A Little More Stratigraphy

Fraser D. Neiman

Thomas Jefferson

Excavation of a Mound at Monasukapanough, 1784

I proceeded then to make a perpendicular cut through the body of the barrow, that I might examine its internal structure. This passed about three feet from its center, was opened to the former surface of the earth, and was wide enough for a man to walk through and examine its sides.

At the bottom, that is, on the level of the circumjacent plain, I found bones; above these a few stones, brought from a cliff a quarter of a mile off, and from the river one-eighth of a mile off; then a large interval of earth, then a stratum of bones, and so on. At one end of the section were four strata of bones plainly distinguishable; at the other, three; the strata in one part not ranging with those in another. The bones nearst the surface were least decayed. No holes were discovered in any of them, as if made with bullets, arrows, or other weapons. I conjectured that in this barrow might have been a thousand skeletons.

Every one will readily seize the circumstances above related, which militate against the opinion, that it covered the bones only of persons fallen in battle; and against the tradition also, which would make it the common sepulchre of a town, in which the bodies were placed upright, and touching each other. Appearances certainly indicate that it has derived both origin and growth from the accustomary collection of bones, and deposition of them together

Questions

1. How many kinds of deposits does TJ recognize, based on lithology?

2. Roughly many strata do you think he was looking at in the cross section. What is a reasonable range? Why?

3. Why is this sediment description unsatisfactory? "*a few stones, brought from a cliff a quarter of a mile off, and from the river one-eighth of a mile off".*

4. What is the significance of variation in decay of the bones?

5. TJ concludes "*Appearances certainly indicate that it has derived both origin and growth from the accustomary collection of bones, and deposition of them together".* But he neglects of provide an explicit argument. How would you help?

Chronological Inference

- The archaeological record is a contemporary phenomenon. Time is an ***inferred*** dimension.

- *All inferences are based on models of the of the processes that created the data we are using.*

    - Stratigraphic Chronology: Steno's Laws
    - Seriation Chronology : seriation models
    - Dendrochronology: models of tree physiology in temperate climates
    - Radiometric Dating: models of isotope decay (*e.g*. 14C, Uranium decay series)
    - Luminescence Dating: models interactions between isotope decay and crystal lattices (e.g. Optically-Stimulated Luminescence -- OSL).

- *Specific inferences can be tested by comparing the results of two different models applied to different data: e.g. chronological order inferred from stratigraphy vs. order inferred from seriation.*

- **"Objectivity" from epistemic independence.**

Steno's "Laws" of (Litho) Stratigraphy

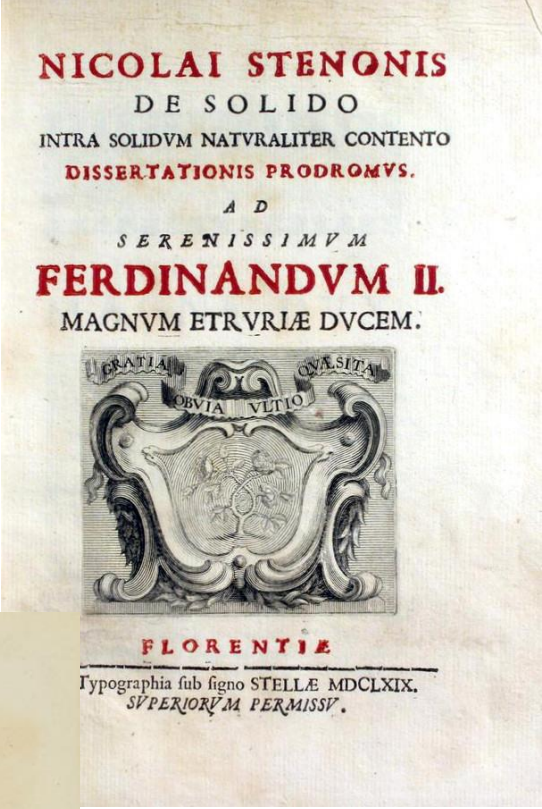
- Steno's "laws" are components of the models we need to infer from the sptial relationships among stata…

  - The chronological relationship between two strata

  - How strata were modified after deposition

- Published in 1669!!

