

David R. Montgomery



# dirt

The Erosion of Civilizations

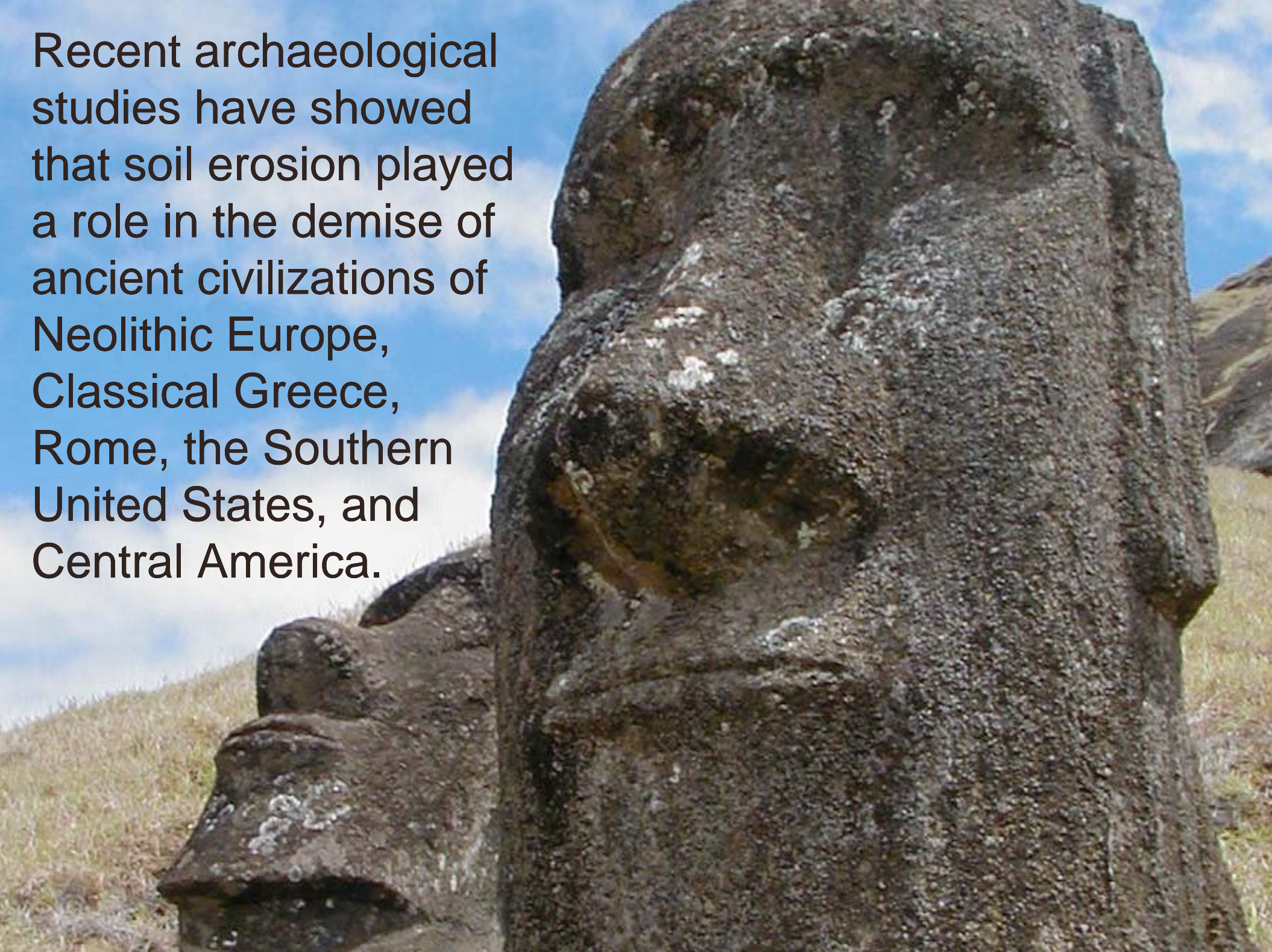


# What would be required to sustain a civilization?

Recognizing that >97% of our food comes from the soil, the fundamental condition for sustaining a civilization is sustaining the soil.

Can soil erosion limit the lifespan of civilizations?

Recent archaeological studies have showed that soil erosion played a role in the demise of ancient civilizations of Neolithic Europe, Classical Greece, Rome, the Southern United States, and Central America.



