging (Assistant 0.68)	1. 85
" Dinner and cleaning costs and toll (Assistant 0.375)	1.18
October 21st Two days keeping (Assistant 0.50)	3.10
Dinner and oats (Assistant 0.25)	0.70
Toll 0.125 and two quires paper 0.125	0.25
October 22nd Supper lodging breakfast dinner in horsekeeping (Assistant 1.03)	3.00
" Box and wrapping paper	0.25
October 23rd Horsekeeping	0.70
" Dinner and Oats (Assistant 0.25)	0.67
Toll	0.25
October 25th Horsekeeping and two meals	2.25
" Box and paper for packing minerals	0.36
October 26th Supper breakfast horsekeeping (Assistant 0.40)	1.13
" Dinner and oats and quire of paper (Assistant 0.15)	0.43
October 27th Supper breakfast lodging and horsekeeping (Assistant 0.50)	1.35
" Toll and 2 quarts oats	0.26
" Dinner and oats (Assistant .25)	0.58
" Toll and oats	0.16
October 28th Supper horsekeeping and lodging	0.64
Breakfast and oats	0.45
October 29th Six sheets drawing paper	0.36

November 19th Postage of letters to and from Governor Lincoln and Colonel Totten 0.70

November 30th Paid for transporting 669 pounds of specimens from Boston and Worcester 4.89

[Expenses 9 Unknown date]

December 30th postage of two letters one to the governor and
the other to Col. Totten 0.22

[Expenses 3 1831-1832]

Commonwealth of Massachusetts D to Edward Hitchcock

1831

For expenses of myself and horse on a geological tour of 13 days viz. from August 29th to September 10th inclusive		14.875
Expenses of my assistant during the same time		5.835
For horse and wagon 13 days at 1.50 per day		19.50
For personal services for 13 days at 6.00 per day		78.00
For expenses of myself, assistant and horse on three other tours viz. September 19th 20th 21st November 2 3rd 4th 5th and November 18th and 19th: in all 9 days		9.38
Horse and wagon for nine days		13.50
Personal services for nine days		54.00

December 5th

Preparing the first part of my report amounting to 70 pages 1.00 per page		70.00
For projecting and coloring the map accompanying report		5.00

1832

May 1st Paper and boxes for specimens and freight on the same since June 1, 1831		10.455
Postage on 31 letters since June 1, 1831		4.055
	Total	284.54
For polishing 142 specimens at 0.125 each		17.75
	TOTAL	302.29

Edward Hitchcock

Forwarded the above amount to the Secretary of the
Commonwealth May 7, 1832

June 7th Received the above account by a draft on the Boston Bank
except the charge of 17.75 for polishing specimens E.H.

[Expenses 10 1831]

Commonwealth of Massachusetts to Edward Hitchcock

1831

For expenses of myself and horses on a geological tour of 13 days viz. from August 29th to September 10th inclusive	14.80
For expenses of an assistant during the same time	5.835
For horse and wagon 13 days at a 1.50 per day	19.50
For personal services 13 days at 5.00 per day	78.00
For expenses of three other tours viz. September 19th, 20th, and 21st, November 2nd, 3rd, 4th, 5th and November 18th and 19th in all 9 days	9.38
For horse and wagon for nine days	13.50
For personal services for nine days	54.00
December 5th Postage and 17 letters written within the past season about the survey	2.255
Freight on boxes of specimens and paper and boxes for packing them	5.775
For preparing the first part of my report amounting to 60 octavo pages at a dollar per page	60.00
For a geological map accompanying report	5.00
Total	268.04

Edward Hitchcock

Amherst December 6, 1831

[From Notes 3, pages 10 -11]

September 17 Geological Tour [1831?]