- Rediscovered by Charles Lyell in 1830 who made them the basis of his uniformitarian geology.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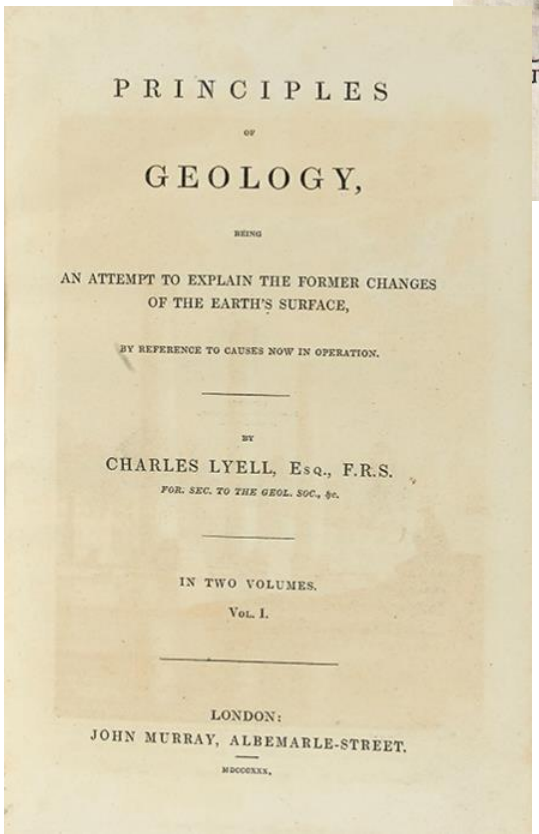
SUPERIORUM PERMISSU.


PRINCIPLES
OF
GEOLOGY,
BEING
AN ATTEMPT TO EXPLAIN THE FORMER CHANGES
OF THE EARTH'S SURFACE,
BY REFERENCE TO CAUSES NOW IN OPERATION.
BY
CHARLES LYELL, Esq., F.R.S.
FOR. SEC. TO THE GEOL. SOC., &c.
IN TWO VOLUMES.
Vol. I.
LONDON:
JOHN MURRAY, ALBEMARLE-STREET.
MDCCCXXX.

Steno's "Laws"

Law of superposition.

Steno: *"... at the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore, at the time when the lower stratum was being formed, none of the upper strata existed*";

Archaeology: "Cool!"

Steno's "Laws"

Principle of original horizontality.

Steno: "*Strata either perpendicular to the horizon or inclined to the horizon were at one time parallel to the horizon*";

Archaeology: *"More or less, with some exceptions."*

- No tectonics.

- Fill and colluvium may follow the sloping sides of the depositional basin.

Steno's "Laws"

Principle of lateral continuity:

Steno: "*Material forming any stratum were continuous over the surface of the Earth unless some other [**earlier**] solid bodies stood in the way*";

Archaeology: "*Often the 'other solid bodies' are the sides of cuts into earlier strata that created basins of deposition"*

- cuts for post holes
- post molds ?

Note: Post molds are tricky. When inserted into a hole, they "stand in the way" of the hole fill. But when rotted or pulled, they become depositional basins.

Steno's "Laws"

Principle of cross-cutting relationships:

Steno: "*If a body or discontinuity cuts across a stratum, it must have formed after that stratum.*"

Archaeology:"*Discontinuities are often cuts or voids that create depositional basis, filled with later sediment*"

Alerts us to the possibility that lithologically similar strata divided by a cut and later deposit were continuous.

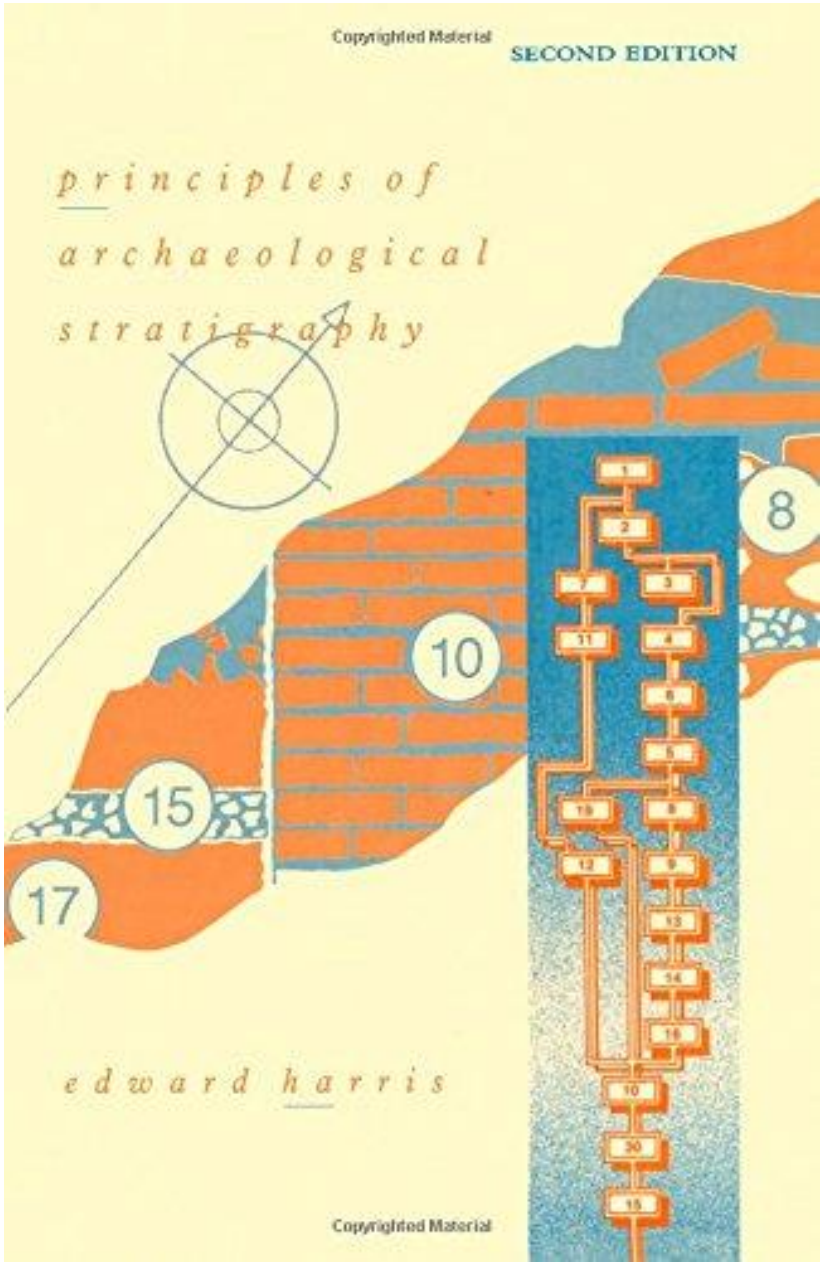
Principles of Archaeological Stratigraphy