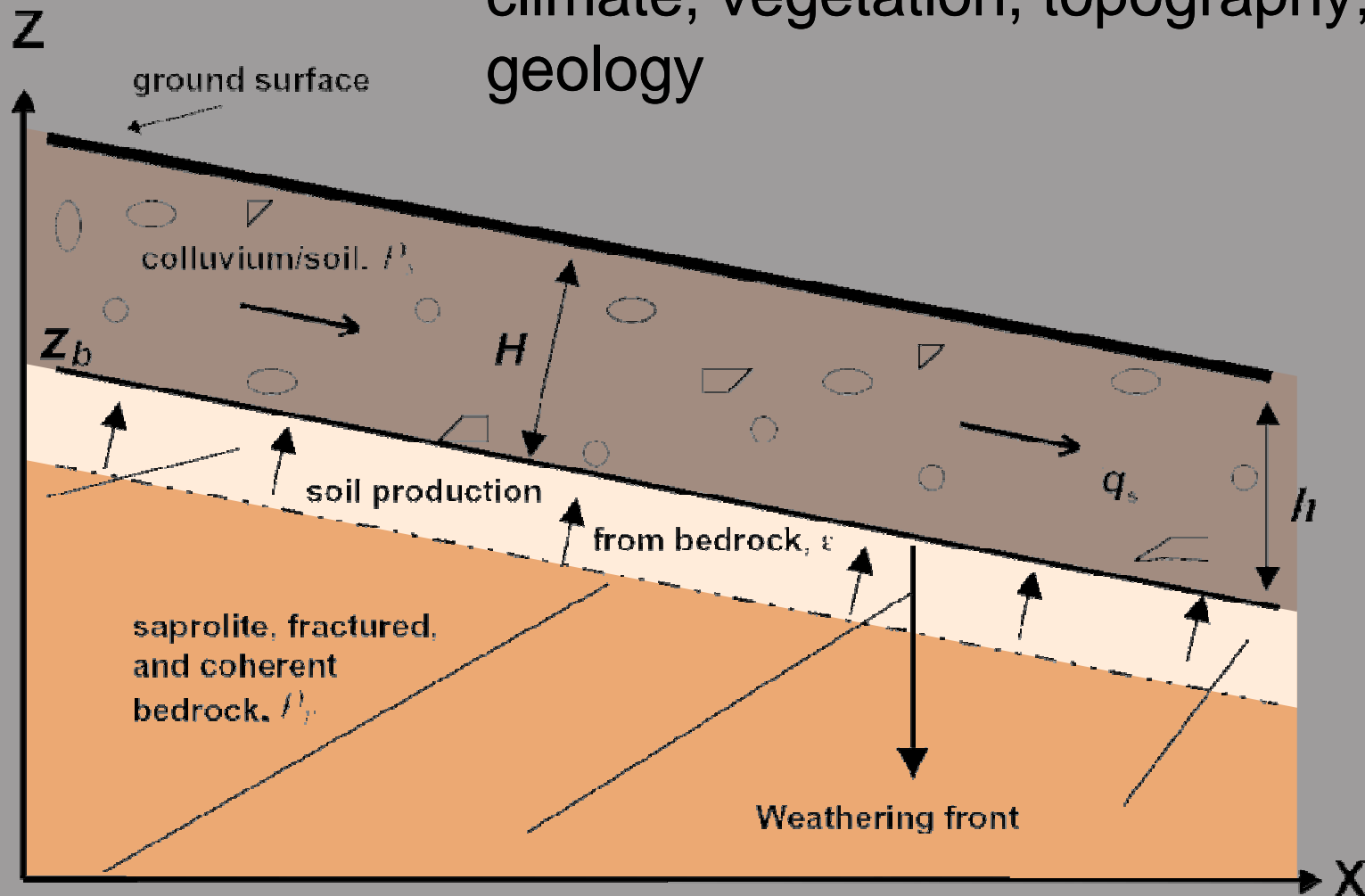
Deforestation often blamed for historical soil erosion, but trees grow back rapidly...



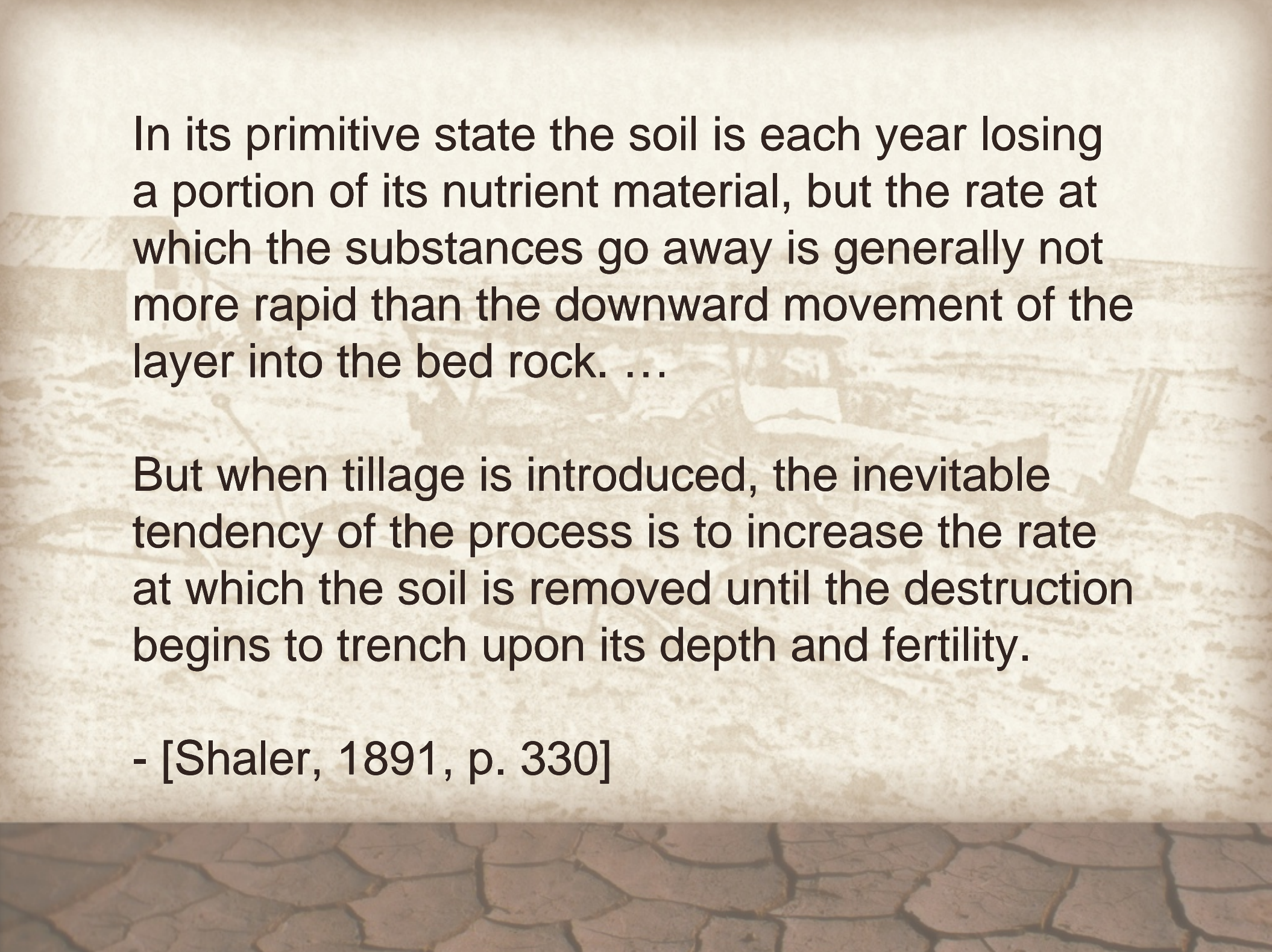
Invention of the plow fundamentally altered the balance between soil production and soil erosion



