History of Archaeology

Different ways to look at the past

The History of Archaeology

- Not a separate discipline until the second half of the 19th century
- The development of the discipline is influenced by current issues and concerns

Before 1900

- Prior to 1800, a limited number of investigations into the past occurred
- And emergent phase of archaeology began after 1800
  - Museums created, chairs in archaeology appointed, more systematic field work
  - Museums filling with artifacts
- Fieldwork was taking place in many parts of the world
  - Jacques Boucher de Perthes – extinct animal bones with hand axe in France (humanity older than 6000)
  - Kalina and Krolmus – Pagan Sacrificial Places, Graves, and Antiquities in Bohemia
  - Squire and Davis – ancient monuments of the Mississippi Valley
- Christian Jorgensen Thomsen – chronological foundation for Old World
  - Three-age system – stone, bronze and iron

Before 1900

- Darwin published On the Origin of the Species in 1859
  - Turning point in our understanding of the past
- Emergence of antiquarian studies distinguished from history and natural science
  - The first PhD in archaeology was granted at Harvard University in 1894
- Emergence of several basic principles of scientific archaeology
  - Principles of stratigraphic excavation
  - The significance of common artifacts
  - The documentation of fieldwork with notes, maps, drawings, and photography
  - The publication of the results

Before 1900

- Investigations of local prehistory
  - Giuseppe Fiorelli – Pompeii 1860s – stratigraphic layers
  - Augustus Henry Lane-Fox Pitt-Rivers "the father of scientific excavation" – the importance of simple artifacts
  - William Matthew Flinders Petrie – importance of stratigraphic excavation and comparative artifact analysis
  - Heinrich Schliemann – popularized his finds at Troy with newspaper accounts that captivated the public

Jefferson at Rivanna River – father of American Archaeology

- In 1784 Jefferson carefully excavated a large burial mound near the Rivanna River on his property
- He found a great deal of information from his excavation
  - Estimated that perhaps 1000 individuals has been buried in the mound
  - Construction was done in several discrete episodes of enlargement and interment
- Remarkable excavation
  - One of the first individuals in the America to conduct any kind of excavation
  - He carefully excavated and recorded stratigraphic observations
  - His research was problem-oriented

1900 – 1950

- Classic stage of exploration and the investigation of culture history
  - Focus on time and location of the major changes and innovations
- Factors contributing to the development of archaeology during this time
  - Search for origins of civilizations – new site were made public
    - Hiram Bingham – Machu Picchu
    - Leonard Woolley – the Royal Cemetery of Ur
  - 'concept of archaeological culture' – V. Gordon Childe
  - Large-scale public works projects in Europe and North America – artifacts and information

1900 – 1950

- Archaeology became a staple in academic settings
  - Autonomous departments of archaeology created
  - In the USA archaeology combined with cultural and physical anthropology into a single departmental unit

1950 – 2000

- Many development occurred
  - Explosion of new scientific methods
  - Computers
  - Theoretical advances
  - Increasing number of archaeologists
- Growing interests in human ancestors, hunters and gatherers and early farmers
- Goals and meaning of archaeology
- Emphasis on culture process instead of culture history in 1960s and 1970s
  - Deductive reasoning, quantitative methods, and a search for general laws and process
- Processual archaeology

1950 – 2000

- Post - processual archaeology – 1980s
  - Emphasis placed on interpretation and the importance of symbol, ideology, and cognition in society
  - Archaeology – many points of view actually valid
  - Bias
- Multidisciplinary approach introduced in many projects
- Social and ideological, along with technology and the environment aspects – significant factors in shaping the past

1950 – 2000

- Emergence of the archaeology of heritage
  - Protection of the past as legal requirement
  - Impact assessments prior to construction – CRM
    - Prior to the start of any federally funded construction, the U.S. Environmental Protection Agency requires an impact study to determine whether important archaeological or historical sites are in danger of destruction
  - Government agencies involved with heritage rescue, preservation and management

What do Archaeologists want to know?

- The basic concept that archaeologist are interested in is CULTURE
- It is a complement to our biology
- It is non-biological means of human adaptation based on intelligence, experience, learning, and the use of tools
- It enables us to modify and enhance our behavior without corresponding change in our genetic makeup

There are many ways to look at past cultures

- Environment
  - Human groups cannot be understood outside the natural and social environment in which they operate
  - The environment includes natural resources in the form of water, plants, animals, and minerals as well as climate, catastrophe, and other human societies
  - Environment operates for human benefit and disadvantage
  - Climate is major factor in human life

Demography

- Human population in the past
- Includes the number of individuals, sex and age distribution, birth and death rates, migration, and geographic extent.
- Population density – the number of people per square kilometer
  - Increase over time – the major forces in social change
- Using burial evidence – problem?

Technology

- It is an interface between human society and the environment
  - Includes the tools, facilities, and knowledge used to obtain or create resources for human existence
  - It is one of the most readily observed aspects of archaeological data
- Changes in technology over time provide clear indications of the development of material culture as well as diagnostic information about the age of various materials
  - New materials and technologies can spread in a region through invention, diffusion, or migration
    - Invention – is the creation or development of new ideas or techniques for solving problems
    - Diffusion – involves borrowing from other areas
    - Migration – involves foreign people bringing new ideas and/or materials to an area

Economy

- How people obtain foods, material, and goods to sustain their lives
- One major aspect of economy is subsistence
  - Hunting or gathering
  - Agriculture – involves herding of domesticated animals and/or the cultivation of domesticated plants
- Exchange – as an aspect of economy
  - Reciprocity – the exchange of items of roughly equal value and can include gift giving
  - Redistribution – the movement of goods to a central place from where they are rationed or portioned to selected members of society
  - Trade – involves buying or selling goods and usually takes place in some sort of market exchange (through the study of exotic material)

Organization

- The roles and relationship in society – many aspects of society including social interaction, marriage, economic activity, and political relationship
- Kinship – the relationship between individual members in society based on family ties
- Society vary with respect to their level of stratification
  - Hunter-gatherers as egalitarian
  - Agricultural societies – status differences based on rank or class
- Shift from egalitarian to hierarchical structures following the origins of agriculture
  - More elaborate and valued material possessions – higher status
  - Increased complexity reflected in political organizations

Ideology

- The way people view and understand the world
  - Norms, values, and beliefs
  - Usually embodied in specialists who maintain ritual knowledge and direct the ceremonies and activities that keep such ideologies active and valid
  - Aspects of cosmology, iconography, ritual, and religion.
    - Iconography – pictorial representation of beliefs, ideas, and concepts
    - Ritual – a universal practice human society and a manifestation of ideology
      - Involves symbolic, prescribed, and structured behaviors that are often repetitive in nature
    - Religion – formalized framework of belief and behavior that helps humans cope with the unknown

How archaeologists study past?

- Ethnography and Archaeology
  - Ethnography – the study of living human cultures
  - Use the observations of ethnographers to help interpret the past remains that they found
  - Often look for comparison between ethnographies and archaeology to explain things
  - Analogy
- Ethnoarchaeology – study of living people by archaeologists
  - The goals is to gain useful information for learning about the past
- Experimental Archaeology
  - It is a hands-on investigation of past human activity and behavior

Survey

Site prospecting

INTRODUCTION

- Human behavior is not random; therefore, they do not use the landscape randomly. It mostly depends on the features of natural environment such as food resources, topography, fresh water availability, ease of transportation, and the availability of other material resources. Hence, people use a landscape in a spatially ordered way, leaving patterned distributions on that landscape. Therefore, it makes it easier for archaeologists to locate sites.

Site

it is any discrete, bounded location where humans lived, worked, or carried out a task – and where physical evidence of their behavior can be recovered.

(but it should not be studied or discovered in the narrow sense of village locations or burials but broadly on how humans used the landscape)

GOALS OF SITE PROSPECTING

- finding new sites as an important aspect of archaeological research
- to add detail to a known site at the evaluation stage

Additional goals

- the examination of the spatial boundaries of sites
- the identification of general distributions of material within sites
- prerequisite of starting any excavation project
- to demonstrate the existence of sites and evaluate the nature of what survives on them before full excavation takes place
- to explain a material representation of the cultural pattern of the use of land and space
- detecting and comprehending a settlement pattern

WHAT ARE WE LOOKING FOR?

- Constituents – categories of archaeological remains
  - ARTIFACTS – objects modified by humans
  - FEATURES OR FACILITIES – concentrations of artifacts and/or organic residue, as well as structural remains
  - ANTHROPIC SOIL HORIZONS – deposits of organic refuse in the soil
  - CHEMICAL ANOMALIES
  - INSTRUMENT ANOMALIES

The nature of evidence

- Artifacts – are portable objects shaped, modified, or created by humans
  - Artifacts made of stone, pottery, metal, or animal/plant remains are the most common categories of archaeological material
  - For example different use of animal remains

The nature of evidence

- Ecofacts (or non-artifactual organic and environmental remains)
  - Unmodified, natural items found in archaeological context
  - They are usually brought to a site by its occupants and useful for the study of past human activity
  - They are used to reconstruct the environment of the site and the range of resources that people used
  - Can be classified as organic or inorganic
  - e.g. various sediments uncovered by excavation

The nature of evidence

- Features – non-portable artifact
- Structures – buildings of all kinds, from houses to palaces and temples
  - Humans dig or build
  - Features are modifications of the earth
  - Features are important for for understanding the distribution and organization of human activities at the site
  - Features are usually studied in the field since they are fixed in place
  - Some features result from accumulation of garbage and debris, rather than intentional construction
    - Midden – is any substantial accumulation of garbage or waste at a place of human activity

The nature of evidence

- Burials – a specific type of feature
  - They are usually in the form of graves or tombs
    - Burials can be either inhumation or cremations
    - They can be single or multiple
- Activity areas – are locations of specific tasks or behaviors focused on a single or limited goal within a site
  - Activity areas may be a combination of artifact and features utilized in the performance of a specialized task
  - They are present at most kinds of archaeological sites where humans performed tasks, ate food, etc.

The nature of evidence

Sites – are places of human behavior, concentrations of the material remains of past activities

- Accumulations of artifacts and features
- They take many different forms and are found in a variety of places in the landscape
- Distinguished as surface or buried
- A distinction can be made between residential and non residential sites

The nature of evidence

- Camps, hamlets, villages, towns, and cities provide a useful five-fold division of residential sites
  - Camps are short-term, temporary settlements usually associated with hunter-gatherers or nomads
  - Hamlets – unincorporated settlements with other settlements e.g. fishing hamlets
  - Villages – are small residential units of permanent houses with populations numbering a hundred or so
  - Towns are larger than villages and exhibit some internal differentiation in the size and location of structures
  - Cities are very large with populations of 10,000 or more inhabitants