Edward Harris

In addition to ***deposits (lithostratigraphic units)*** Harris urges us to recoginize….

- ***Upstanding strata***
  - But masonry walls are also deposits.
- ***Interfaces***
  - Cuts, e.g. the walls and floor of a cellar
  - Upper surface of a stratum.
  - Both may represent a period of time
- ***Features***
  - A archaeological term of art…. often a depositional basin and the strata that fill it.

Harris Matrix: a way to summarize the ***chronological implications*** of the stratigraphic relationships among these units.



Harris Matrix

- Not a “matrix”!!

- A **DAG: Directed Acyclic Graph**

  - Graph: **Nodes** or **Vertices**(boxes) and **Edges** (lines between boxes).
  - Directed: **Edges** denote a one-way ***chronological*** relationship (earlier-later).
  - Acyclic: No loops or cycles (*e.g.* if A > B > C >D, it cannot be true that D >A)

- **Nodes** are Harris’s “Stratigraphic Units”. These can be
  - Deposits (Lithostratigraphic Units)
  - Interfaces
  - Features

- **Edges** are chronological relationships implied by the stratigraphic relationships,

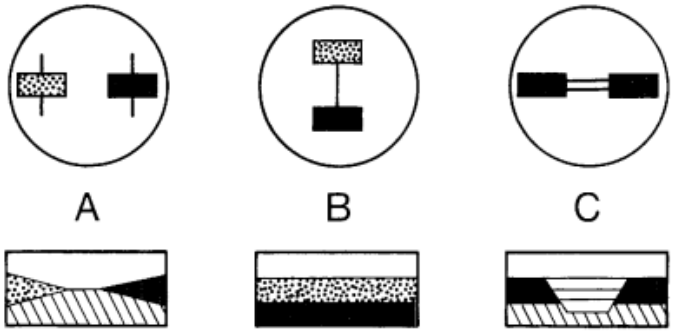


Fig. 9 The Harris Matrix system recognizes only three relationships between units of archaeological stratification. (A) The units have no direct stratigraphic connection. (B) they are in superposition; and (C) the units are correlated as parts of a once-whole deposit or feature interface.

Harris Matrix

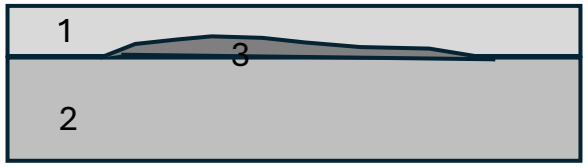
- **Edges** do not represent stratigraphic contacts, but rather what the contacts imply about chronological order.

- A critical distinction:

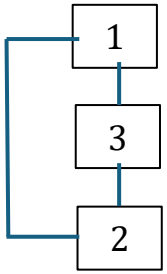
  - The stratigraphic sequence - the complete physical record including all actual contacts between layers

  - The chronological sequence - the inferred temporal ordering of when l layers were deposited.