Under native vegetation, a typical soil thickness develops, reflecting the local climate, vegetation, topography, and geology



Over time, the change in soil thickness equals the net difference between soil production and soil loss.

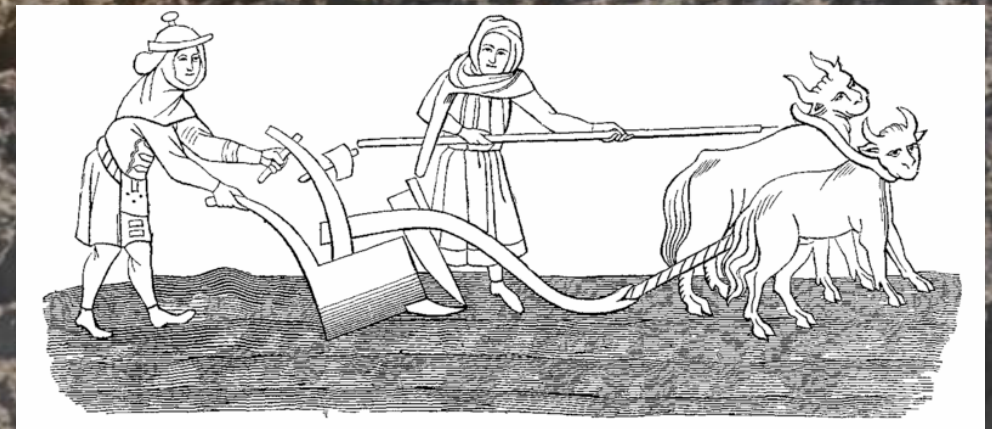
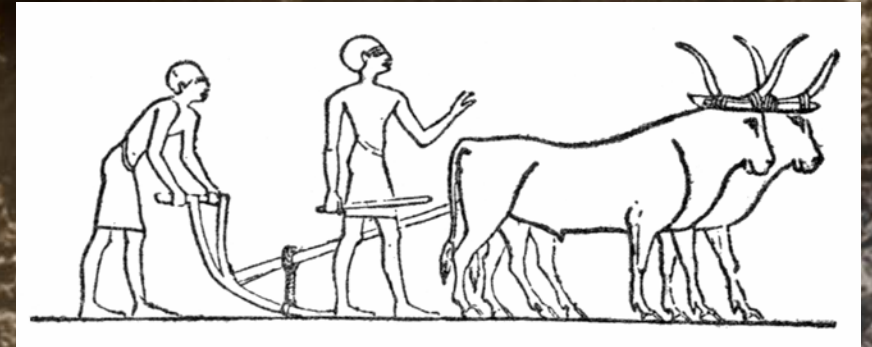
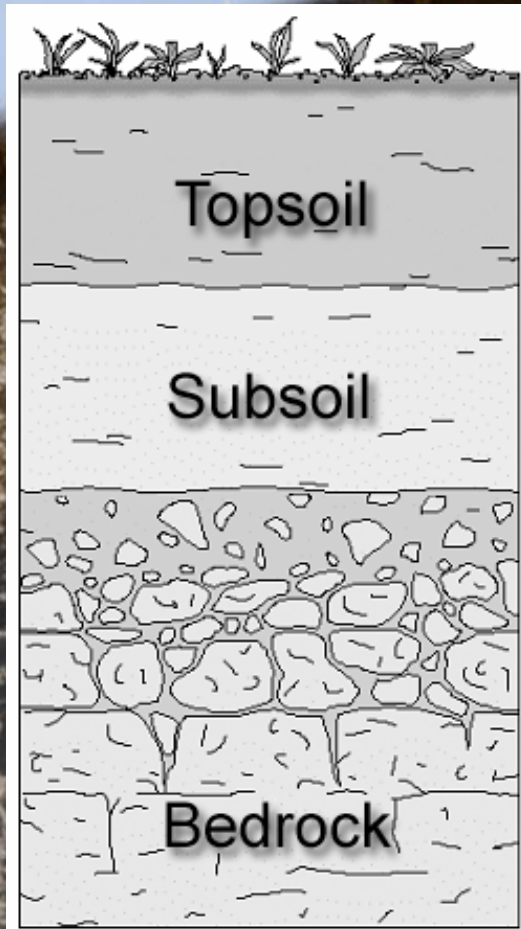


In its primitive state the soil is each year losing a portion of its nutrient material, but the rate at which the substances go away is generally not more rapid than the downward movement of the layer into the bed rock. ...