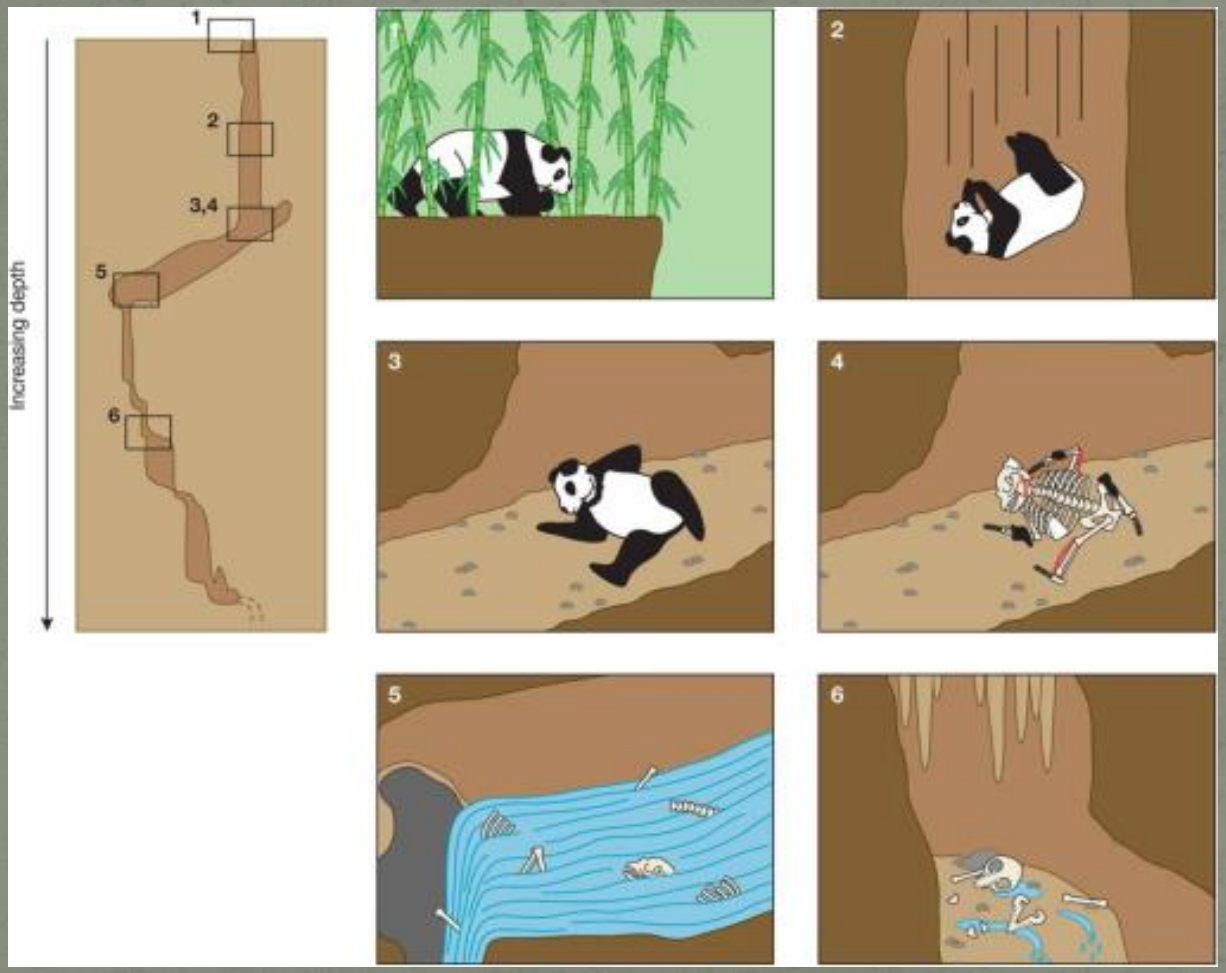
The nature of evidence

- Regions and Landscapes
  - Two different terms are often used to describe larger geographic areas
    - A region is a physical or geographic entity
    - A landscape is a humanly modified or perceived area
    - Questions about regions and landscapes focus on how material culture is distributed in space
      - Emphasis is on a large scale patterns in human behavior and the use of landscape
      - Regional studies often involve settlement pattern analysis or the study of specific features of environment
      - Emphasis on the space between the sites and artifacts

The nature of evidence

- Monuments
  - Are an important category of archaeological remains, found either within sites or across the landscape
    - Various kinds of monuments are found in most parts of the world
    - Monuments take a variety of forms
    - Why are they important?

Taphonomy



Context

The importance of context

- Context has to do with place and association among archaeological items and the situation in which they occur
  - At the basic level it concerns relationships among artifacts
  - In a broader sense, it is the physical setting, location, and association of artifacts and features
  - Context is essential for learning about age, use, and meaning

The importance of context

- A find's context consist of
  - Its immediate MATRIX – the material surrounding it, usually some sort of sediment such as gravel, sand, or clay
  - Its provenience – horizontal and vertical position within the matrix
  - Its association with other finds – occurrence together with other archaeological remains usually in the same matrix

The importance of context

- A distinction is made between primary and secondary context
  - An object in its original position of discard or deposition, in the place where it was left, it is said to be in primary context
  - Objects that have been moved from their original place of deposition are in secondary context and less useful for learning about the past

Survey

Survey Phases

Reconnaissance phase – background research

- Literature review
  - Find out what is known about the area before
  - Permits identification of sites already discovered and investigated
- Local informants – local body of knowledge about archaeological remains (kind of folk-archaeology)
  - Amateur archaeological group in the US
  - "accidental archaeologists" – people who are not professional but came upon remains accidentally
  - Reaching out to local people to let them know who to talk to about archaeological artifacts discovered on their property can be an important preliminary step in a survey

Background research

- History and ethnohistory
  - Historical maps
  - Ethnohistory can supply information about the ways in which a historical group utilized the landscape – helps to determine how and where to focus one's energy in the field
- Environmental variables – resources available to humans in a given area
  - The presence of water, firewood, chippable stone, building material, minerals, and native metals
  - Soil fertility
  - Defensibility
  - Ease of transportation
  - Trade
  - What would make an area attractive?

Background research

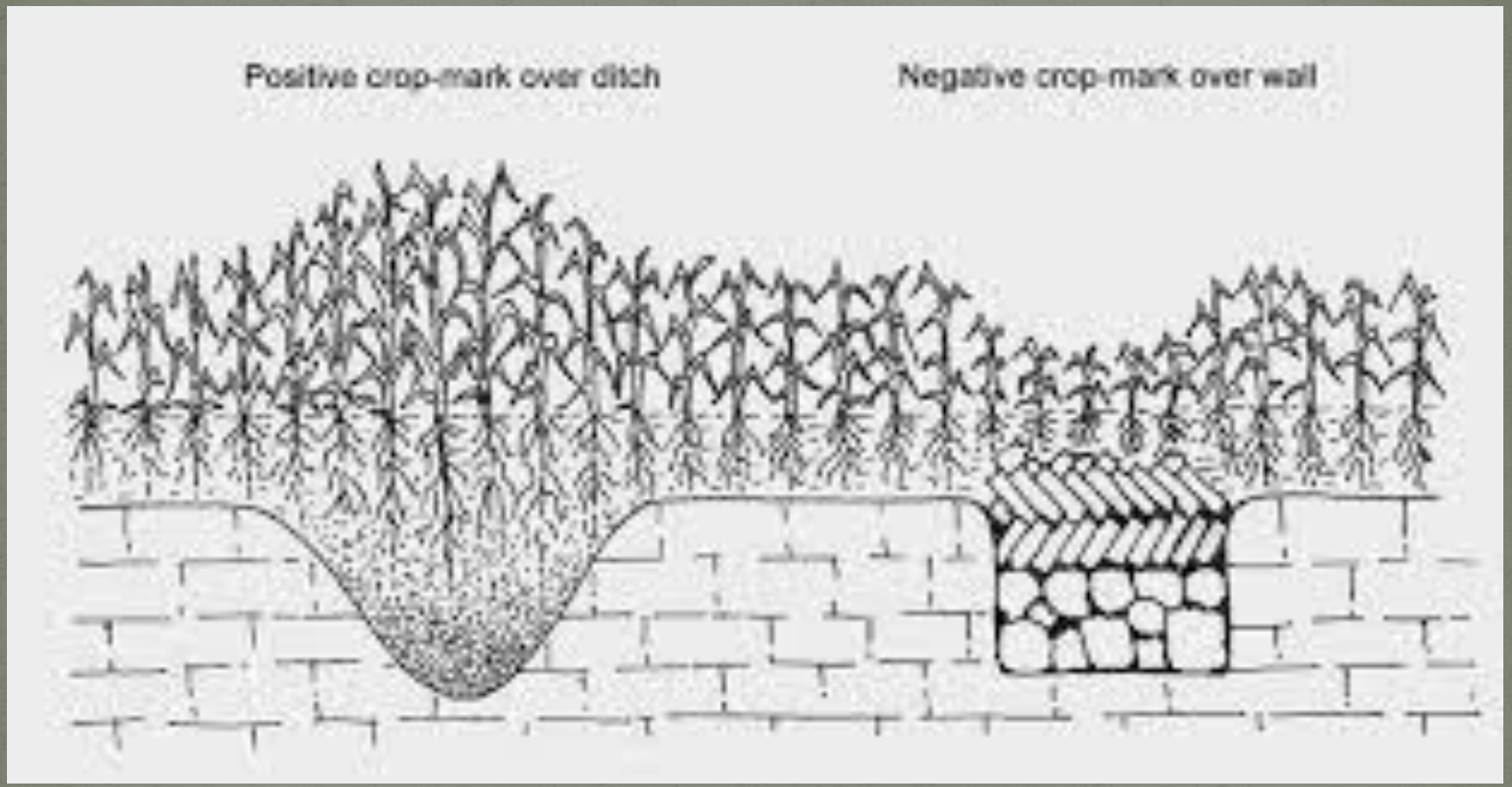
- Aerial survey
  - Maps and photographs allow archaeologists to examine the area as a whole
  - 'bird's eye view'
  - To see subtle changes in ground surface elevation, as well as vegetation color and growth patterns, to detect the presence of archeological remains
  - Black and white, color, or infrared
  - Taken under various lighting conditions
  - Better to see structures that may be too complex or too weakly defined at the ground level – you may be able to see a coherent plan from above
    - Depends on favorable direction and angle of sunlight
      - Low-ranking light casts shadows that can reveal the most delicate variations in topography
  - Needs interpretation and analysis – distinction between archaeological and natural features

Background research

- Remote imaging
  - Active remote sensing systems
    - High-frequency energy Radio Detection and Ranging
    - Laser Light Detection and Ranging
  - High-altitude photography
    - Mapping of the earth's surface from space
    - Great potential for examining poorly mapped and relatively inaccessible areas
    - Good resolution
  - Multispectral imaging
    - Sensors simultaneously record separate wavelength bands
    - Based on electromagnetic spectrum and wavelengths not visible to naked eyes
    - Passively measures the reflections and emissions from the earth's surface

Crop marks

- Positive
  - Dry conditions
  - The moisture and fertility of the soil in a buried ditch or pit allow the crop above it to grow more vigorously than the surrounding crop
  - A pattern of different crop growth – color difference; the stronger crop visible as greener and surrounded by yellow, bad-condition crops
- Negative – underlying feature restricts the crop growth and the crop ripen sooner because they have less water
  - Yellow mark is visible in a greener field
- Clarity of the crop marks are then influenced by soil conditions and season, and depth of the feature, the nature of the overlying crop itself, its stage of growth, time and lightning conditions when photographs are taken
- Most commonly seen in the cereal crops


Positive crop-mark over ditch
Negative crop-mark over wall

Bare soil

- Has to be exposed by cultivation – the plow is already biting into archaeological feature and deposits
- Depending on the type of sediments you may see contrasts – e.g. brown and red soil vs paler shades
- Weather and timing are critical

- **Many types of marks may only be seen when a certain combination of conditions momentarily prevails**

Field Methods in Survey

- Surface survey – field walking
  - Walking over the surface of a region and visually inspecting for the constituents of archaeological sites
  - Useful where erosion or human activity exposed ancient strata