Forage	0.125
Oats	0.125

September 18 Dinner and horse assistant	$0.25	0.75
September 19 Supper breakfast and assistant	$0.30	0.70
Dinner and oats (Assistant 0.125)	0.35	
Bridge toll	0.125	
Total	$2.175	

[Illustration]

Riverboat

Notes 3, Page 11

[Upside down]

August 27 bridge toll	0.125
August 28 bridge toll	0.065
Corn	0.08
Boat at Gill	0.0125
Twine wrapping paper	0.06
August 29 Boatman at Turners Falls	$0.25
Quire of paper	$0.15
August 30th Meals lodging & horse	$1.50
Dinner and horse	0.875
August 31 Supper breakfast	1.50
Dinner and horse	1.00
Quire of paper	$0.14
September 1 Guide to the Glen	$0.25
Bridge toll	0.06
September 3 Dinner and oats	$0.33
September 4 Oats	0.125
Dinner and oats	1.06
September 5 bridge toll and paper	$0.19
September 6 Expenses for board in Deerfield 6.00	

September 14 Postage of letters to Pittsfield and Williamstown	$0.20
Freight on barrel of minerals from New Bedford	$0.63
Expenses for transporting minerals from Deerfield	1.00

[Expenses 11 1831]

Commonwealth of Massachusetts Dr. Edward Hitchcock

1831		
April 1st For freight on boxes of minerals collected last year		6.00
" For postage on letters relating to the geological survey		2.30
June 1st Expenses for myself and horse during a geologic tour of 17 days ending this day		27.685
" For my assistant same time		11.145
" For wrapping paper and boxes for specimens		1.075
" Map of Essex County		0.20
" Mending harness		0.75
" Personal services for 17 days viz. from May 10 to June 1 leaving out three days Spent in Boston and three at home: 6.00 per day		102.00
" Horse and wagon for the same time at 1.50 per day		25.50
	Total	176.655
[In pencil]		699.77
[In pencil]		84.00
	TOTAL	960.425

Amherst June 9, 1831 See the above

Edward Hitchcock

[Expenses 12 1831]

Commonwealth of Massachusetts to Edward Hitchcock

1831	
For expenses for myself and horse for 13 days of geological tour viz.	
from August 29th to September 10th inclusive	14.875
For ditto of my assistant for the same time	5.805
For postage on letters boxes and paper for specimens	
of minerals and freight on boxes	3.095
For horse and wagon for 13 days 1.50 per day	19.50
For personal services for 13 days at 6.00 per day	78.00
For ditto for three days September 19th 20th and 21st	18.00
For horse and wagon for the same time	4.50
For expenses for the same time	2.115
September 29th postage and 4 letters relating to the survey	0.54
November 7th ditto on 8 letters	0.93
" Toll and oats after, mineral specimens	0.375
Expenses of myself and horse four days from November 2nd	
to November 5th	3.54
Ditto of assistant the same time	1.69
Horse and wagon same time	6.00
Personal services for same time	24.00
November 10th For freight on five boxes from Berkshire	2.33
Ditto on two boxes from Boston	
November 18th and 19th Expenses for two days tour to Bernardston	1.66
Postage of letter to Windsor	0.10
Personal services of horse and wagon	15.00
November 27th Freight on box from Blandford	0.25
Total	202.965

[Expenses 13 1831]

Brought forward	202.965
December 5th for making out the First Part of the Report amounting to 60 octavo pages at 1.00 per page	60.00
Execution of a Map of the state to accompany the report	5.00
Total	267.955
Postage of a letter to New Bedford	0.125
Total	268.09
Received heretofore of the state for the survey	876.425
Amount sent December 5, 1831	268.04
Total	1144.465

[Expenses 14 1831]

Expenses incurred in my geological survey of the Commonwealth 1831

1831 February	
Postage on letters	
To Sutton	0.10
To Dorchester	0.125
To Williamstown	0.12
Paid Mr. Dickinson for freight on boxes from Boston and one back again	?.??
Ditto John Tappan Esquire for freight	?.??
April	
Postage on letters	
From Williamstown	0.10
From Milton	0.12
To Boston Drs. Bass and Smith	0.25
To Cambridge (Mr. Nuttall)	0.12
To Chapel Hill (Professor Hentz)	0.25
To Boston (Dr. Ware)	0.12
Ditto	0.125
To Worcester (Governor)	0.10
From North Carolina	0.50
From Newburyport	0.20
May 9th	0.75

[Expenses 15 1831]