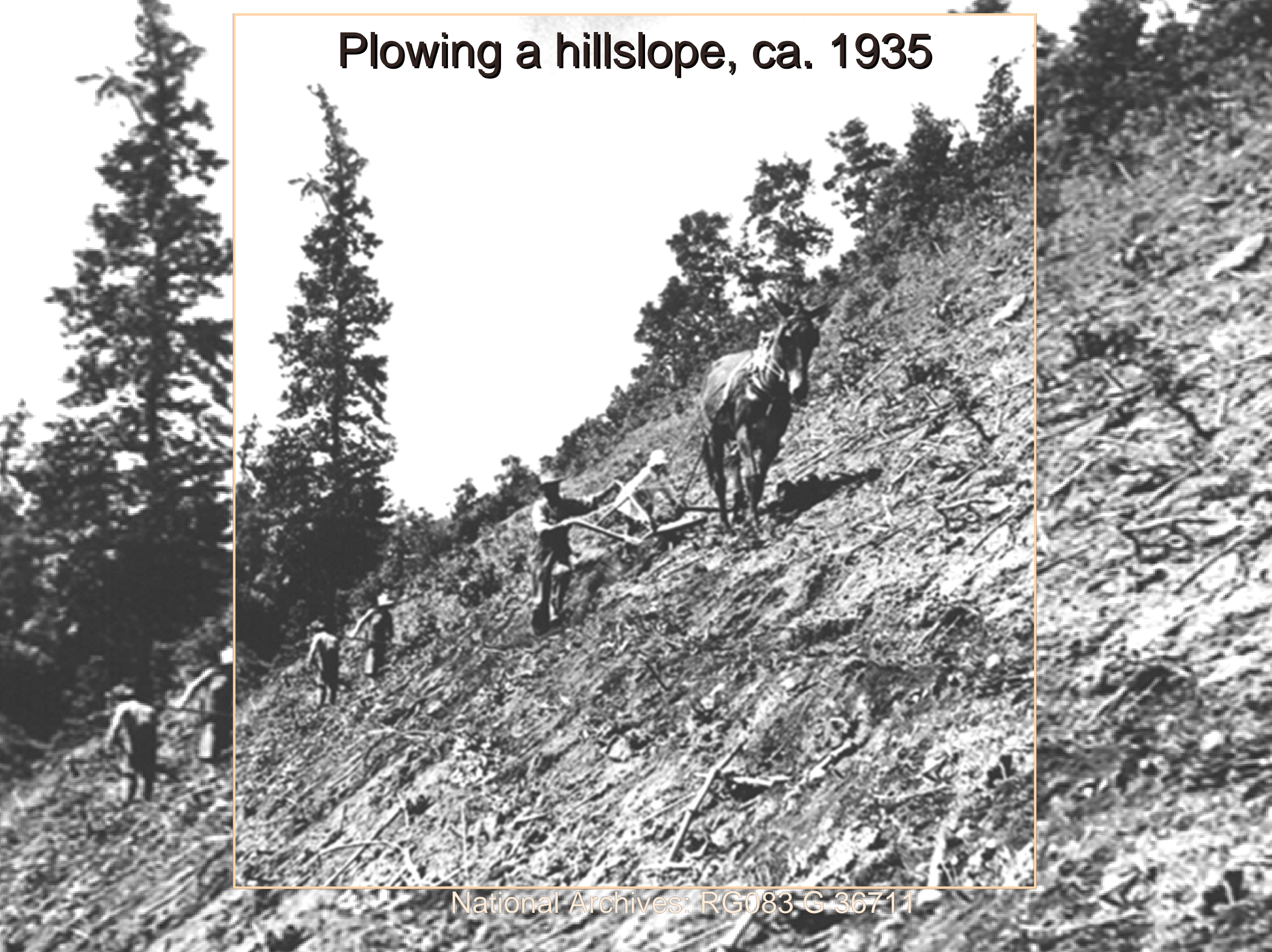
But when tillage is introduced, the inevitable tendency of the process is to increase the rate at which the soil is removed until the destruction begins to trench upon its depth and fertility.

- [Shaler, 1891, p. 330]

Conventional plow-based agriculture increased soil erosion by more than an order of magnitude...