Field methods

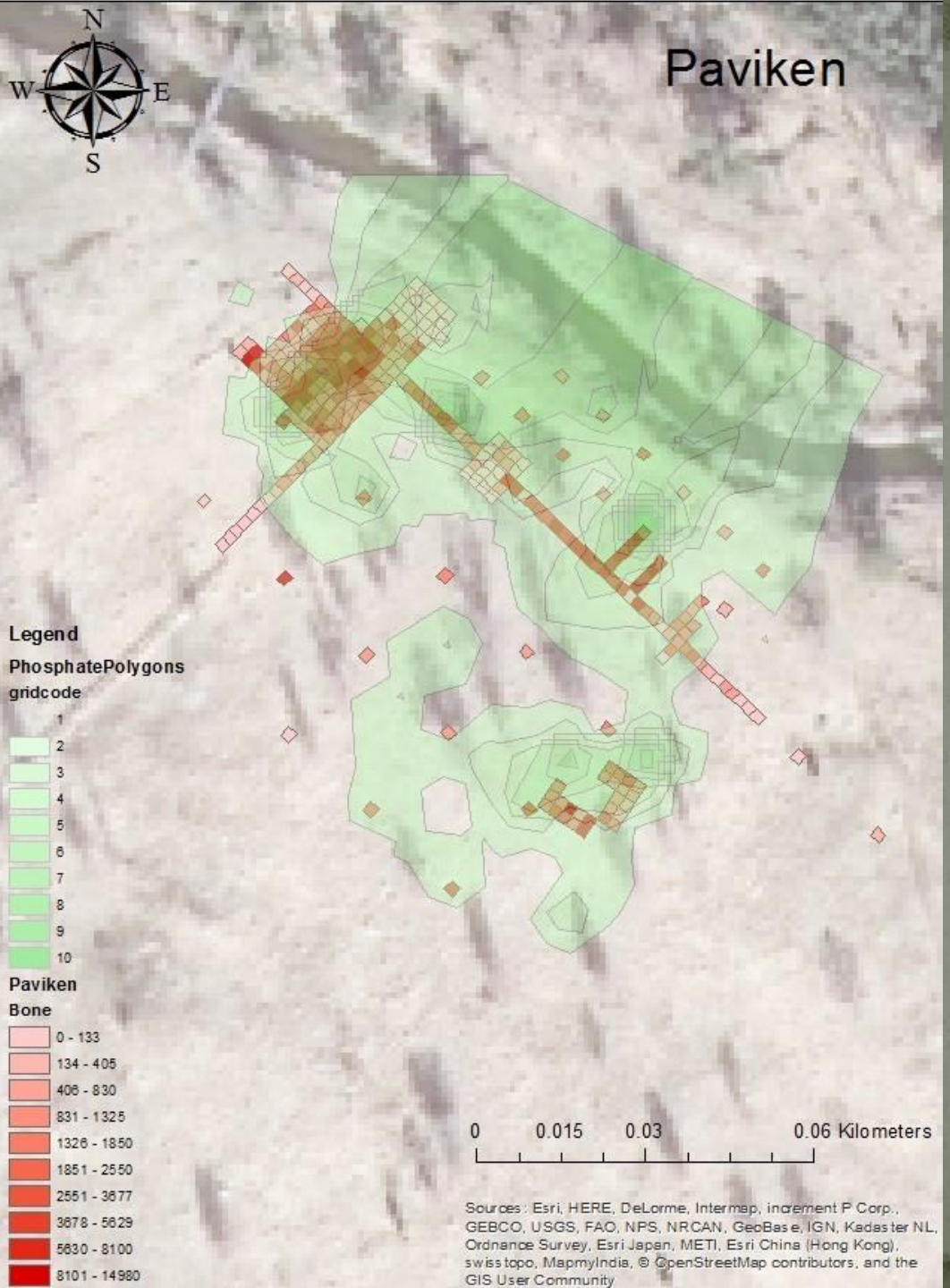
- SUBSURFACE SURVEY – involves in one way or another digging holes, bringing up the dirt, and inspecting it for visible constituents of archaeological sites.
  - Various methods of digging holes and bringing up the soil (3 cm soil corers, 10-15 cm augers, 25-30 cm divots, 25-75 cm shovel-dug test pits)
  - TEST PITS – most common, most effective but also the most expensive because the most labor intensive (the amount of the soil moved)

Field methods

- pits are shovel dug
- between 25 cm – 100 cm – 50 cm on a side the most common
- placement pattern varies – usually placed in straight-line transects
- once a site is found and marked there may be some additional pits excavated around to determine site size, boundaries, and general pattern of artifact or feature distribution (usually placed at shorter intervals in several direction from the original test pit)
- different sampling techniques

Field methods

- CHEMICAL SURVEY
- the concentration of organic residue by-products – phosphorus, nitrogen, calcium, and carbon
  - phosphorus – reflects the presence of former human activity and it is added to the soil through the decay of bodily tissue and excreta as well as waste and ashes
- can be mapped and interpreted in a similar way to artifact distributions
- usually used as a supplement to other methods of site investigations
- lab analysis determine the relative concentrations of inorganic, organic, or total phosphate but there is no widely applicable single value for any of the elements that conclusively indicates the presence or absence of a site



- 559 794 g of animal bones

Field methods

- GROUND-BASE REMOTE SURVEY – GEOPHYSICAL SURVEY
  - instrument anomaly survey
  - surveying for instrument anomalies involves detection from the surface of archaeological features at some depth without the movement of soil
  - the techniques can be used to determine the presence of artifacts, features, or anthropic soil horizons

MAGNETIC SURVEYING

- measures the strength of the earth's magnetic field at the surface that, under optimal conditions, when the device is pulled over a flat, uniform surface above a homogenous soil matrix, the earth's magnetic field is uniform across that surface
- any deviation from the homogeneity of the soil matrix alters slightly the earth's magnetic field
- involves the use of proton magnometer that detects these differences in the otherwise uniform magnetic field

Magnetic surveying

- features causing highly localized, slight variations in the earth's magnetic field (they have a different magnetic susceptibility than the surrounding soil, leading to slight alternations of the earth's magnetic field as it passes through them):
  - trash pits and middens
  - ditches
  - walls and foundations
  - hearths
  - burned structures
  - bricks
- however, still extremely weak anomalies in magnetic field (0.5-30 nT) – earth's magnetic field is around 48,000 nT
- extreme sensitivity to ferrous metals (containing iron)– modern things can create anomalies

ELECTRICAL RESISTIVITY SURVEY

- an electric current is passed through the soil to measure electrical resistivity
- metal probes are inserted into the ground (many different configurations) but the most common is having four probes mounted on a rigid frame
- the resistivity depends on a number of factors primarily related to water content, ion content, and soil structure (result from the presence of buried archaeological remains or from previous human activity)

ELECTRICAL RESISTIVITY SURVEY

- usually foundations or walls can alter soil resistivity from that of non-archaeological conditions
- also any human activity that results in compaction (from road or path construction) to loosening (pits, cellars, middens, and ditches) of soil
- better for detailed investigation of a site than site reconnaissance
- soggy soil conditions can interfere with results and skew data

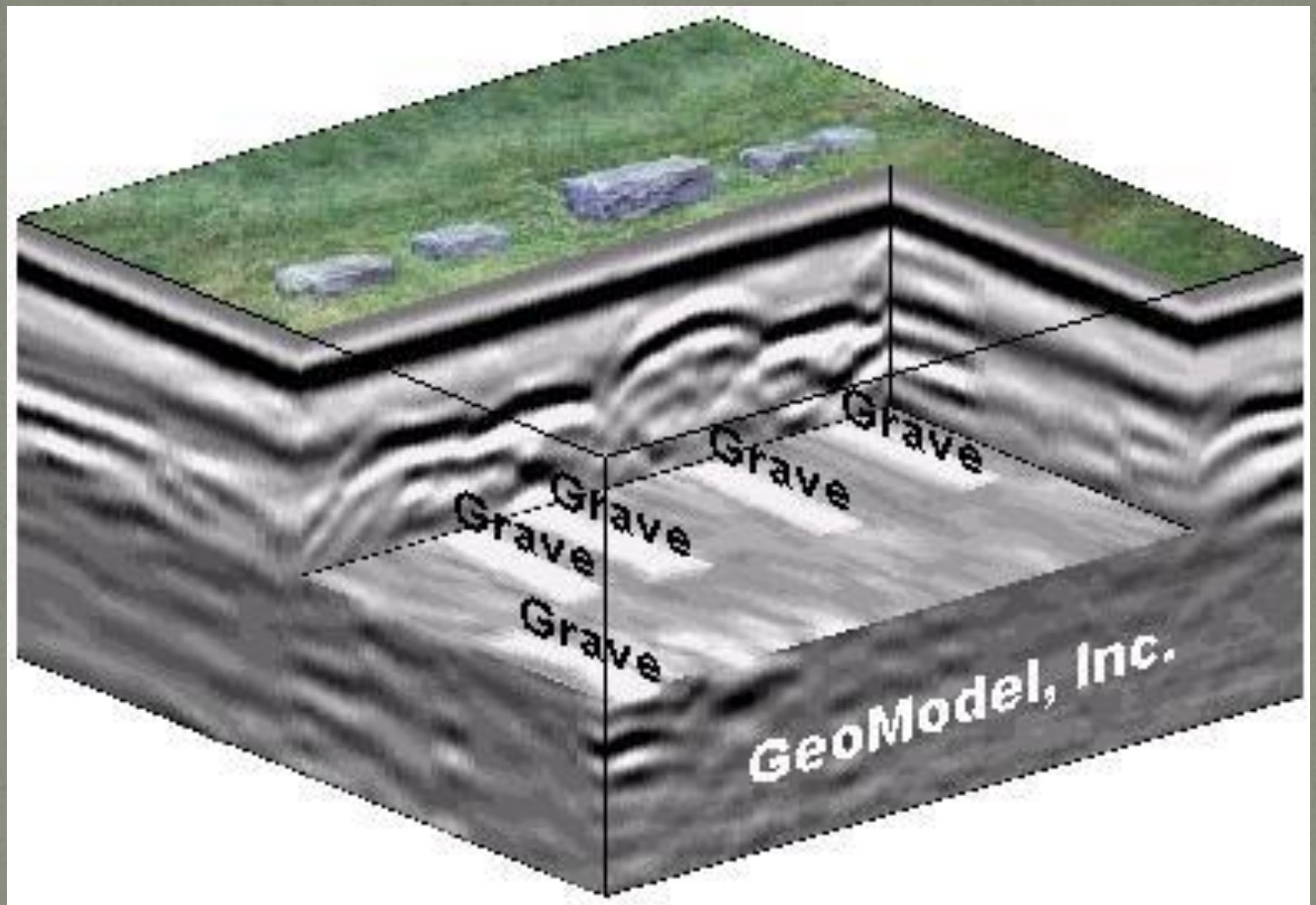
GROUND-PENETRATING RADAR

- an electromagnetic pulse is released into the ground
- the return time of the electromagnetic pulse after it is reflected back to the radar receiver is measured and depends upon the physical characteristics of the ground, the efficiency of the transmission of the radar wave, the density and distance (depth) of whatever the pulse encounters
- best for abrupt than subtle discontinuities in the electrical properties of the subsurface – buried walls, foundations, houses with highly compacted floors, etc.

GROUND-PENETRATING RADAR

- handy for measuring changes in soil density that could indicate buried features
- able to map archaeological features both horizontally and vertically in 3D
- tree roots or other shallow objects can obscure deeper archaeological remains.
- however, in many cases the radar returns are highly complex and difficult to interpret

GROUND-PENETRATING RADAR



Cemetery with Headstones Showing Cut-Away View of GPR Data Detecting Grave Sites

FACTORS IN SURVEY DESIGN

- VISIBILITY – environmental factor
  - The extent to which an observer can detect the presence of archaeological materials at or below a given place
  - Vegetation, erosion, geological deposition
- OBSTRUSIVENESS – the archaeological or cultural 'visibility' of the materials produced by the society
  - Presence/absence of agriculture
  - Monumental work
  - Durability of material used in construction and tool manufacture
  - Degree of sedentism
  - Population density

FACTORS IN SURVEY DESIGN

- ACCESSIBILITY – practical
  - The effort required to reach a particular survey area
  - The climate and how it can affect the efficiency of a crew
  - The terrain
  - The biotic environment (the presence of dangerous animals and insects)
  - The presence/absence of roads
  - Political upheavals
  - Patterns of land ownership

Excavation

Archaeological excavation

- Excavation is the technique that archaeologists use to uncover buried remains from the past.
- - Retains central role in fieldwork – yields the most reliable evidence for 1) human activities at a particular period in the past, 2) changes in those activities from period to period
- - Contemporary activities take place horizontally in space, changes in those activities occur vertically through time

Archaeological excavation

- - Buried materials usually are more abundant and better preserved than those found on the surface.
- - Excavation often is essential to obtain more information.
- - Excavations are conducted to answer specific questions that the archaeologist would like to resolve.
- - However, it is both costly and destructive – wherever possible non-destructive methods should be used

Selecting Sites for Excavation

- The choice of a site for excavation is determined by several factors.
- - The potential threat to the archaeological remains is typically considered. (Erosion or construction)
- - The level of preservation or the possibility that new information will be obtained is also considerations.
- - It is important to know as much as possible about a site prior to full scale excavation in order to choose the best strategy for the project.
- - a site grid is laid out from a datum – selected location that serves as a reference points for all horizontal and vertical measurements so that the site can be properly mapped and the exact location of any artifact or feature can be recorded in 3D