May 10th Dinner–8 quarts of oats and hay (Assistant 0.20)	0.68
May 11th Supper breakfast lodging horsekeeping him quire of wrapping paper (Assistant 0.50)	1.625
Dinner and oats (Assistant 0.17)	0.50
Four quarts oats	0.155
May 12th Supper breakfast lodging etc. (Assistant 0.40)	1.43
Dinner and oats (Assistant 0.125)	0.44
May 13th Supper breakfast lodging etc. (Assistant 0.60)	2.00
Box for minerals and shading	0.12
Dinner (Assistant 0.25)	0.75
Map of Essex County	0.20
May 14th Wrapping paper two quires	0.125
Hostler	0.06
4 quarts oats	0.28
Dinner and oats (Assistant 0.20)	0.50
May 16th Box for minerals	0.20
Board over the Sabbath (Assistant 1.25)	4.00
May 19th Stage from Newburyport to Boston and back again	4.00
May 20th Board at Newburyport from Tuesday to Saturday (Assistant 3.50)	6.75
May 21st Lodging in horsekeeping (Assistant 0.42)	1.06
Oats and Bridge fare	0.20
May 2nd Dinner and horse (Assistant 0.375)	1.00
May 23rd Keeping over Sabbath (Assistant 1.00)	3.25
Breakfast (Assistant 0.25)	0.75
Bridge toll	0.10
Mending wagon	0.125
Bridge toll	0.10
Dinner (Assistant 0.17)	0.53
Five quires wrapping paper	0.25
Two boxes for specimens	0.37
Oats	0.125
May 24th Supper lodging (Assistant 0.375)	1.25
Breakfast (Assistant 0.17)	0.53

Oats	0.125
Dinner and oats (Assistant 0.17)	0.35
May 25th Supper breakfast lodging and horsekeeping (Assistant 0.375)	1.125
Tollgates and hostler	0.22
Oats	0.125
Dinner and Oats (Assistant 0.25)	0.68
Oats	0.125
May 26th Supper and lodging (Assistant 0.25)	1.00
Bridge toll	0.10
Oats	0.10
Dinner	0.25
Bridge toll	0.18
"	0.125

[Expenses 16 1831]

Four quarts of oats		0.125
Expenses of the whole tour		37.97
Add for expenses on first page		8.825
	Total	46.795
May 30th 6 quarts oats and hay		0.25
Dinner (Assistant 0.125)		0.25
Oats and hay		0.25
May 31st Lodging and horsekeeping (Assistant 0.125)		0.69
Oats		0.18
Supper and oats		0.25
June 1st Oats and straw		0.125
Ditto		0.125
June 2nd for postage on letters to the Governor		0.125

[Expenses 17 1831]

Expenses of the geological survey of Massachusetts

June 14th 1831	
Freight of three boxes from Boston	1.00
Postage of letter to Professor Hentz	0.25
Ditto Postage in reply	0.25
August 29th One quire wrapping paper	0.17
Bridge toll and oats	0.28
Steel pen	0.20
August 30th Supper lodging and horse keeping (Assistant 0.25)	0.97
Breakfast and oats (Assistant 0.125)	0.43
August 31st Oats	0.10
Dinner and Oats (Assistant 0.25)	0.62
September 1st Supper lodging etc. (Assistant 0.16)	0.52
Tollgate	0.10
Postage of letter and box for minerals	0.18
Breakfast and oats (Assistant 0.10)	0.55
Dinner and oats (Assistant 0.10)	0.55
Toll gate	0.10
September 2nd Supper breakfast etc. (Assistant 0.54)	1.50
Dinner and a guide to the top of Saddle Mountain	1.00
Bathing at Williamstown	0.17

[Expenses 18 1831]