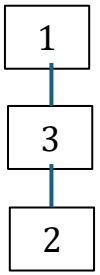
- Example:



Section



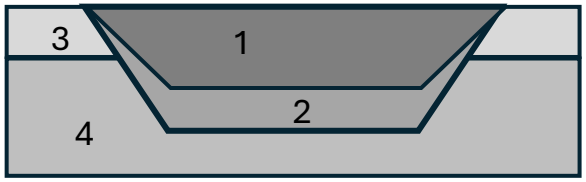
Contacts



Harris Matrix

The Harris matrix is specifically designed to represent the **chronological sequence**, not the complete stratigraphic record of physical contacts.

Harris Matrix



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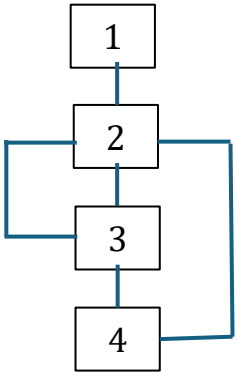

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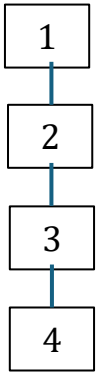
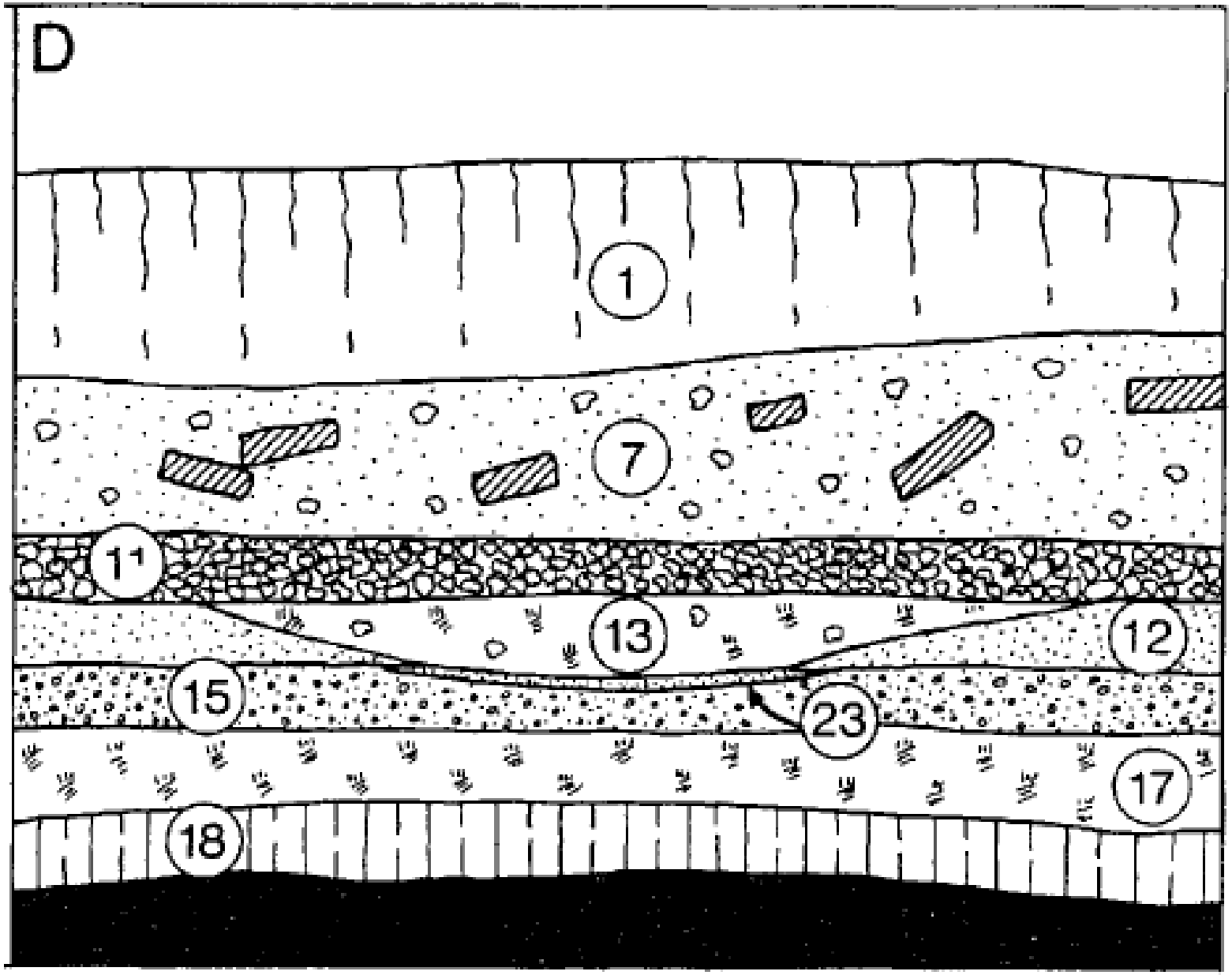