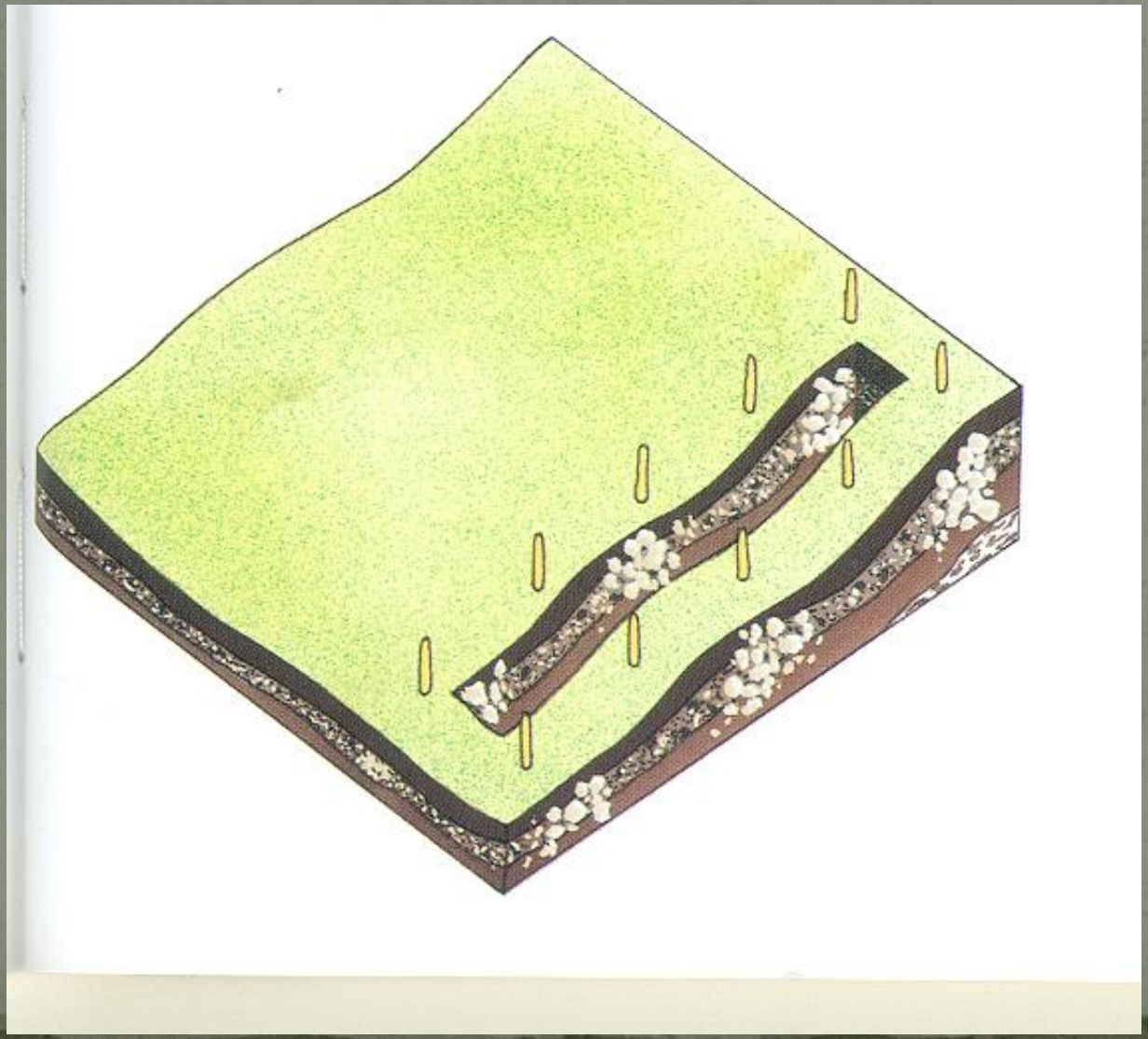
Test Pits

- - Preliminary examination of a site usually involves making a few small excavations to preview the site.
- - Test excavations can be small, vertical test pits, or a series of one or more trenches across the site.
- - The size and number of test pits to be excavated depends on the kind of information being sought.

Vertical Excavations

- Vertical excavation takes the form of squares or rectangles carefully positioned across a site to expose stratigraphy and artifact contents.
- - The stratigraphy, or layers of natural sediments and human deposits, reveals how the site was formed and accumulated.
- - The bottom layer is deposited first as the oldest layer in the sequence.
- - The thickness of a layer is determined by the natural and human activities involved in the deposition of the materials.

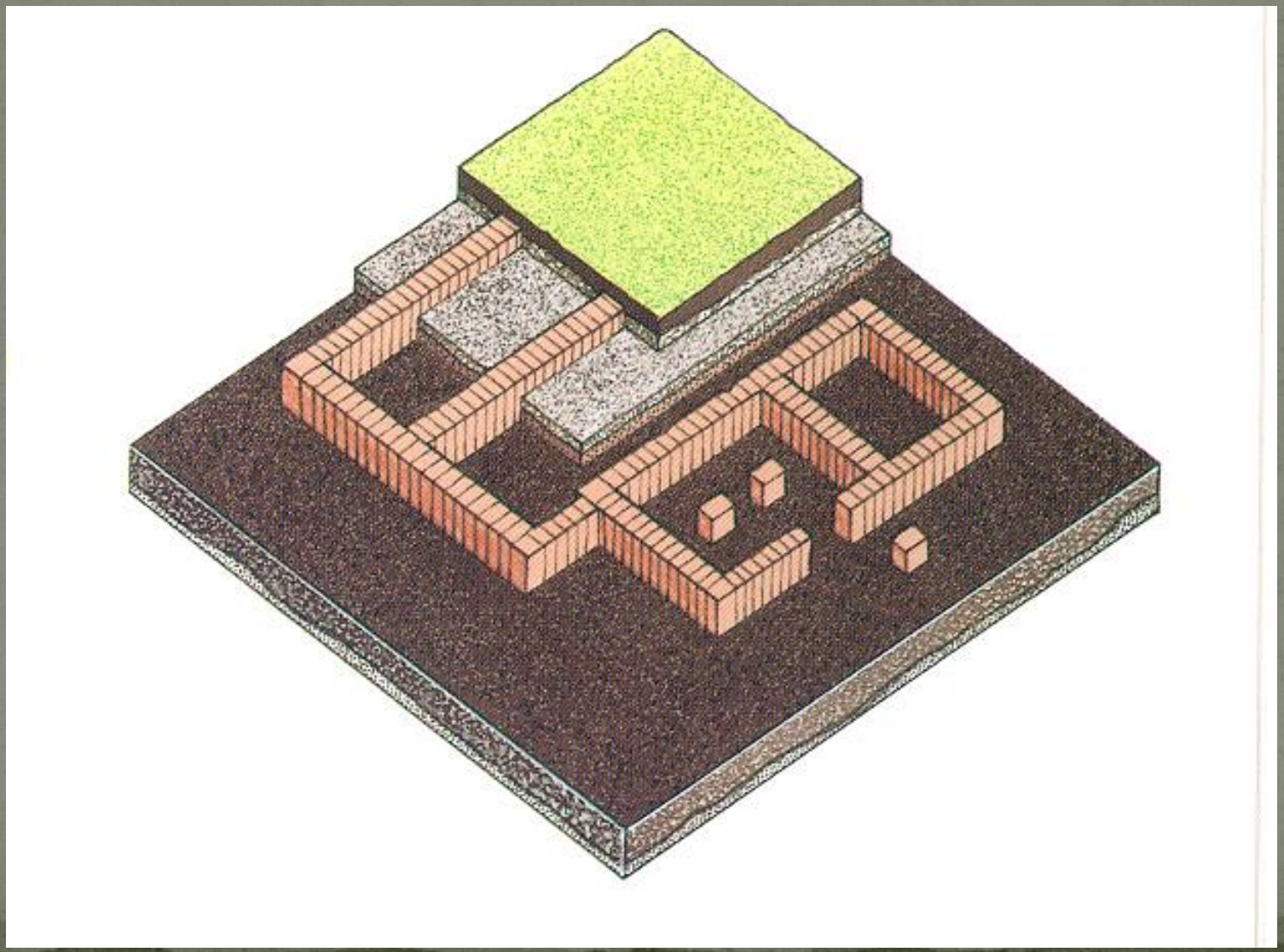
Vertical Excavations



Horizontal or Area Excavations

- Horizontal or area excavations expose large open areas of ground, one layer at a time.
- - Area excavations are intended to recover information on site arrangement and structures.
- - Several different kinds of burials can be found.
- - When the site stratigraphy is relatively simple it is sometimes possible to separate the remains from each stage of occupation.
- - A variety of samples are taken from different layers in the walls of the excavation and from the occupation floor.
- - Soil samples are taken to help define and characterize the deposits at the site.
- - Pollen samples are sometimes taken to assist in defining the vegetation in and around the site.
- - Samples of charcoal and bone are taken for radiocarbon dating at most sites.