September 3rd Lodging supper and breakfast and horsekeeping (Assistant 0.375)		1.25
For a piece of polish marble		0.25
Oats 0.125 paper 0.125		0.25
September 5th Gate toll		0.06
Box for minerals		0.125
Board from Saturday noon to Monday noon (Assistant 1.00)		3.00
September 6th Supper lodging (Assistant 0.18)		0.71
Breakfast (Assistant 0.25)		0.70
Dinner and oats (Assistant 0.10)		0.33
Paper and box for minerals		0.20
September 7th Breakfast lodging (Assistant 0.30)		0.82
Toll 0.20 Oats 0.12		0.32
Toll 0.08 bread and chips 0.08		0.16
Dinner (Assistant 0.25)		0.75
For specimens of Gibbsite		0.31
Two quires wrapping paper		0.125
September 8th specimen of marble		0.125
Supper breakfast and lodging (Assistant 0.525)		1.42
Specimen of iron ore		0.16
Box and paper		0.25
Dinner (Assistant 0.20)		0.50
September 9th Supper and lodging (Assistant 0.375)		0.94
Breakfast (Assistant 0.125)		0.42
Dinner (Assistant 0.08)		0.25
Wrapping paper		0.10
September 10th Lodging breakfast and horsekeeping (Assistant 0.23)		0.94
Oats		0.125
Dinner (Assistant 0.25)		0.625
Oats and bridge toll		0.25
	Amount of expenses	24.40
	Assistant	5.835
	Total	18.50
Letters boxes paper and minerals		3.695
	Total	14.875
September 19th Ferry		0.10
Dinner etc. (Assistant 0.25)		0.75

September 20th Horsekeeping		0.25
Dinner toll and minerals		0.40
September 21st Oats and hay		0.31
Paper and box for minerals		0.18
Bridge toll		0.125
	Total	4.115

September 29th Postage on a letter to Milton 0.125 to Pittsfield 0.10

[Expenses 19 1831]

To New Bedford 0.125 to Edgartown 0.18		0.54
October 8th Two letters from Newburyport		0.25
Toll and Oats at Northampton		0.375
October 25th Postage of letter to Williamstown Plainfield from Pittsfield		0.30
November 7th Postage of letters from New Bedford and Brimfield and Nantucket		0.375
November 2nd Bridge toll and oats		0.25
November 3rd Supper breakfast etc. (Assistant 0.62)		1.80
Dinner (Assistant 0.125)		0.47
Box and paper		0.25
November 4th Box and paper		0.125
Dinner and oats (Assistant 0.125)		0.475
November 5th Supper lodging breakfast etc. (Assistant 0.62)		1.24
Dinner and ferry (Assistant 0.20)		0.62
	Whole expenses for four days	5.23
	Assistant	1.69
	My own and horse (subtract)	3.54
November 10th Freight on five boxes from Berkshire County viz. 1.33 at Northampton and bridge toll 0.25 at Greenfield 0.75		2.33
November 18th Two bridge tolls		0.18
November 19th Supper breakfast		1.125
Three bridge tolls		0.25
Letter postage to Windsor		0.10
November 27th freight on boxes from Blandford		0.25

January 1, 1832–Mail out a bill of all expenses to this date

[Expenses 20 1832]

January 1st 1832

Letter from Worcester three letters from Boston	0.48
Freight on package to Professor Silliman	0.25
Quire of the paper for copying report	0.15
January 3rd Expenses of going to Greenwich on business connected with coloring the maps	0.375
January 4th Postage of three letters one to Boston one to Braintree one Randolph	0.37
January 24th Two letters of New Haven and one to Boston	0.375
For putting up marble specimens	0.50
Freight on a box of marl from Pittsfield	0.25
January 27th Letters from Boston (Cary and Dickinson)	0.125
January 30th One letter from and two to Mr. Pendleton and freight on one proof map	0.50
February 3rd Freight on map to Professor Silliman	0.25
February 5th Ditto	0.25
Letter to Pendleton	0.125
February 22nd Ditto	0.12
February 22nd Letter (double) from Leominster	0.20
Ditto from Braintree	0.125
Ditto from Cary and Dickinson	0.125
February 29th Ditto from Pendleton	0.125
Ditto from Professor Silliman	0.125
Ditto to Pendleton	0.125
March 10th A letter to ? from Professor Silliman and one to Pendleton	0.37
March 19th Letter from Professor Silliman to the governor	0.25
March 21st Letter to the governor	0.125
April 5th Letter from Professor Silliman	0.125
April 10th Freight on four boxes from Boston of 425 pounds and one to Boston of 100 pounds	3.93

May 1, 1832

Made out my account against Government and included all the above charges marked with a cross–the rest are to be settled with Mssrs. Adams.