# Plowing a hillslope, ca. 1935



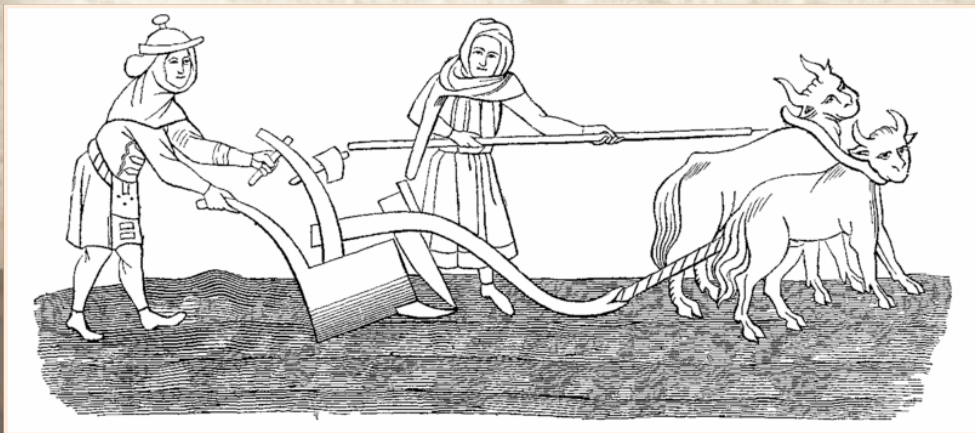
National Archives: RG083 G 36711

# Post-Revolution France

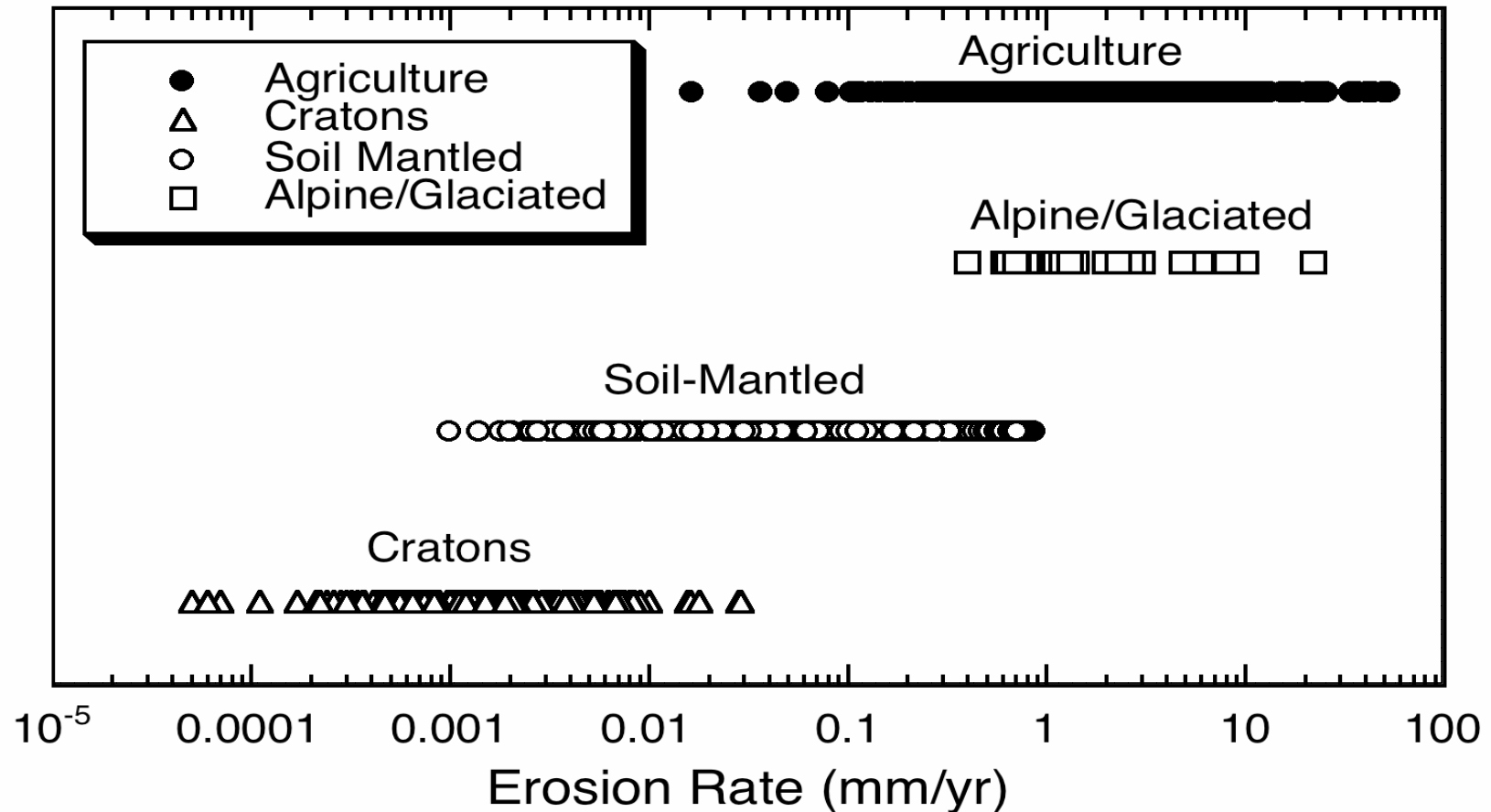


Lowdermilk (1953)

In researching the book, I began compiling additional data on both contemporary and long-term (geological) erosion rates—and agricultural erosion rates in particular...