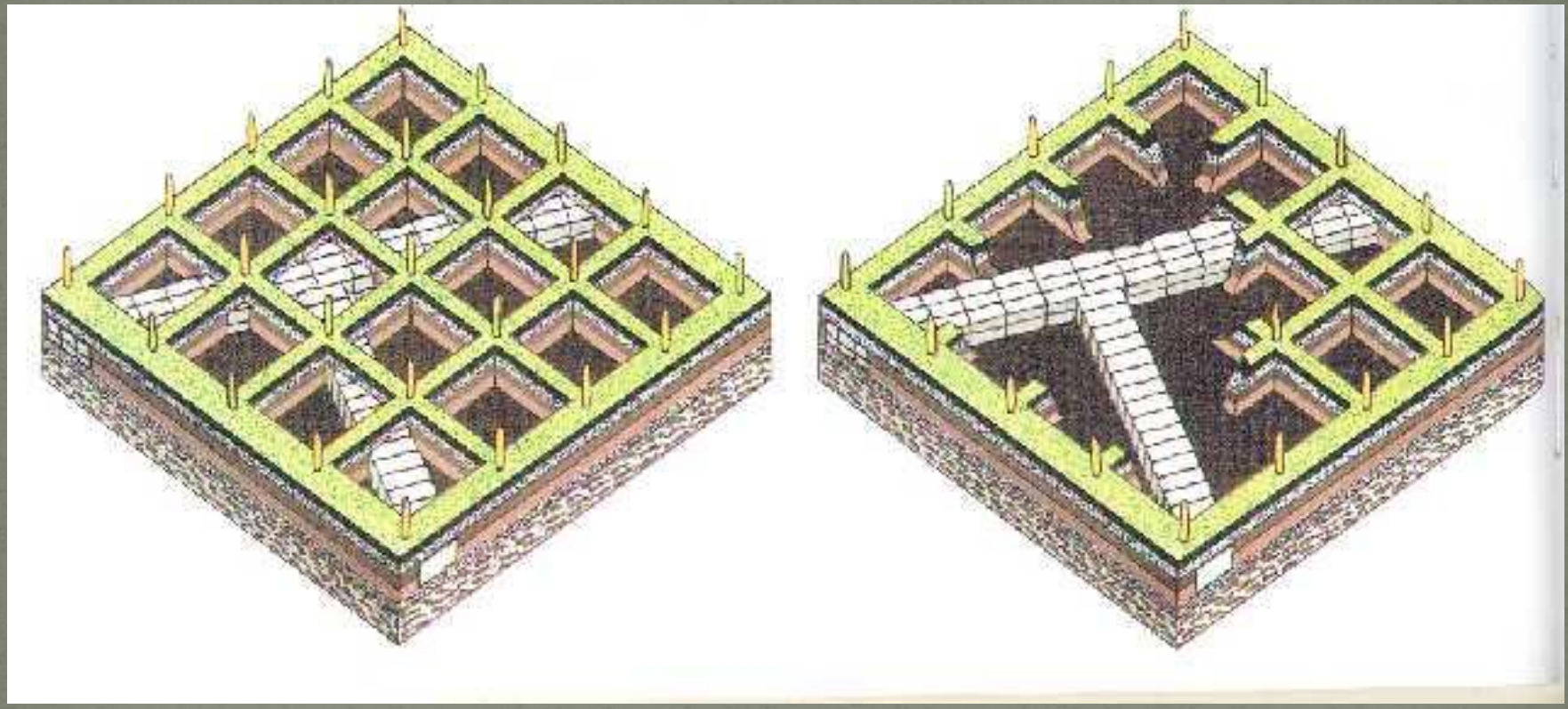
Horizontal or Area Excavations



Wheeler box-grid

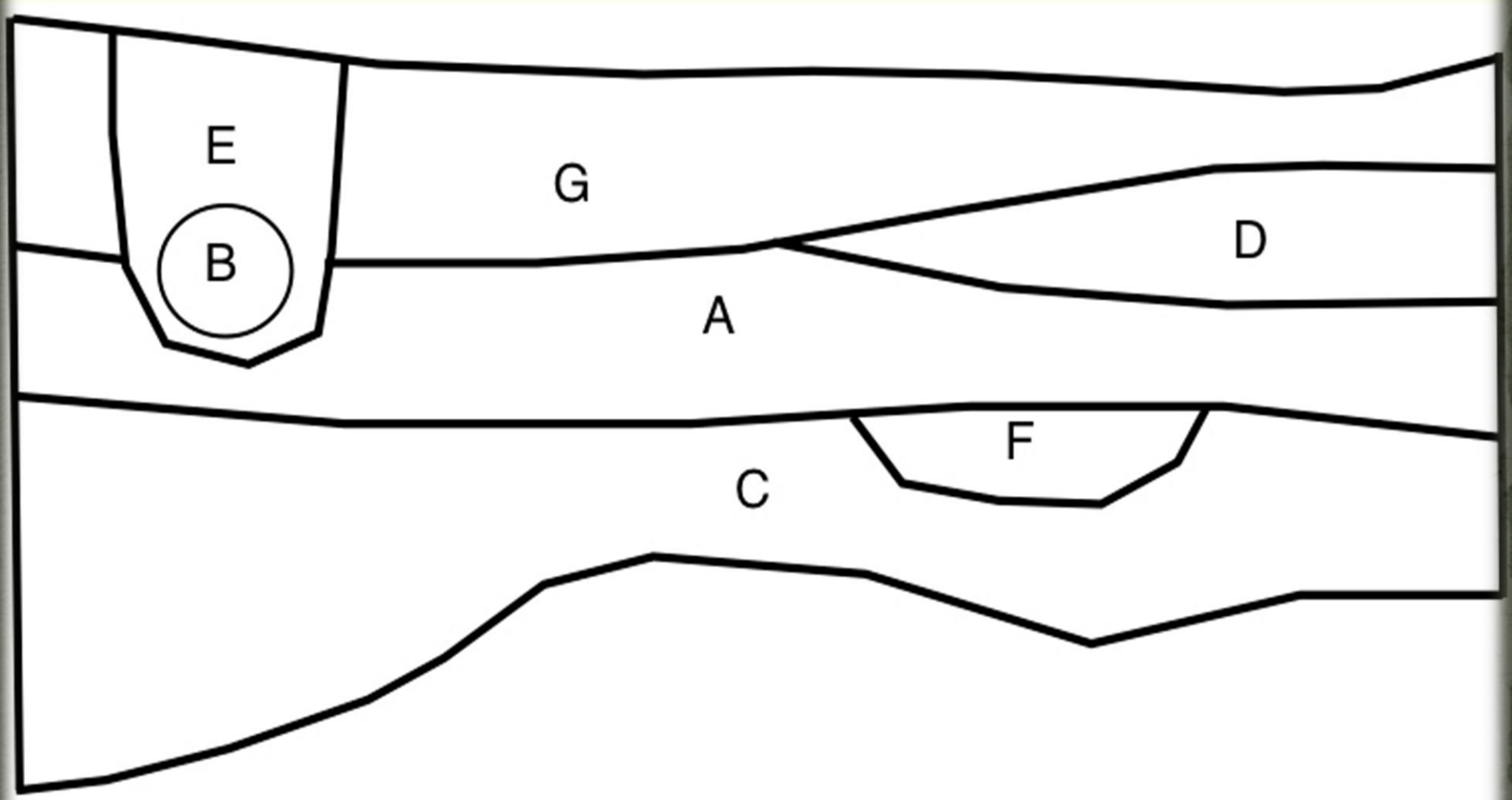
- used to satisfy both vertical and horizontal requirements by retaining intact balk of earth between the squares of the grid

Wheeler box-grid



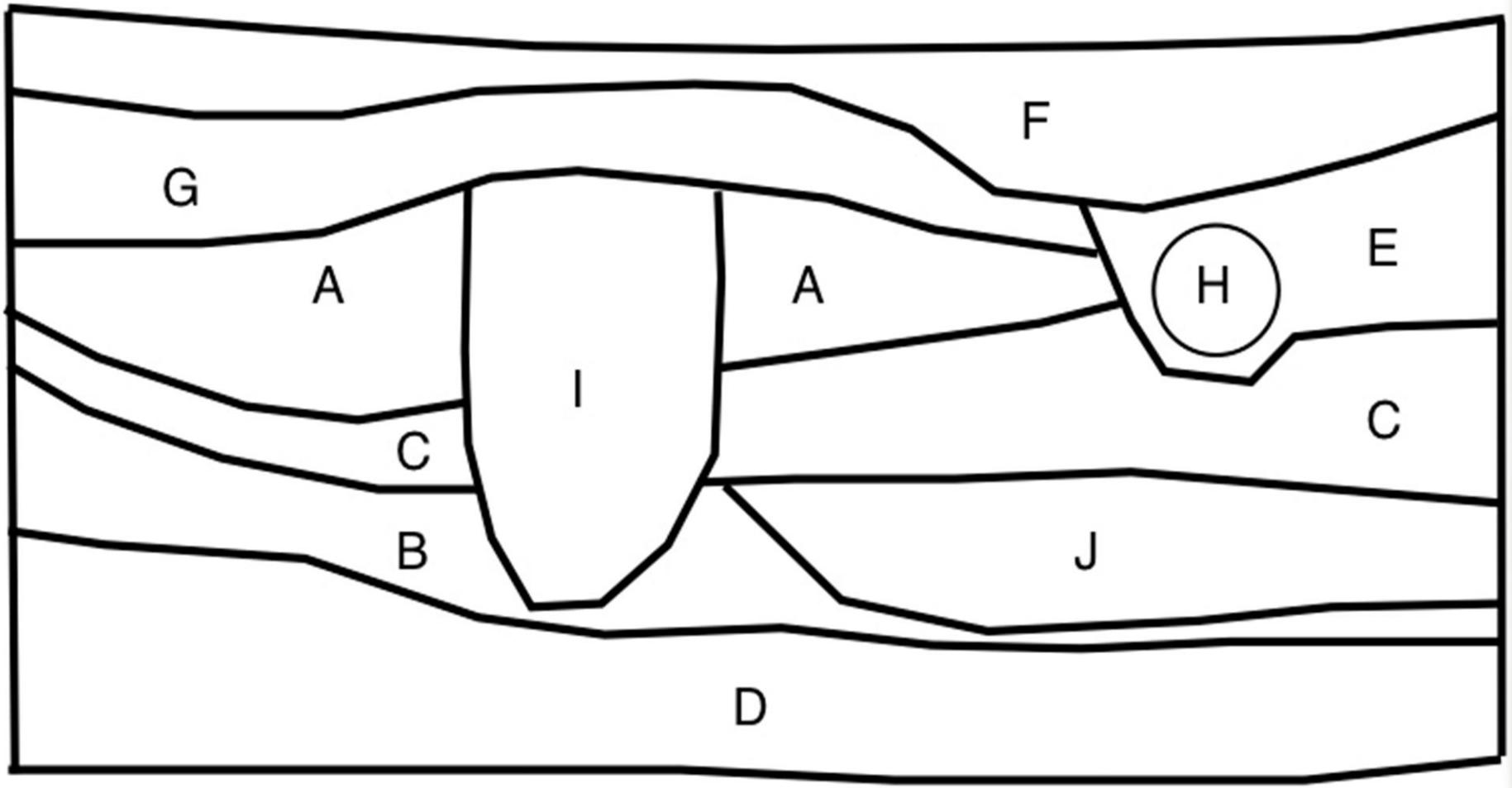
Stratigraphy

- - From the geological process of stratification – the layers are laid down, one on the top of the other.
- - Law of Superposition – where one layer overlies another, the lower was deposited first.
- - an excavated vertical profile showing a series of layers constitutes a sequence that has accumulated through time
- - sequence of deposition
- - However, pits dug down from a higher layer or burrowing animals may introduce later materials into lower levels


E
G
B
D
A
F
C

Stratigraphy

The answer: C is the oldest. Then F, A, D, G, E, and B. F comes after C because it is an intrusion into that level, meaning that C must exist in order for F to be dug into it


F
G
A
A
H
E
I
C
C
B
J
D

Stratigraphy

From oldest: D, B, J, C, A, I, G, E, H, F

Screening and Flotation

- - The excavated soils are usually sifted through screens and/or washed with water to find even the smallest objects, fragments of bone, and plant remains.
- - Dry sieving works reasonably well in loose.
- - Water screening is recommended in most situations to insure more complete recovery of small items.
- - Mesh size of the screen is variable from place to place and from archaeologist to archaeologist.

Flotation

- Flotation has become a standard technique at sites where carbonized plant remains are preserved.
- Flotation involves the use of tubs of water for separating sediment and artifacts from the plant remains.
- Normal water sieving tends to destroy fragile materials such as plant remains.

The Tools of Fieldwork

- Archaeological projects in the field require tools and information to operate effectively.
- These tools include maps and positioning information to locate sites and artifacts exactly in geographic space.
- Maps are one of the most important tools of fieldwork.
- Archaeologists today try to peer into earth before they dig using a variety of remote sensing techniques and technologies.

Maps And Grids

- Accurate mapping of layers and artifacts is the key to the proper recording of information on an archaeological project.
- Maps and plans are made by instrumental surveying, a technique used by land surveyors and cartographers.
- A grid is marked out across the surface of an area prior to reconnaissance or excavation to be used for all horizontal measurements.
- Location of the site and the site grid in relation to global latitude, longitude, and elevation above sea level must be determined.

The Total Station

- A total station measures both horizontal and vertical directions simultaneously.
- Total stations use an infrared laser to calculate distance and three-dimensional angles to determine the precise location of the target in terms of grid coordinates and elevation.
- The total station can be used to produce contour maps and to located artifacts and architecture precisely in three dimensions.

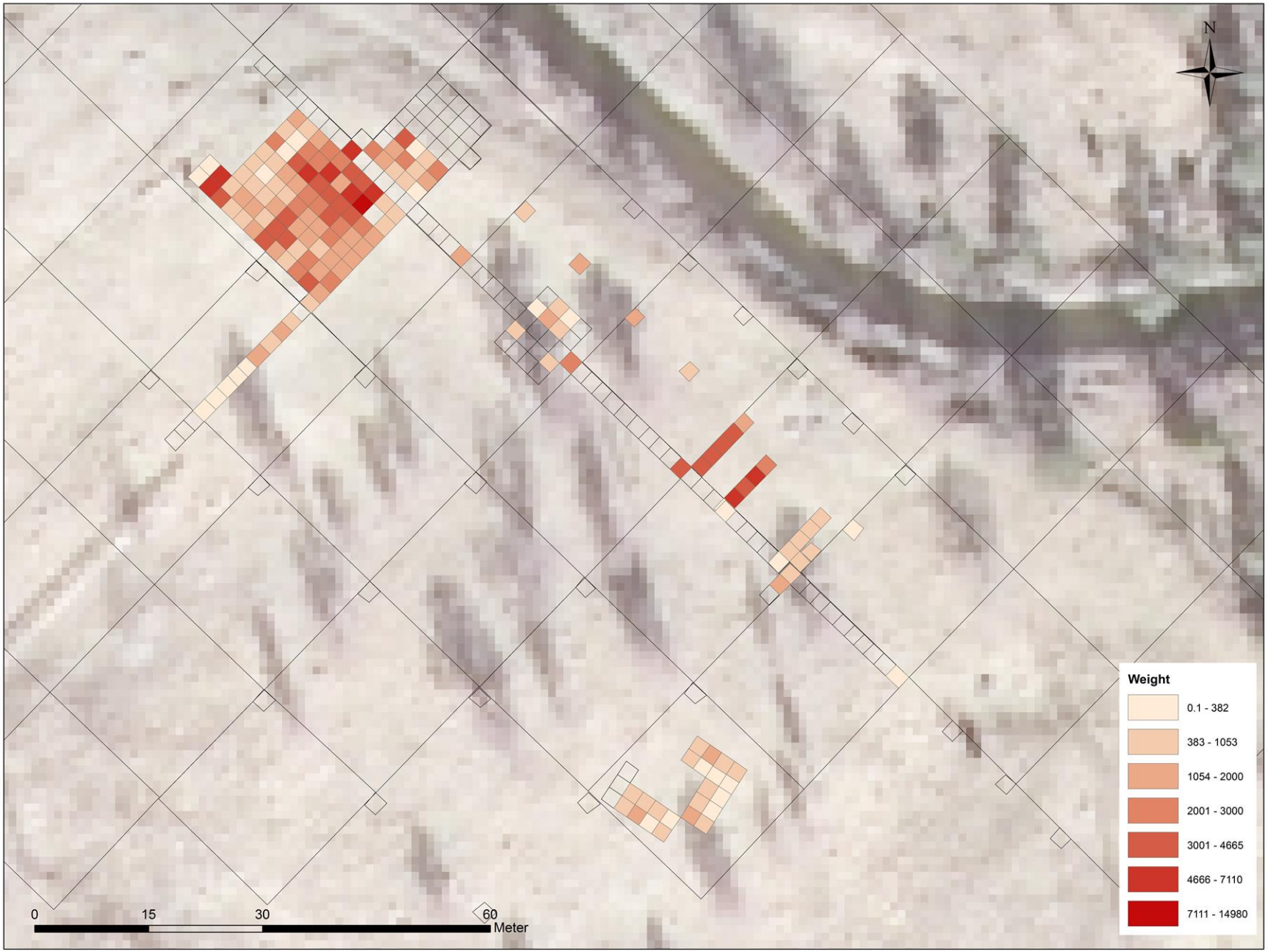
Total station

Science in Archaeology: Global Positioning System (GPS)

- A series of satellites broadcasts information for determining exact locations on the earth's surface.
- Portable GPS equipment can determine precise locations within a few centimeters.
- The use of GPS is now standard in archaeology.
- The combination of GPS and Geographic Information Systems provides a powerful set of tools for archaeology.