April 30, 1830 Sent a draft on US Branch Bank in Hartford to General Hershiak Howe of New Haven amounting to 77.32 in payment of his bill for printing 1100 copies of the Geological Report.

[Expenses 21 1832]

May 7th Paid Mr. W. S Pendleton bill of $125.55 by an order of $100.00
on the state treasury and the remainder in cash.

May 8th Two letters from Professor Silliman 0.25

[Expenses 22 1832]

Commonwealth to Edward Hitchcock

1832 Postage on 27 letters		3.59
Freight, boxes, paper, marble, minerals		15.19
Stage fare to Nantucket etc.		28.25
Board and horse and paper same trip		15.87
Personal services 17 days same trip		102.00
(Assistant expenses paid on the route)		9.50
Expenses for 21 days in September October and November		17.70
Horse and wagon 21 days		31.80
Personal services 21 days		126.00
	Total	350.60

Amherst, January 1, 1832 [?] Edward Hitchcock

January 18th Received the above sum of the treasury of the state $10.50
for horse hire not allowed by the council -340.50

[Difference] 10.10

[From Geological Notes 3, p. 24]

Expenses Incurred upon a geological survey of the Commonwealth 1832

May 8th Fitting a leather bag for hammers	.375
May 11th Stage fare to Worcester	2.25
Breakfast dinner supper and lodging	1.375
May 12th Breakfast	0.375
Stage fare to Providence	1.50
Passage from Providence to Newport and dinner	1.50
Coach from steamboat	0.50
Boat to visit Ft. Adams	0.50
Shaving and crackers	0.13
May 14th Horse and chaise 5 miles Newport to ____rocks	1.25
May 5th Board for three days	2.75
Stage fare to New Bedford	2.25
May 17th board 1.5 days	1.50
Fare from N Bedford to Nantucket	2.00
Breakfast and dinner	0.50
May 19th Board for two days	2.00
Board for Mr. Belcher	2.00

[Possibly Nathan Belcher 34; see letter to Silliman 1834]

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May 19th Passage from Nantucket to Holmes Hole	1.50
Ditto for Mr. Belcher	1.50
Dinner for each of us	0.50
Ride to Chilmark 10 miles	2.50
May 21st from ___ to Gay Head for myself and Mr. Belcher	1.25
May 25th Board for three days	2.125
Dtto for Mr. Belcher	2.125
Barrel for minerals	0.25
To bag for specimens	0.10
Passage to N Bedford	1.25
Ditto for Mr. Belcher	1.25
Box and paper for minerals	0.62
Carting baggage and minerals	0.17
May 25th Let Mr Belcher have five dollars	5.00
Paid also his bill	0.56
May 28th Board four days	4.00
Working six articles	0.375
Stage fare N Bedford to Providence	3.00
To porter	0.26
June 1st Horse to Cambridge from Boston	1.00
Horse keeping and blacking boots	0.25
Bridge toll	0.08
Stage fare from Boston to Worcester	2.30

June 2nd Day's board	1.00
Horse and chaise to quarry in Worcester	0.50
Stage fare from Worcester to Amherst	2.25
Dinner	0.375
Carrying trunk	0.125
TOTAL EXPENSES	59.72
Paid for Mr. Belcher	14.56
My own expenses	45.12
June 15th postage of three letters to Duxbury, Taunton, and Philadelphia	0.43
Ditto of me from Philadelphia	0.1875
Ditto of excursion of one day with Mrs. H to take landscape Sugarloaf–expenses	0.50
June 21st Excursion of 2 days with Mrs. H. to take landscape	0.25
June 28th Paid for sawing out flexible marble	3.00
July 14th Paid freight of box of minerals to Boston	1.25
Letter to Newport	0.125
August 15th expenses during a day spent in collecting and drawing on Mt. Holyoke	0.825
Postage on letter to Philadelphia	0.19
September 14th Letter to Pittsfield and Williamstown	0.20
Freight on barrel of org. sem. From N Bedford	0.63