Harris Matrix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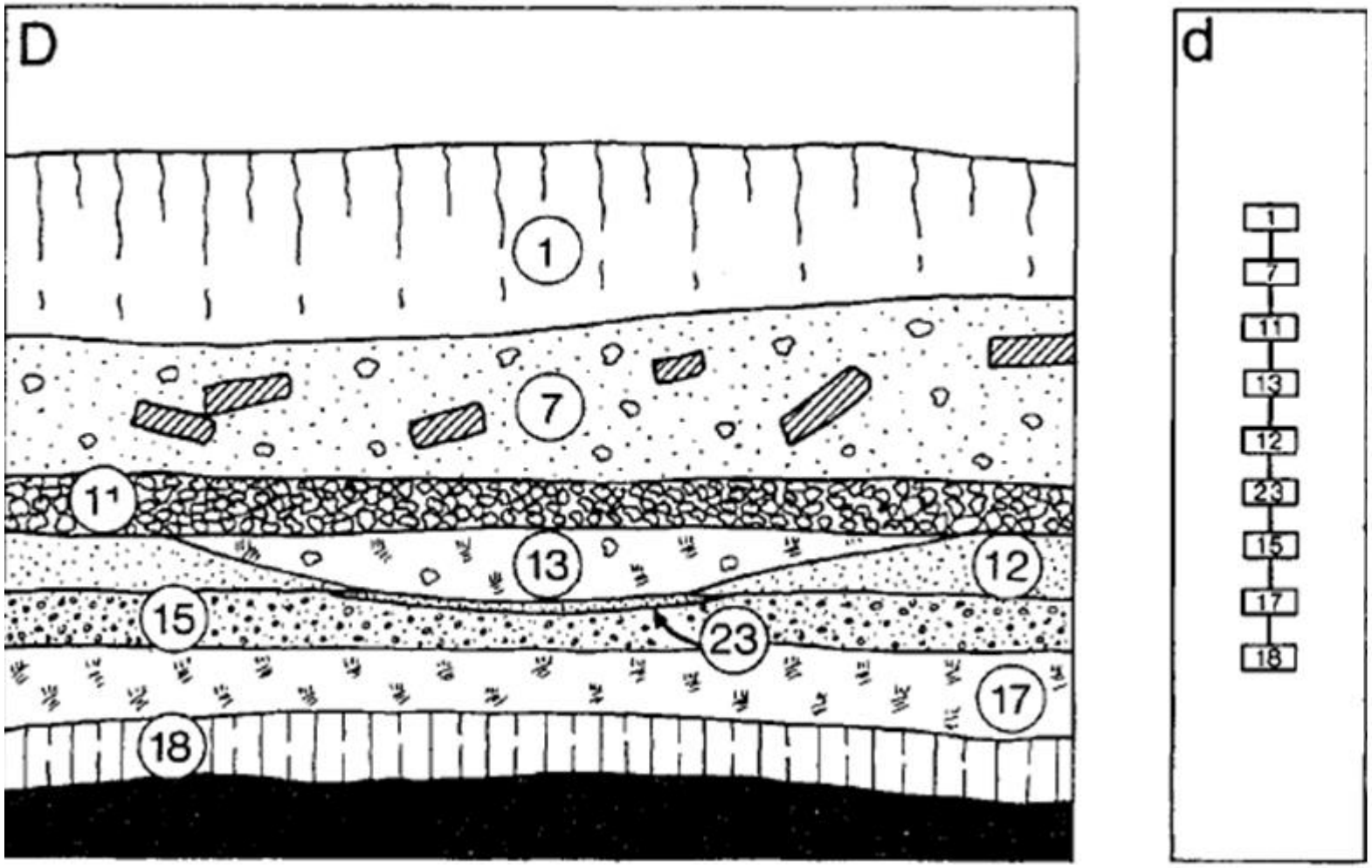
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Nodes are "Stratigraphic Units"