Geographic Information Systems

- Geographic Information Systems (GIS) are a potent means for recording, analyzing and
- presenting geographic or spatial information in archaeology.
- GIS resulted from the marriage of computers and cartography.
- A GIS representation of an archaeological project would include a set of maps or plans of
- GIS can be used to project where archaeological remains might be expected.
- the area of interest and a series of locations in that area.
- The technique is called "predictive modeling".
- This use is popular with planners because it is cheaper than fieldwork.


N
Weight
0.1 - 382
383 - 1053
1054 - 2000
2001 - 3000
3001 - 4665
4666 - 7110
7111 - 14980
0
15
30
60
Meter

Several things happen after a dig.

- The excavation has to be filled up.
- Records, artifacts, and samples must be shipped back to the home laboratory.
- More detailed analyses of the recovered materials and the writing of excavation reports occur.
- Final results of the investigations are made available to the public and to professional archaeologists.

Processing and Classification

- when done in the field lab
- initial sorting – into broad categories e.g. stone tools, pottery, metal objects
- then subdivided – usually on the basis of three kinds of characteristics (attributes):
  - surface attributes – decoration and color
  - shape attributes - dimensions as well as shape itself
  - technological attributes – primarily raw material
- artifacts found to share similar attributes are grouped together into artifact types – typology
  - Three Age System – Thomsen
  - Used as means of defining archaeological entities at a particular moment in time
    - Assemblages – groups of artifact types at a particular time and place
    - Groups of assemblages have been taken to define archaeological cultures

Dating methods and chronology

Relative dating

Types of dating

- Two types of dating
- Relative dating – the idea that something is older or younger in relative to something else
- Absolute dating – the full or absolute date in years.
  - only in the last 60 years we have independent means of absolute dating
  - before then, only reliable absolute dates were historical ones

Relative Dating

Relative dating

- Stratigraphy
  - The study of stratification – the depositing of strata one above the other
  - The law of superposition – the underlying layer was deposited first and therefore earlier than the overlying layer.
  - Stratigraphy provides a relative chronological sequence.
  - It involves detecting whether there has been any human or natural disturbance of the layers since they were originally deposited e.g. garbage pits
  - We do not aim at dating the layers but the materials that humans have left within them – artifacts, structures, organic remains, etc.

Relative dating

- Association
  - When two objects were found in association within the same archaeological deposit we mean that they were buried at the same time.
  - If it is a sealed deposit (no intrusions from another deposit) the associated objects cannot be more recent than the deposit itself.
  - IMPORTANT – when one of the objects can be assigned an absolute date then an absolute date can be assigned to the deposit and other objects within the deposit
  - A series of such dates from different deposits will give an absolute chronology for the whole sequence.

Typological Sequences

- When you are looking at the artifacts, buildings, or any other human creations you can mentally arrange them into a rough chronological sequence.

- Archaeologists define the form of an artifact by its specific attributes of material, shape, and decoration.
- Several artifacts with the same attributes constitute an artifact type – TYPOLOGY
- TYPOLOGY groups artifacts into such types.

Style

- Products of a given period and place have a recognizable style – through their distinctive shape and decoration they are in some sense characteristic of the society that produced them.
- Change in style (shape and decoration) is evolutionary.
- Particular artifacts produced at about the same time are often alike, but those produced several centuries apart will be different as a result of change
- Different types of artifact change in style at different rates:
- With pottery surface decoration changes most rapidly but the shape of a vessel or container may be most strongly influenced by practical requirements, which need not alter for hundreds of years.

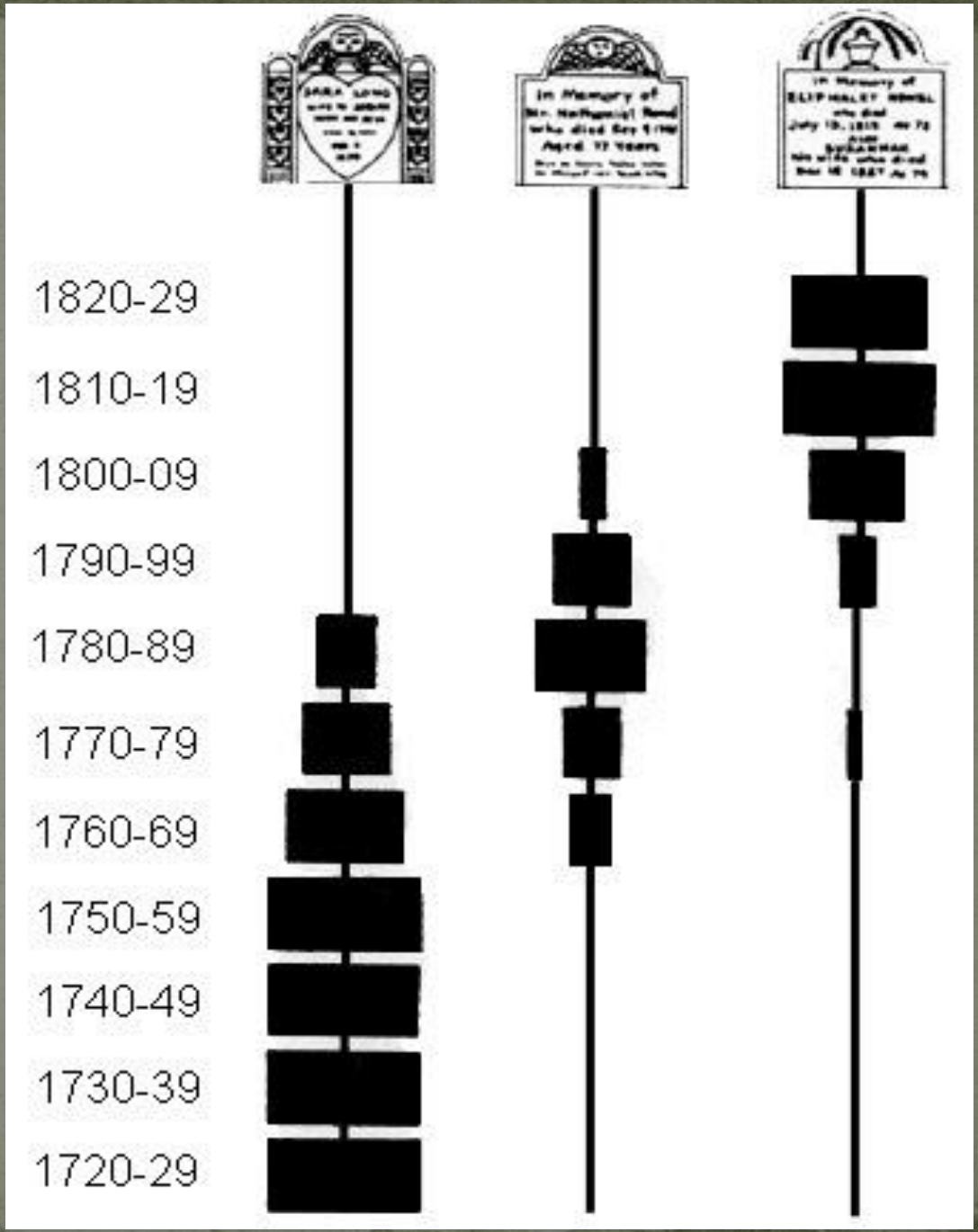
Seriation

- The determination of the chronological sequence of styles, types, or assemblages of types by any method or combination of methods.
- Stratigraphy may be employed, or the materials may be from surface sites.

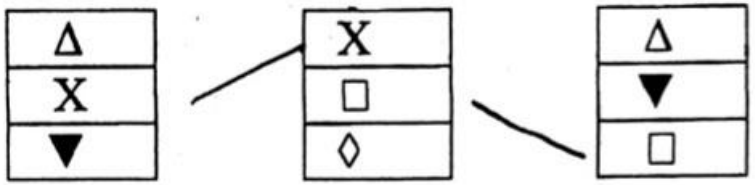
Seriation

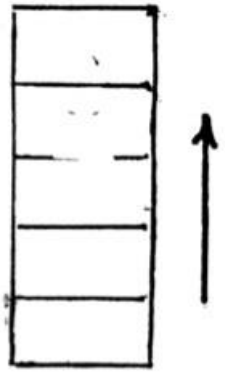
- The technique allows assemblages of artifacts to be arranged in a succession or serial order to indicate their ordering in time, or their relative chronology.
- 'battleship curve' – the frequency of a particular attribute is usually small to start with, rises to a peak as the style gains popularity, and then declines.
- Three tombstone designs found in central Connecticut cemeteries dating from 1700 to 1860.
- The Death's head design – Cherub – The Urn and willow tree

Seriation


1820-29
1810-19
1800-09
1790-99
1780-89
1770-79
1760-69
1750-59
1740-49
1730-39
1720-29

Based on the following three stratigraphic sequences, construct a composite sequence of geometric forms in the column to the right.





Seriation

	Type 1	Type 2	Type 3	Type 4	Type 5
Site A	X	X	X	-	-
Site B	-	-	X	-	X
Site C	-	X	X	-	X
Site D	X	X	-	-	-
Site E	-	X	X	X	-

X: present

Arrange the five sites (rows) shown above such that the five ceramic types display continuous (that is, gap-free) distributions.

Seriation

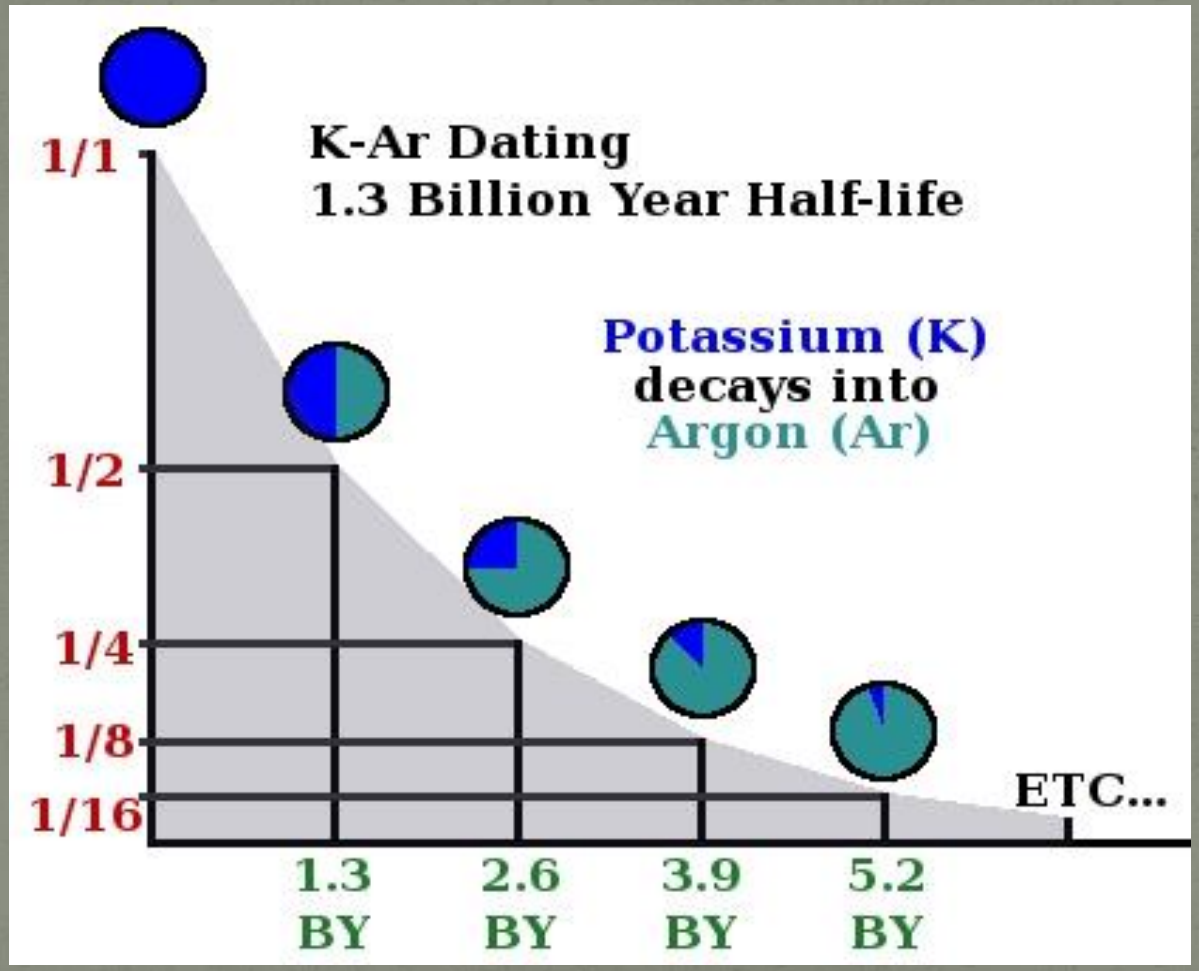
	%Type 1	%Type 2	%Type3	%Type4
Site A	5	55	30	10
Site B	30	30	5	35
Site C	20	40	10	40
Site D	5	40	50	5
Site E	10	50	25	15