[Expenses 23]

Blank

[Expenses 26 1833]

Commonwealth of Massachusetts to Edward Hitchcock

1833

January 15th Paid Cary and Dickinson in Boston (stonecutters) for smoothing and polishing about 240 specimens of marble serpentine granite and porphyry two of which I suppose is reasonable the government should pay about 20 as I take a part of the specimens In the poorest of the least less than half (see Cary and Dickinson receipt)	28.32
February 28th Postage on three letters Boston and Waltham	0.355
March 9th Letter to Cambridge and Waltham	0.225
March 20th Letter to Troy in New York	0.31
March 22nd Letter from Boston and double one to Boston	0.375
March 26th Letter from Troy to Boston	0.25
April 8th Two letters from Boston one from Sutton and one to Worcester	0.45
April 29th Letter from Boston and to Troy	0.25
May 8th Expenses on the tour to Albany etc. of seven days personal services	9.795
Personal services from May 2 to May 8 included	42.00
Horse and wagon for the same	10.50
May 18th Expenses on the tour to Providence etc.	7.71
Personal services from May 13th to May 18th 6 days	36.00
Horse and wagon for the same	9.00
May 20th Letter from Boston	0.125
July 20th Five letters to and from Pendleton Boston	0.62
August 26th Four letters to and from Boston and New Bedford	0.50
August 30th Letter to and from New York	0.39
September 30th Letter to and from Boston	0.25

[From Geological Notes 1833 Book 4]

Expenses of geological tour

May 2, 1833		
	Ferriage	0.125
	Oats	0.14
	Dinner and oats	0.395
May 3		
	Supper breakfast lodging and housekeeping	1.00
	Oats	0.73
	Dinner and hay	0.28
	Oats and turnpike gate	0.15
	Two other gates	0.08
May 4		
	For supper breakfasts housekeeping	0.81
May 6		
	Board and housekeeping two days	3.10
	Ferries and tollgates	0.375
	Dinner and oats	0.45
	Tollgates and minerals	0.20
May 7		
	Lodging breakfast and housekeeping	0.66
	Horse dinner and tollgate	0.50
May 8		
	Supper,lodging,toll,breakfast,dinner,horse	1.15
	Oats and bridge toll	0.19
		Total $9.79

[NEW EXPENSES 1 1833]

Expenses

May 13, 1833	
Dinner and 8 quarts oats	$0.34
May 14th Breakfast dinner horsekeeping and tollgate	$1.17
May 15th Supper lodging breakfast and horsekeeping	1.00
Dinner oats and two tolls	$0.60
May 16th Supper lodging horsekeeping and toll with breakfast	$1.53
Dinner horse and tolls	$0.93
May 17th Dinner and oats	$0.31
May 18th Supper lodging horsekeeping breakfast and dinner and paper	$1.83
Total	$7.71

[NEW EXPENSES 2 1833]

Commonwealth of Massachusetts to Edward Hitchcock

1833

January 15th Paid Cary and Dickinson of Boston for smoothing and polishing 130 specimens porphyry, granite, and serpentine and in the general collection items which work I was permitted by the Governor to get done provided cost should not exceed $20.00	20.00
Postage on 32 letters from February 28 to September 30	4.00
May 18th Expenses for myself and horse on two geological tours this month one of seven in the other of six days	$17.50
Horse and wagon for conveying specimens during the same time 1.50/day	$19.50
Personal services for the same time 13 days at 6.00 per day	$78.00
October 1st for writing the second and third parts of my report at one dollar per printed page see report	$470.00
Paid to amanuensis for preparing the fourth part of my report	$20.00
For arranging ticketing and packing including paper boxes for packing the specimens which I've collected for the government and the three colleges in the state amounting to nearly 5000 in making a catalog of the state	$100.00
Total	$729.08
[In pencil]	$350.50
[In pencil]	$960.55
[In pencil]	$2030.00

[EXPENSES 4 1833?]