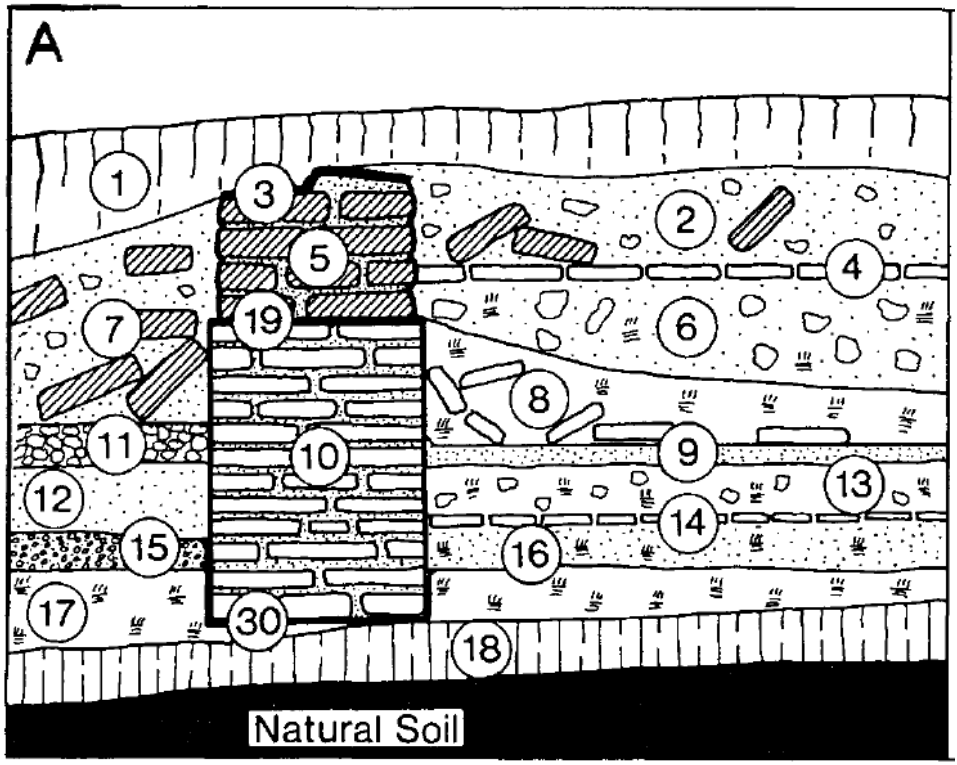
- **Deposits** (Lithostratigraphic Units)
- **Interfaces**

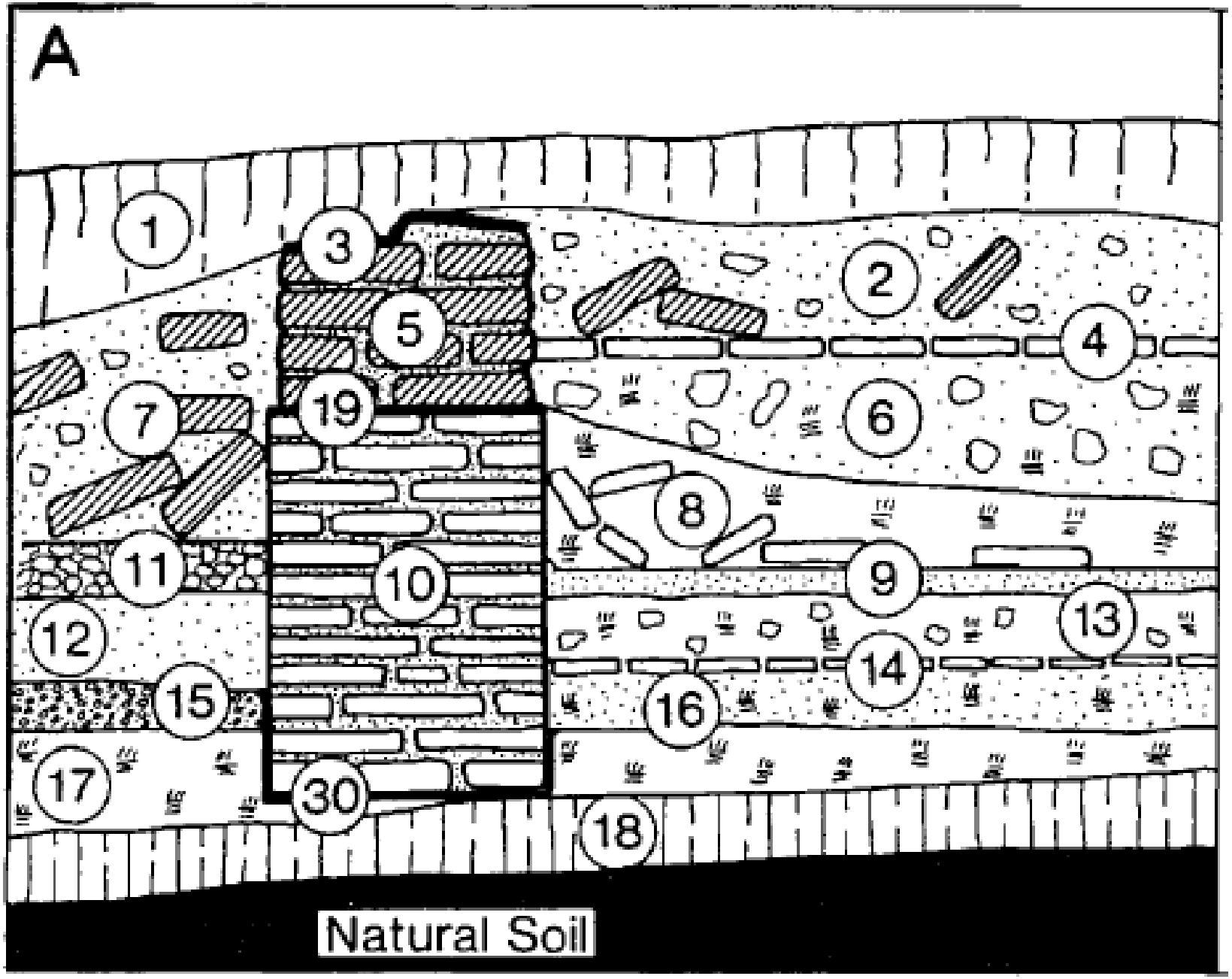
Horizontal Layer Interface: the contact between two deposits. Not shown in the graph *a la* Harris.

