Biology 117- Introduction to the Geology of the Messiah College Campus
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If the earth beneath our feet seems solid and unchanging, it is only because we see so brief a portion of its life process. Change, slow and continuous, is everywhere, and the dramatic story is written all over the rocky face of the earth. It is a story of mountains which have sunk beneath the ocean and are still sinking: of submerged forests and of hapless seaport towns which have crumbled into ocean waters. (Elliott Roberts, Our Quaking Earth, 1969)

Devotion-
The combined events since the beginning bring us to a unique point in history and formed the very geography that helps give Messiah College its special sense of place- its beautiful Yellow Breaches Creek, its rolling hills, the trees of its woods. An understanding of this history is necessary for understanding the place itself. If you are struggling with the dates on the geologic framework that's fine. However you must learn what ages geologists assign to these rocks regardless of what age you assign to them. At the very least so you will know the common argument.

Geologic History of Messiah College Area
Devotional: Habbakuk 3:6 He stood and measured the earth: he beheld, and drove asunder the nations; and the everlasting mountains were scattered, and the perpetual hills did bow; his ways are everlasting. 7 I saw the tents of the land of Cushan in affliction: and the curtains of the land of Midian did tremble. 8 Was the Lord displeased against the rivers? Was thine anger against the rivers? Was thy wrath against the sea, that thou didst ride upon thine horses and thy chariots of salvation? .... 10 The mountains saw thee and they trembled: the overflowing of the water passed by: the deep uttered his voice, and lifted up his hands on high.

The Source of Important Rocks circa the Yellow Breeches

Pre Cambrian
Pre opening of the Proto Atlantic. Greenville Orogeny. 1 BYBP to 600 MYBP- South Mountain Meta Volcanics (rhyolite)

Cambrian
570-500 mybp – many carbonates deposited along the continental shelf, of which the ones forming the valley floor the yellow breeches runs in most significant. Marine Life proliferates at this time. Ct on 1939 Map, Tomstown Dolomite (South of Willow Grove), at Willow Grove race track on Lisburn Road there is red shale and limestone Waynesboro formation. Mid-Cambrian Elkbrook Limestone N of Willow Grove. Older, Lower Cambrian Antietam Quartzite forms the top of White Rocks ridge.

Ordovician
Deposits include abundant carbonates in lower Ordovician strata, sandstone and shale in upper. These rocks yield calcium to the water of the yellow breeches. Calcium forms the basis for much of the biological productivity, directly as an ion important in many life processes and structures, and indirectly as bicarbonate (HCO_3-) which serves as an alternate carbon source for photosynthesis in aquatic plants.

Late Ordovician 440-435 MYBP- Closing of Proto Atlantic forms Taconic Mountains (see handout)

Then the Acadian Mountains and supercontinent Laurentia of NA and Eurasia
Remnants include Juniata sandstone (top of North Mountain ridge) underlain by darker, carbonate rich, Martinsburg Shale (Orchard Hill, Messiah College).

Mississipian
345 MYBP- Acadian Mtn Orogeny as Europe and NA collide, continents separate, proto Atlantic forms.

Pennsylvanian
325-280 MYBP, shallow inland seas, tropical climate, coastal swamps advance and retreat their peat forming layers of coal. Messiah is near equator.

Permian
280-225 MYBP, proto-Atlantic closes as Pangaea assembles (ca. 250 mybp.),

Alleghenian/Appalachian Orogeny (300-220 mybp) from collision of ancestral Africa and NA, thrust faulting, anthracite (such as that near Reading) forms under intense compression of soft coal. Followed so closely after Acadian that no carbonates were deposited. Messiah is central to edge of this collision that threw up ridge and valleys that line central Pennsylvania and run N into New York.
Dinosaurs arise. (See Handout)

Triassic
225-190 MYBP, Pangaea begins to rip apart, subsidence of zone along
collision forms the Gettysburg Valley as it fills in from sediments of eroding mountains the block faulting allows intrusions of diabase dikes such as the two that come together forcing the water out of Permian limestone below at Boiling Springs to start the Yellow Breaches, widespread volcanism and desertification. Messiah is now at ~20 degrees N latitude on the margins of a large desert and the edge of proto NA. The blowing dune sands from this interior desert form the red sandstones interbedded with shale found commonly in the Gettysburg basin.

TrD- Triassic Diabise, Dikes and Sills, much of this is rich in Iron.

Trpd- a differentite of diabase (Pegmitic) with pink feldspar and hornblende. These are newest of Triassic Rocks.

TrGs- Heidelburg member-conglomerate beds

Trh- conglomerate beds

TrLC- conglomerate beds (our “limestone” cliffs)

Jurassic
190-136 MYBP, most of the rest of the rocks in this area lain down by erosive deposits during this era as the Proto Atlantic opens. Mammals arise ~ 165 MYBP but do not diversify.

NA moving (and thus Messiah with it) slowly northward.

Other than erosional deposits and sedimentary phenomena, most of Messiah's and the Yellow Breeches Rocks are formed already.

Cretaceous
136-65 MYBP, continents continue to drift and erosion marks the landscape. By about 110 MYBP the genera of angiosperms making up our present deciduous forests are represented in the fossil record. Center of diversity for these groups are in the central Appalachians.

The close of the Cretaceous period is marked by massive animal extinction. 90% of all animal families extinct in ~ 2 million years including the dinosaurs. Mammals widely diversify.

Tertiary
65-2 MYBP continents approach present positions. The Atlantic Ocean largely open. Earliest hominid fossils appear near the close of the Tertiary Period.

Quaternary Period, Pleistocene epoch
2-0.01 MYBP, cyclical glaciation dominates Northern Hemisphere. Wave after wave of ice sheets till the land with glacial periods marked by dramatic decreases in seas level (extending shoreline as far as 100 miles into Atlantic Ocean). Humans make it to NA and SA late in this cycle perhaps over the Bering land bridge and are definitely present by 9,000 YBP. Recorded biblical history and agriculture begin shortly after last cycles of glaciation.

Quaternary Period, Holocene epoch
10 KBP to present, opening of this epoch is marked by global warming of at least 2.3 C greater than present. Ice margins retreat. Global CO2 levels increase from about 210 ppb (parts per billion) to 280 ppb, where they remained until industrial revolution. Wave of vertebrate extinction between 12K and 10 KYBP (50 species in NA). At 7 KYBP the temperature reached a maximal level here in PA. Sea levels were much higher and the landscape was much drier. Cooling from this period until nearly 90YBP. Present boundaries of many species farther south now than during this period.