Cost of 600 copies of my report

[Undated, probably around 1833]

Paper and printing and freight on same from New Hampshire	$42.18
For lithographing the map	$50.00
Paper and printing 600 copies	$42.00
Freight on the same from Hartford	$4.25
Coloring 600 copies	$36.00
Postage on letters and freight on packages ??? at Amherst	$6.65
Printing title page contents and cover	$6.55
Folding and covering the same	9.00
Amount	$196.63

Second page

August 7 Discussed M. M. Strong who has not paid his room rent four weeks ago I gave a discussion to

Case of Houston Mr. Strong the writing master.

[From Geological Notes Book 6 1834?]

<<<PROOFING COMPLETED 9/9>>>
Page 1

September 26		
Bridge toll		0.10
Dinner and oats and guide		0.53
Three quires paper		0.20
September 27		
Supper breakfast lodging		0.65
For minerals		0.375
Dinner		0.125
September 29		
Oats		0.13
Ferriage		0.10
	Total	2.21
Paid Dr. Wright for specimens of minerals		1.00
	Total	$3.21

[Expenses 27 1837]

Commonwealth of Massachusetts to Edward Hitchcock

1837

June Paid for trowel to dig soils, preparing drills: three quires of wrapping paper and book for catalog of specimens collected	3.37
Postage on 10 letters relating to the geological survey	1.34
For printing 250 circulars respecting survey	5.00
For 100 boxes for specimens of soils	8.00
July 5th Personal services June 14th, 21st, 27th, and July 4th at 6.00 per day	24.00
Assistant for four days	8.00
Horse and wagon for four days at 1.50 per day	6.00
Expenses for four days	1.975
August 2nd Personal services for 24 days from July 10 to August 2 inclusive	144.00
Assistant for 24 days	48.00
Horse and wagon for 24 days	35.00
Expenses for myself assistant and horse 24 days	33.06
Total	318.74

[Expenses 28 1837]

Commonwealth of Massachusetts to Edward Hitchcock

For services at geological surveyor

1837 For postage on letters and circulars from October 16, 1837 to March 24, 1838		7.15
Freight on boxes of specimens during the same period.		4.45
Assistance in getting out specimens		10.81
Traveling expenses for same time		16.27
170 white glass half pint bottles for soils marls etc.		10.35
Blank book for records		0.50
Horse and wagon three days		4.50
Personal services 111 days between October 16, 1837 and March 25, 1838 in analyzing soils preparing reports and labor in the fields at 6.00 per day		666.00
Assistant in analyzing soils 40 days at 2.00 per day		80.00
Expenses of apparatus and ingredients for analysis		50.00
	Amount	$850.03

[Expenses 29 1838]

Commonwealth of Massachusetts to Edward Hitchcock
for services as geological surveyor

1838	
Postage between August 23rd and November 12th	0.22
Blank book for recording analysis	0.37
Personal services from August 23rd to September 22nd	
31 days at 6.00 per day	86.00
Assistant 24 days	48.00
Horse and wagon for 24 days	36.00
Expenses for myself (Assistant and horse from August 23rd to September 22nd	40.125
August 22th For a guide upon the mountains today two days	2.00
October 4th Expenses on a journey of 12 days to Philadelphia relating to	
the geological survey	12.245
Personal services during the same period of 12 days	72.00
October 30th Paid Deacon Robert Peckham (voucher enclosed) for the	
224 paintings of geological specimens	18.00
Board of himself and horse 12 days	7.00
November 12th for assistant in making an analysis of soils 35 days	70.00

[Expenses 30 1838]

November 12th personal services and making analyses 20 days 120.00

[Expenses 31 1843-1844]

Commonwealth of Massachusetts to Edward Hitchcock

1843	
For eight days service in retracing and revising the geological map of the state at 6.00 per day	48.00
For postage and freight on packages by express	1.75
1844	
January for fare from Amherst to Boston and from Boston to Amherst	8.00
For 3½ days board in Boston	5.25
For three days service in revising the proof of the map in Boston	18.00
Amount	81.00

March 22 received the above

E Hitchcock