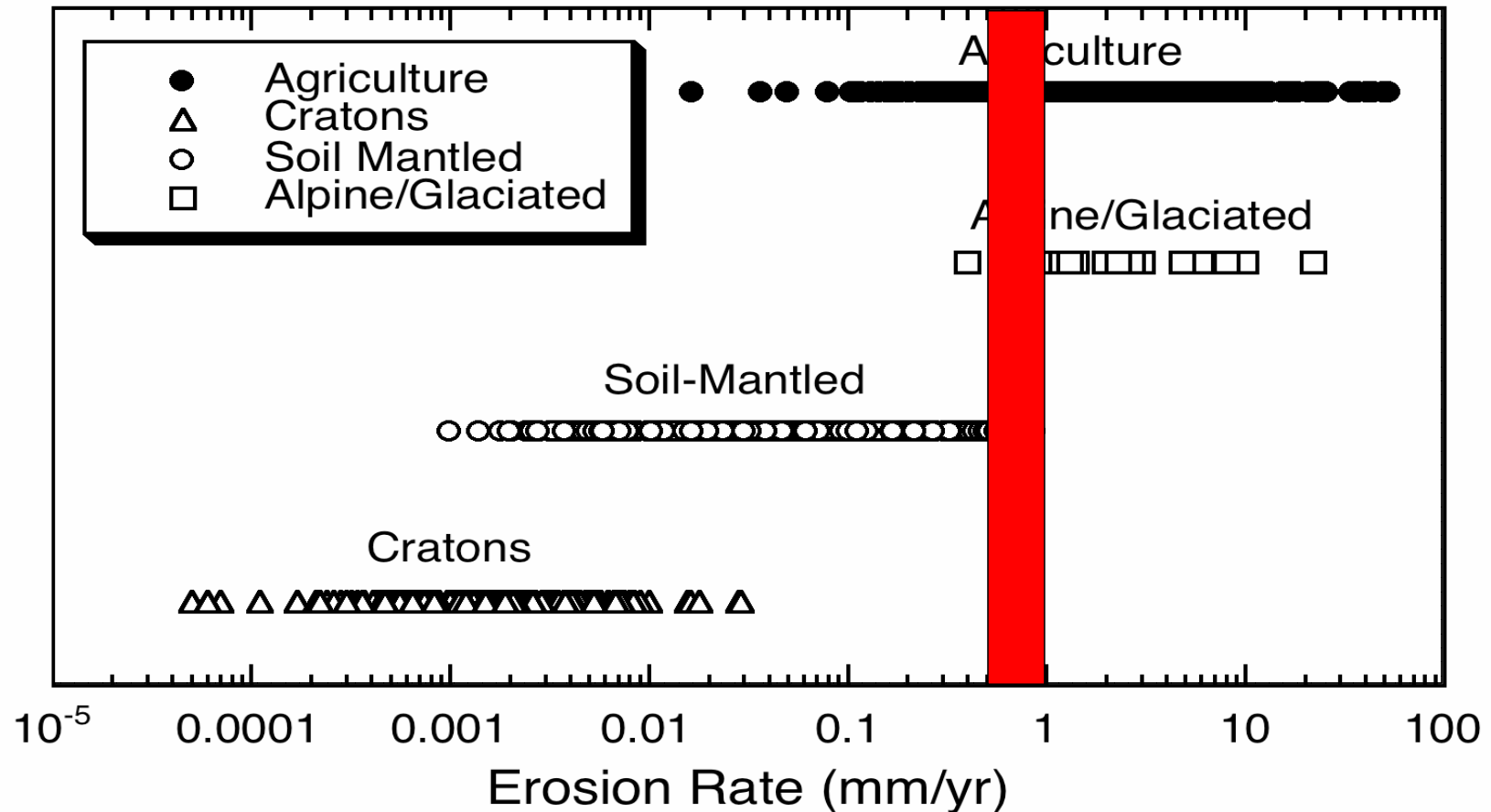


# 1402 measurements of agricultural and geological erosion rates



Did not include sediment yield and USLE-based studies

USDA soil loss tolerance values range from 0.4 to 1 mm/yr

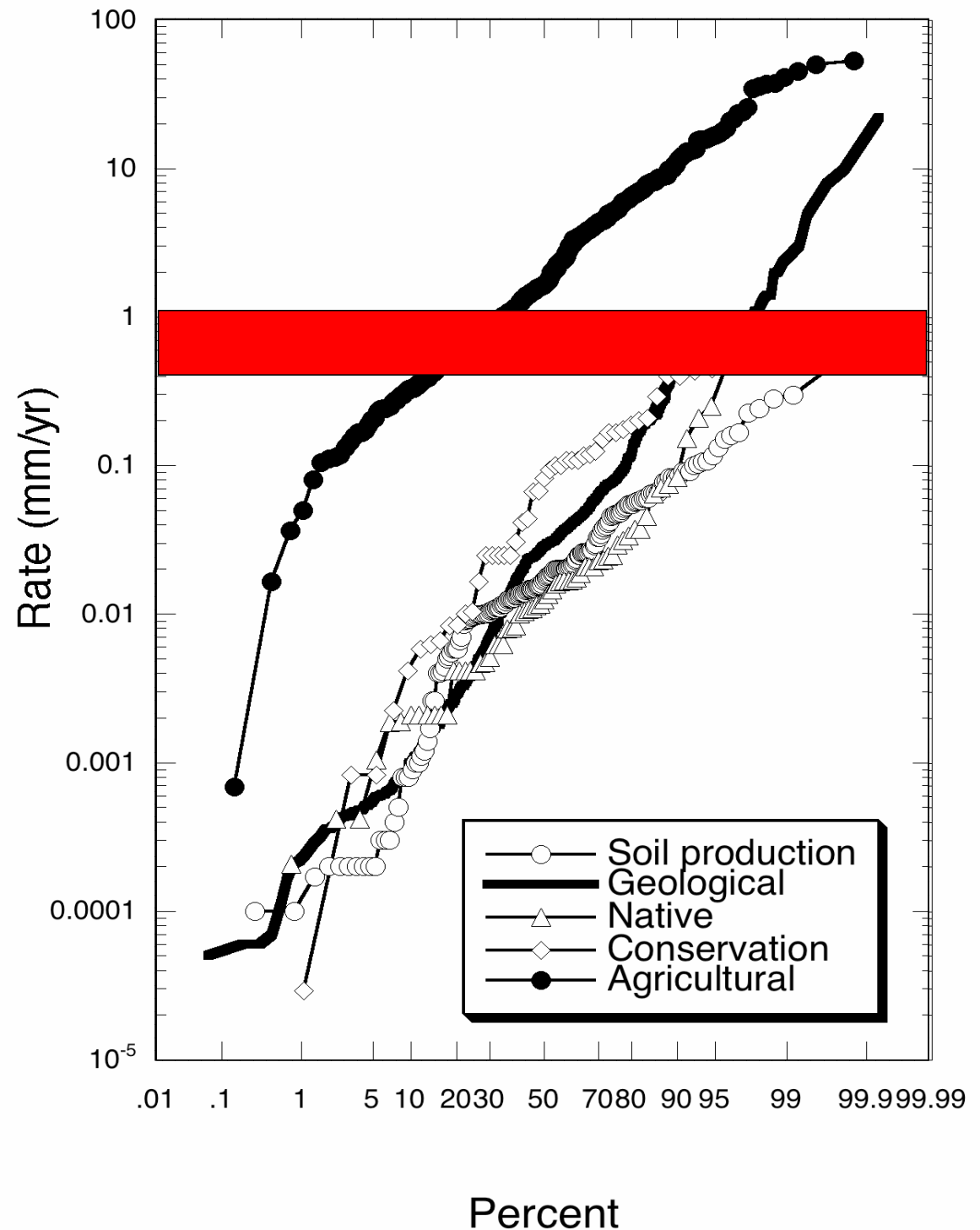