Arrange the five sites (rows) shown above such that the percentage composition of neighbors are as similar as possible.

Chronometric Dating Techniques

- Potassium/Argon Dating
- Carbon-14
- Thermoluminiscence
- Paleomagnetism
- Biostratigraphy

Potassium/Argon Dating



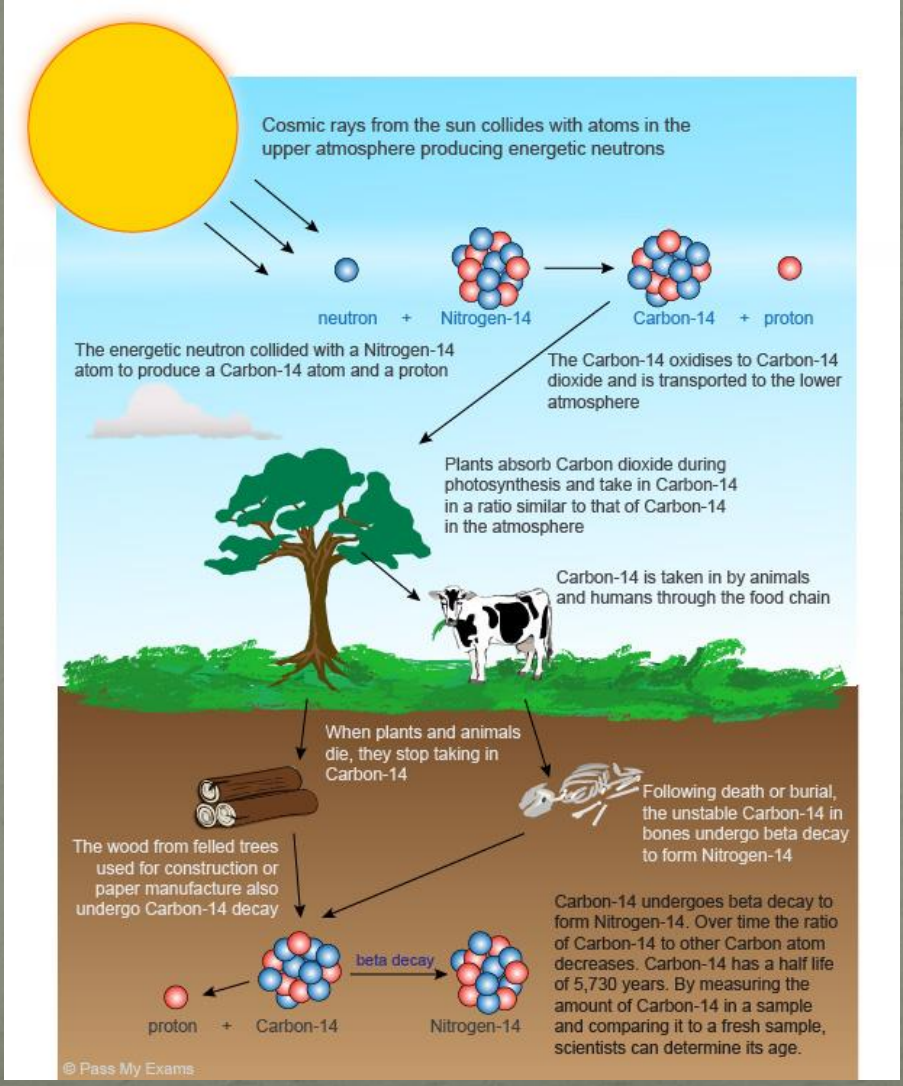
Radiocarbon Dating

- The key to this procedure involves the principle of radioactive decay.
- Carbon (abbreviated as C) is a chemical element with several isotopes.
- Unstable radioactive isotopes in various materials decay into stable isotopes over a known period of time.
- All living things absorb both stable carbon (primarily ^{12}C) and its radioactive isotope (^{14}C) throughout their lifetime.
- The proportion of ^{12}C and ^{14}C remains constant in an organism until its death when the intake of fresh carbon stops.

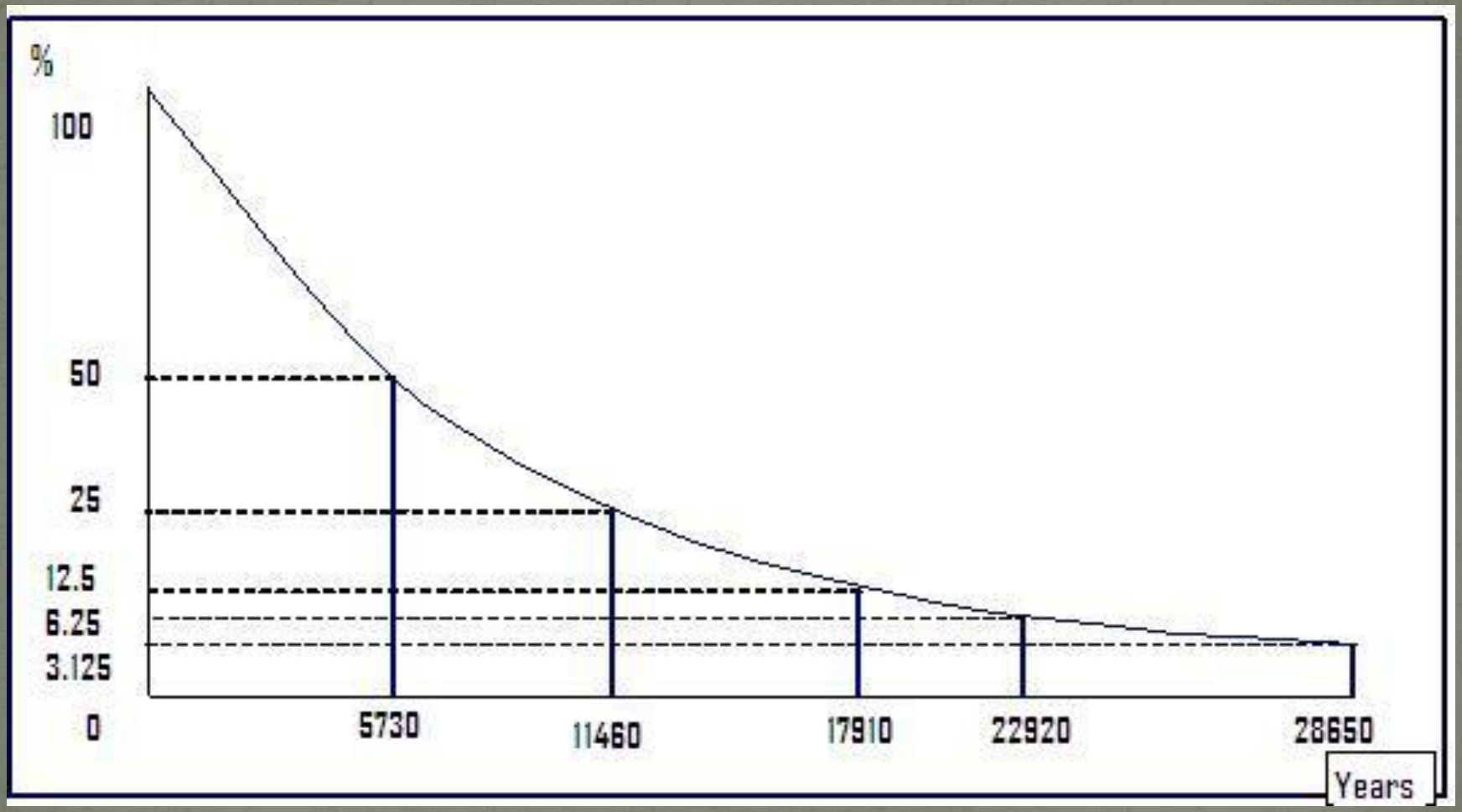
Radiocarbon dating

- The rate of decay for ^{14}C has a half-life of about 5730 years.
- The limit of radiocarbon dating is around 40,000 years ago.
- There are a number of minor corrections that are made to radiocarbon dates to improve their accuracy.

Radiocarbon dating



Carbon-14



Radiocarbon dating

- Radiocarbon dating does not establish a single point in time
- Dates are established from 1950
- It establishes a distribution of values
  - 1035 +/- 35 BP
    - 1950 – 1035 = 915 AD
    - 915 + 35 = 950
    - 915 – 35 = 880
    - So AD 880 - 950
  - 2500 +/- 100 BP

Tree-ring Dating

Lithic analysis

Stone tools and human behavior

- Simple stone tools are the earliest human artifacts that archaeologists study
  - Small cobbles were first broken to produce sharp edges in Africa between 3 and 2 million years ago
  - Prior to the introduction of cast metals about 5000 years ago, most tools with cutting edges were made of stone.
  - Stone tools were sometimes works of art and important symbols of status

Stone tools and human behavior

- Sharp fragments of stone are perhaps the most common prehistoric artifacts on earth
  - The earliest worked pieces of stone have been found in East Africa dating to 2.6 million years ago
  - Our ancient ancestors may also have used pieces of wood or bone for tools, but these have not survived

Stone tools and human behavior

- Stone can be shaped in a variety of ways
  - The technique for making stone tools by intentionally removing a series of flakes is called flaking or knapping
  - Archaeologists often refer to shaped stone artifacts as lithics, or lithic artifacts

Fracture mechanics and raw material

- Fracture mechanics is the concept used to describe how raw materials break
  - The key to making stone tools is to use a raw material that will break in a predictable way and produce a sharp edge
  - The makers of stone tools sought hard, fine-grained, crystalline rocks
  - The most common materials used were a form of cryptocrystalline quartz including basalt, obsidian, jasper, quartzite, chert, and flint
  - A piece of raw material for making stone tools is usually called a nodule or core