Upstanding Layer Interface: *in situ* walls., (10), (5). [Not really an interface just a special kind of deposit]

Horizontal Feature Interface: *e.g.* surface created by the destruction of walls, (19), (3).

Vertical Feature Interface: surface created by a cut, *e.g.* trenches, ditches, pits, postholes, (30).

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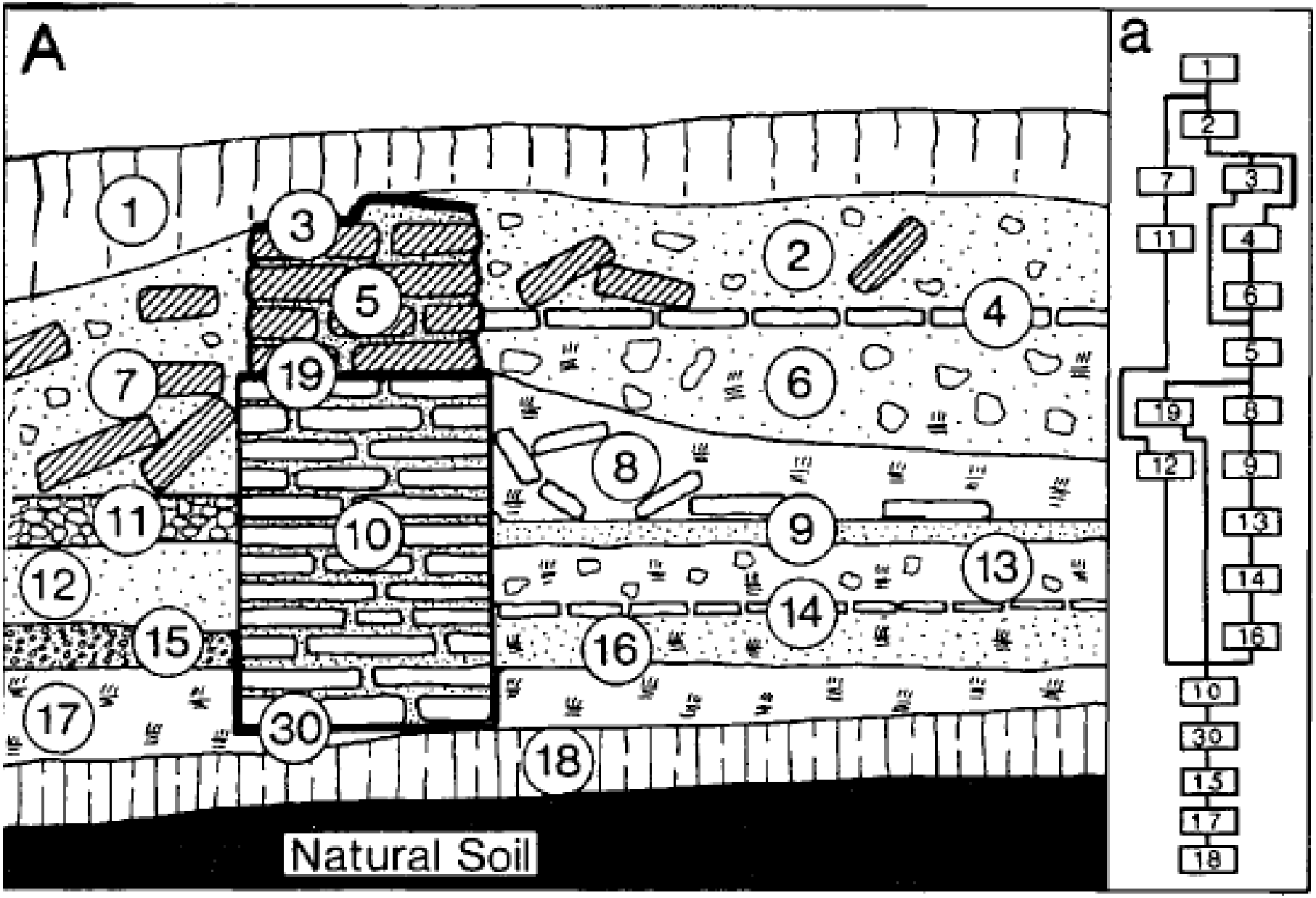