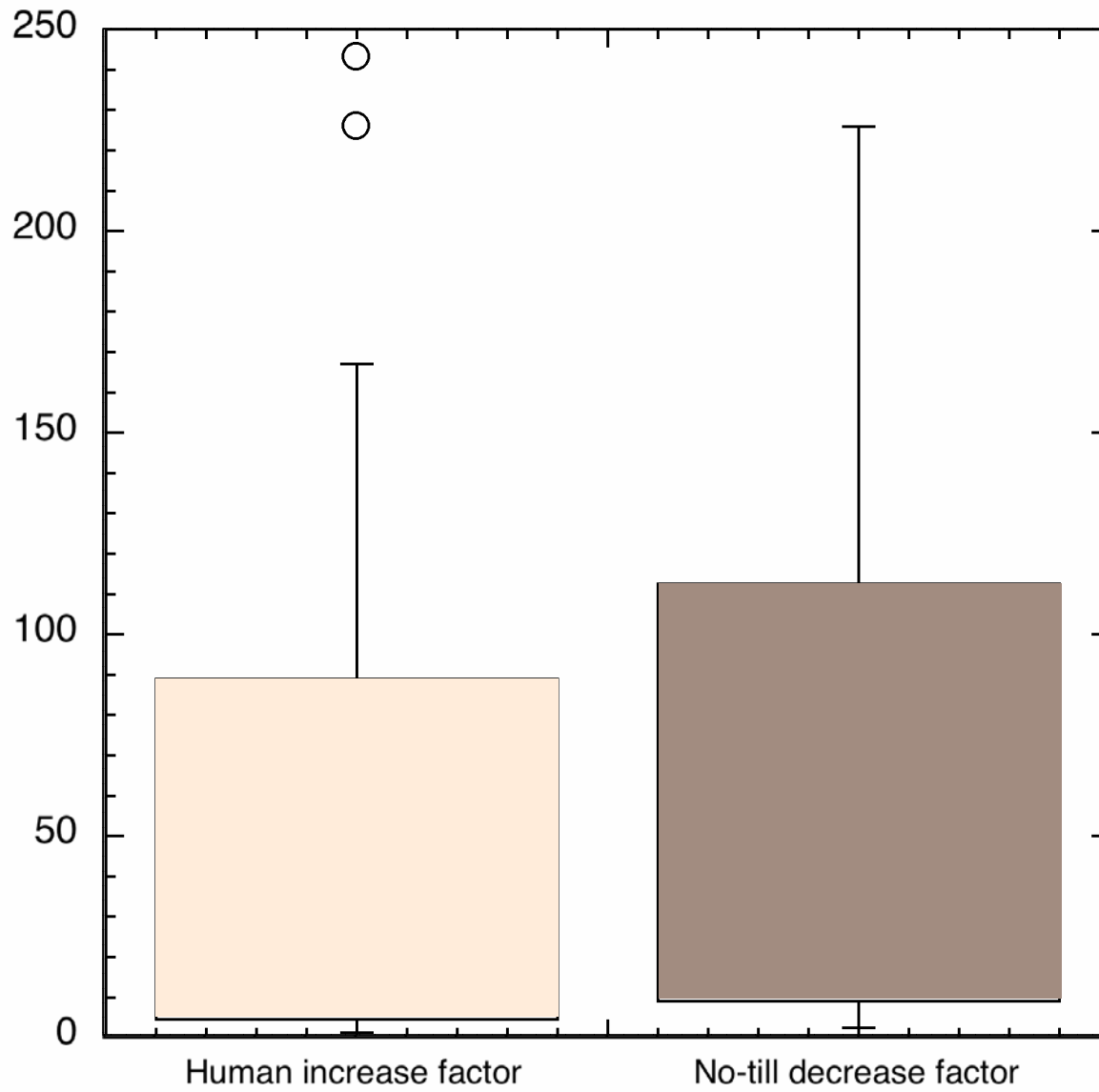
Farms erode like alpine topography

Conventional agriculture unsustainable in soil-mantled landscapes

Probability distributions for geological erosion rates, erosion under native vegetation, and by no-till agriculture are all comparable.

Erosion from conventionally plowed fields generally exceeds T values



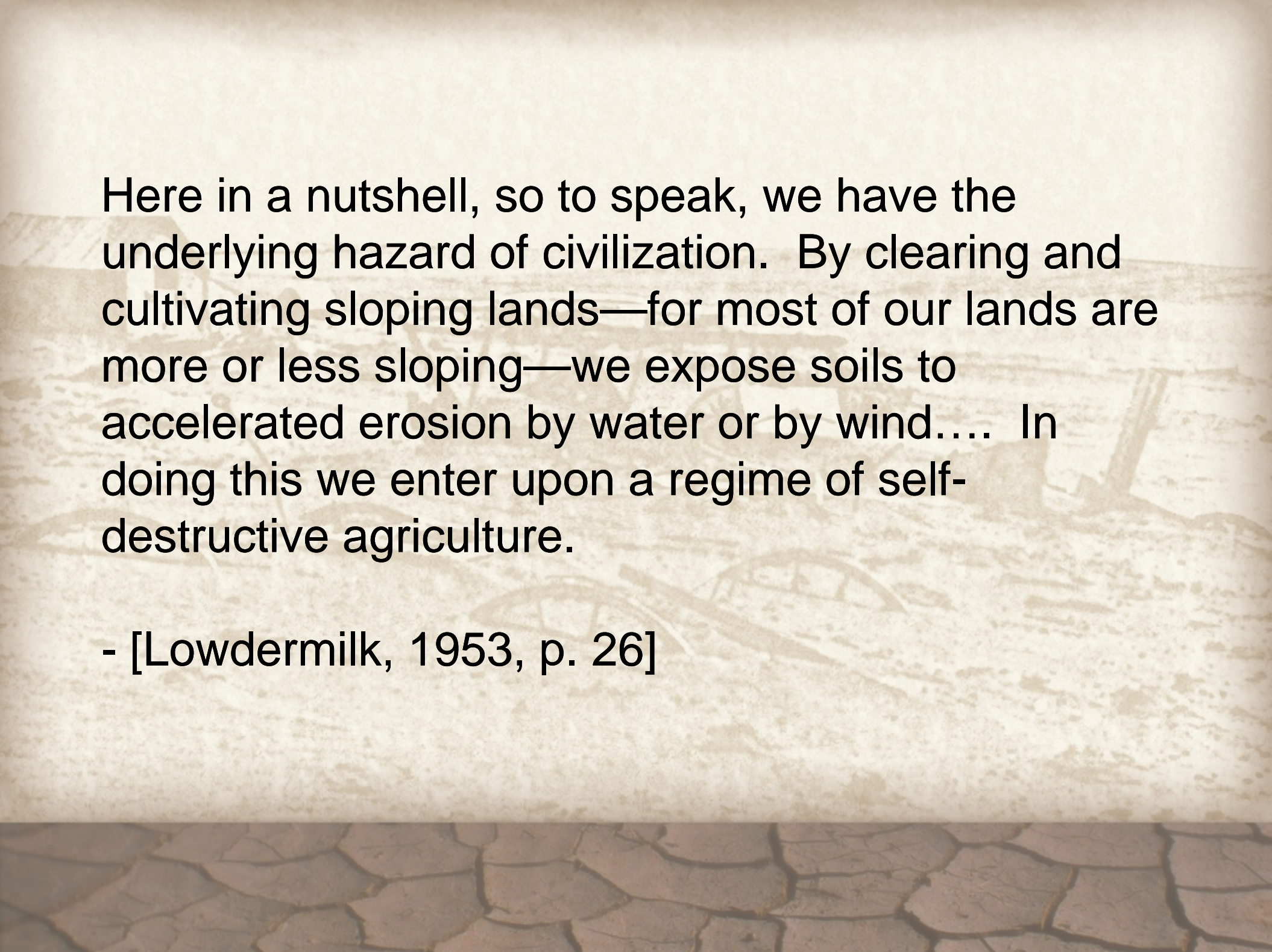


# Erosion Rates

Measurement type (sample size)	median (mm/yr)	mean (mm/yr)
Conventional Agriculture (448)	1.537	3.939
No-till Agriculture (47)	0.082	0.124
Native Vegetation (65)	0.013	0.053
Soil Production (188)	0.017	0.036
Geological (925)	0.029	0.173



1 to 2 order of magnitude increase in soil erosion under conventional agriculture implies that erosion of a typical 0.5 - 1 m thick soil could occur in roughly 500 to 2000 years; approximately the lifespan of most civilizations...



Here in a nutshell, so to speak, we have the underlying hazard of civilization. By clearing and cultivating sloping lands—for most of our lands are more or less sloping—we expose soils to accelerated erosion by water or by wind.... In doing this we enter upon a regime of self-destructive agriculture.

- [Lowdermilk, 1953, p. 26]

A nation that destroys its soils, destroys itself.  
– President Franklin D. Roosevelt, Feb. 26, 1937.





David R. Montgomery



# dirt

The Erosion of Civilizations