Natural Soil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Natural Soil
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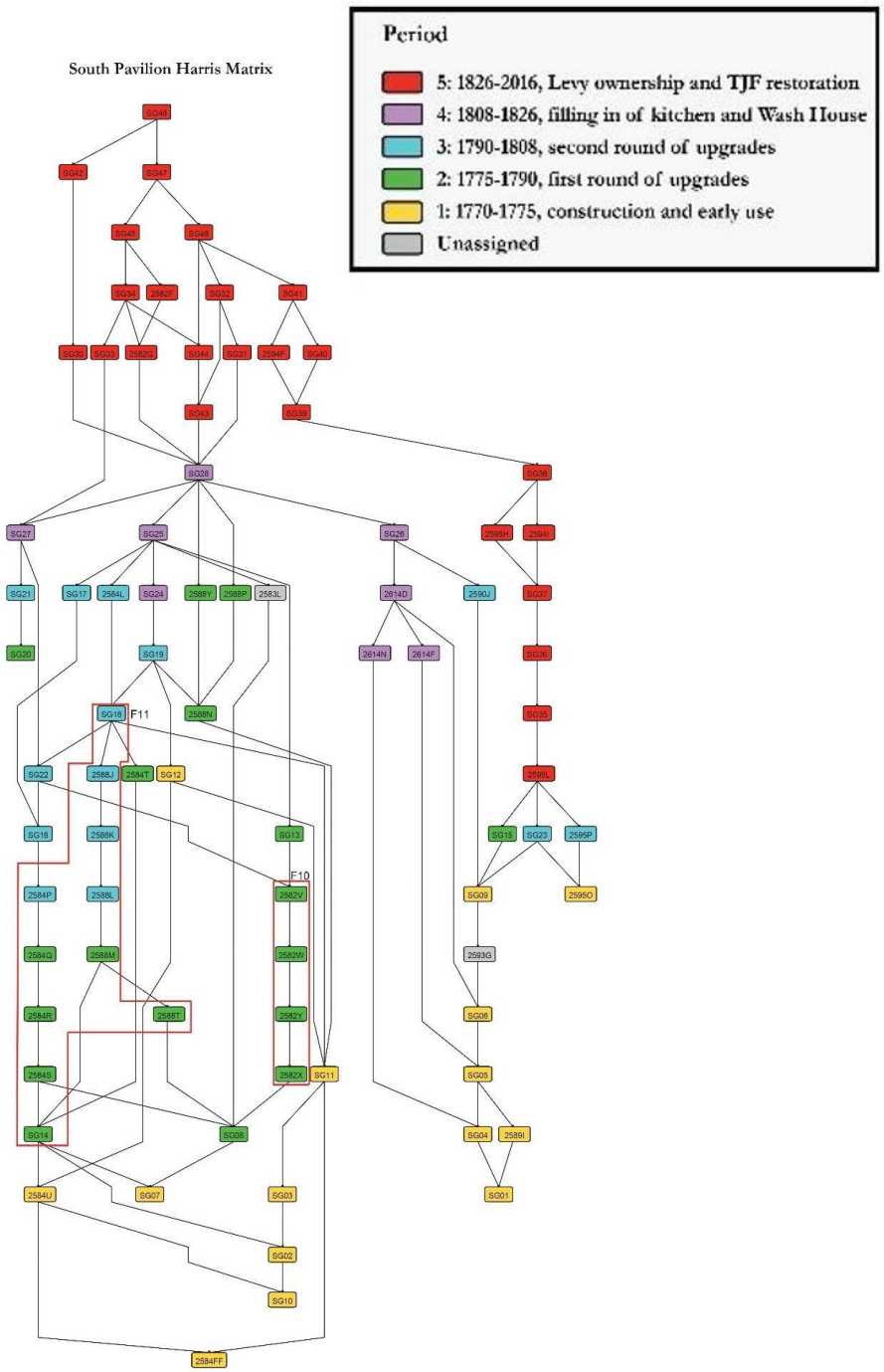
South Pavilion Harris Matrix



Recording Stratigraphy vs. Excavating Stratigraphically

- Drawing a stratigraphic section allows you to infer a chronological order.
- To evaluate the order (is it right?), estimate the timing of deposits, or even their absolute dates requires stratigraphic excavation.