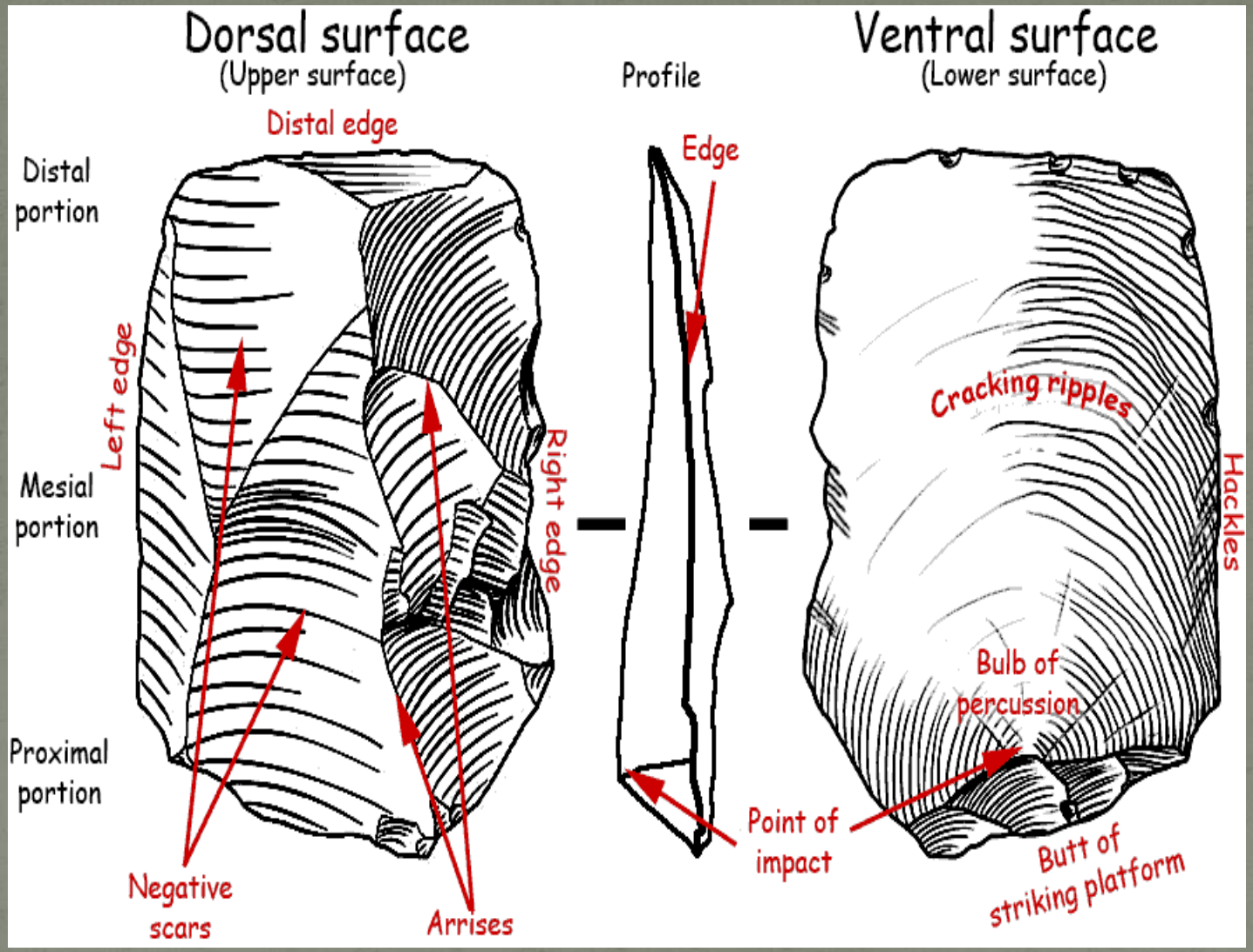
Fracture mechanics and raw material

Fracture mechanics and raw material

- Flint, or chert, was the type most often used prehistorically.
  - The term chert is commonly used in North America
  - The term flint is more commonly used for this material throughout the Old World
  - Predictable fracture is the important characteristic of this material so that desired shapes can be achieved by flaking

Fracture mechanics and raw material

- Because of the cone of fracture and the nature of the material itself, flakes have a number of distinctive characteristics
  - The place where force was applied to remove the flake is called the striking platform
  - The outer surface of the flake is called the dorsal surface
  - The inner, fresh surface of the flake itself is called the bulbar, or ventral, surface.

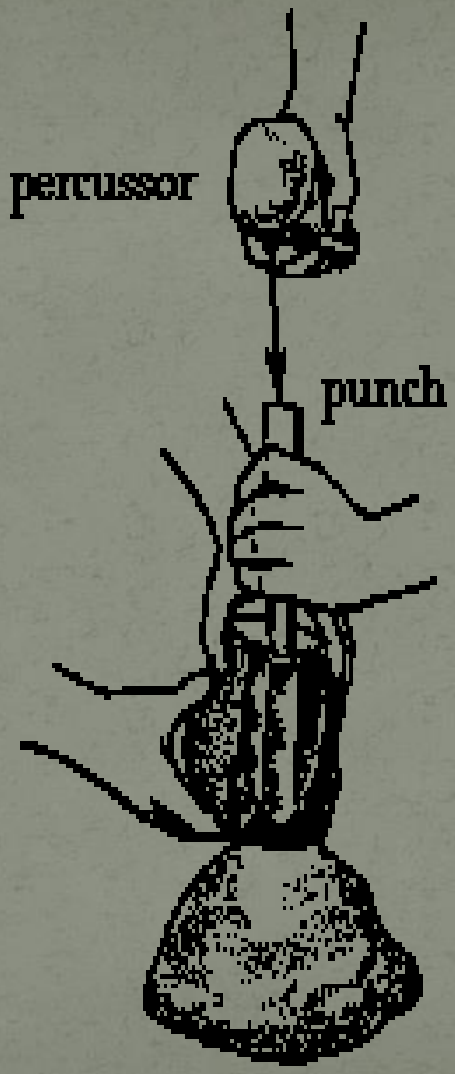

Dorsal surface
(Upper surface)
Profile
Ventral surface
(Lower surface)
Distal edge
Distal portion
Left edge
Mesial portion
Right edge
Proximal portion
Negative scars
Arrises
Edge
Point of impact
Cracking ripples
Hackles
Bulb of percussion
Butt of striking platform

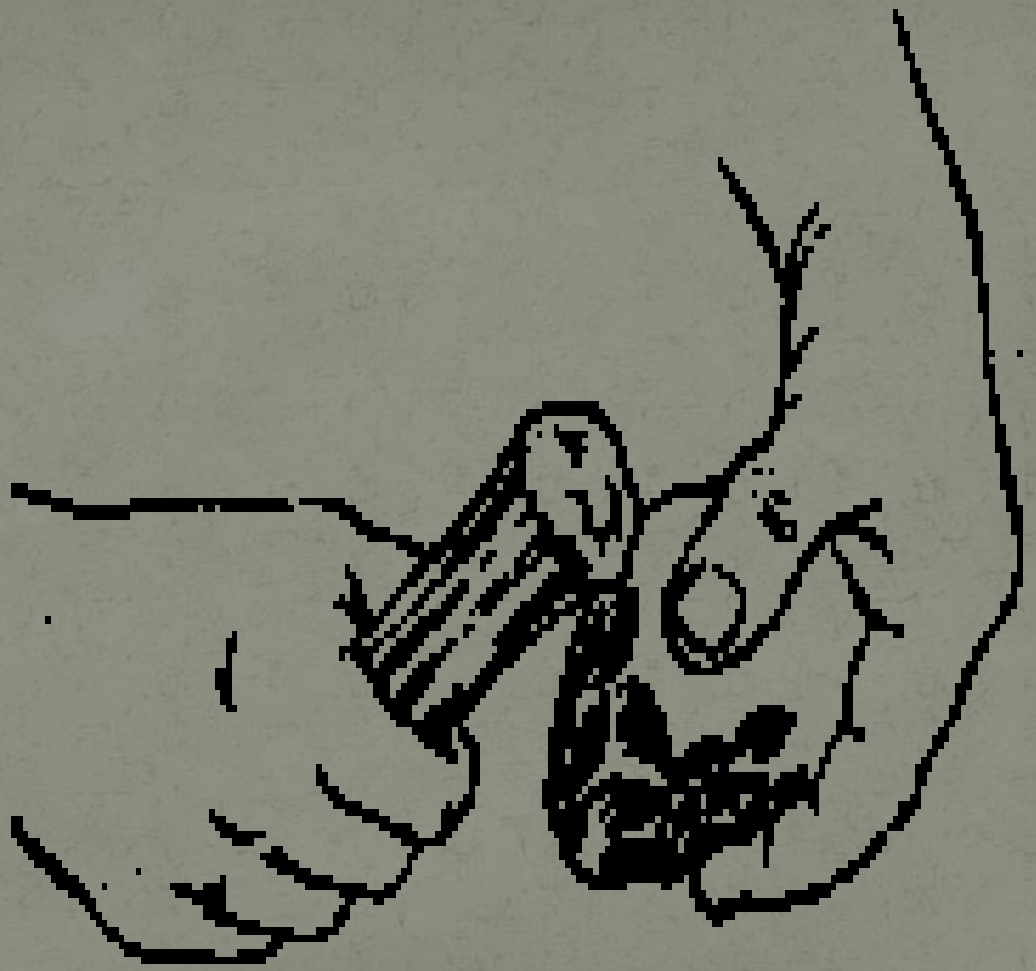
Making stone tools

- The flake can be removed from core either by a blow or pressure
  - The technique of striking stone to remove a flake is called percussion
  - Pressure flaking is the term used to describe removals made by pressing a point into the edge of a core

Making stone tools

- Percussion can be done using a hard hammer, hammer and anvil, or soft hammer
  - The term hard hammer refers to the use of a hammer of equal or greater hardness than the core
  - The hammer and anvil method is performed when the core is held in the hand and struck against a rock fixed in the ground
  - Soft hammer means the use of a hammer of lighter, softer material, usually antler, bone or even wood.
  - Percussion can be direct or indirect


percussor
punch



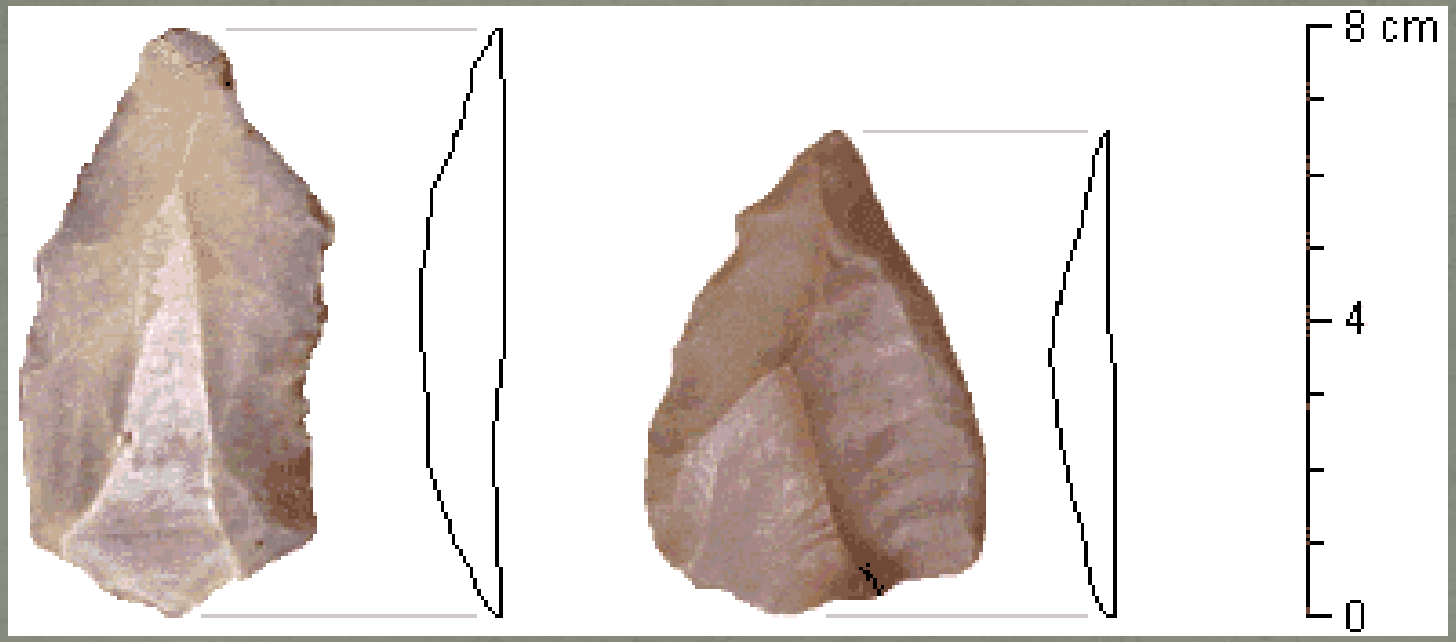
Making stone tools

- Pressure flaking involves the use of a pointed tool to press on the edge of a core to remove very long, narrow flakes
  - Usually antler or bone was used
  - Copper was sometimes used for this pointed tool as well

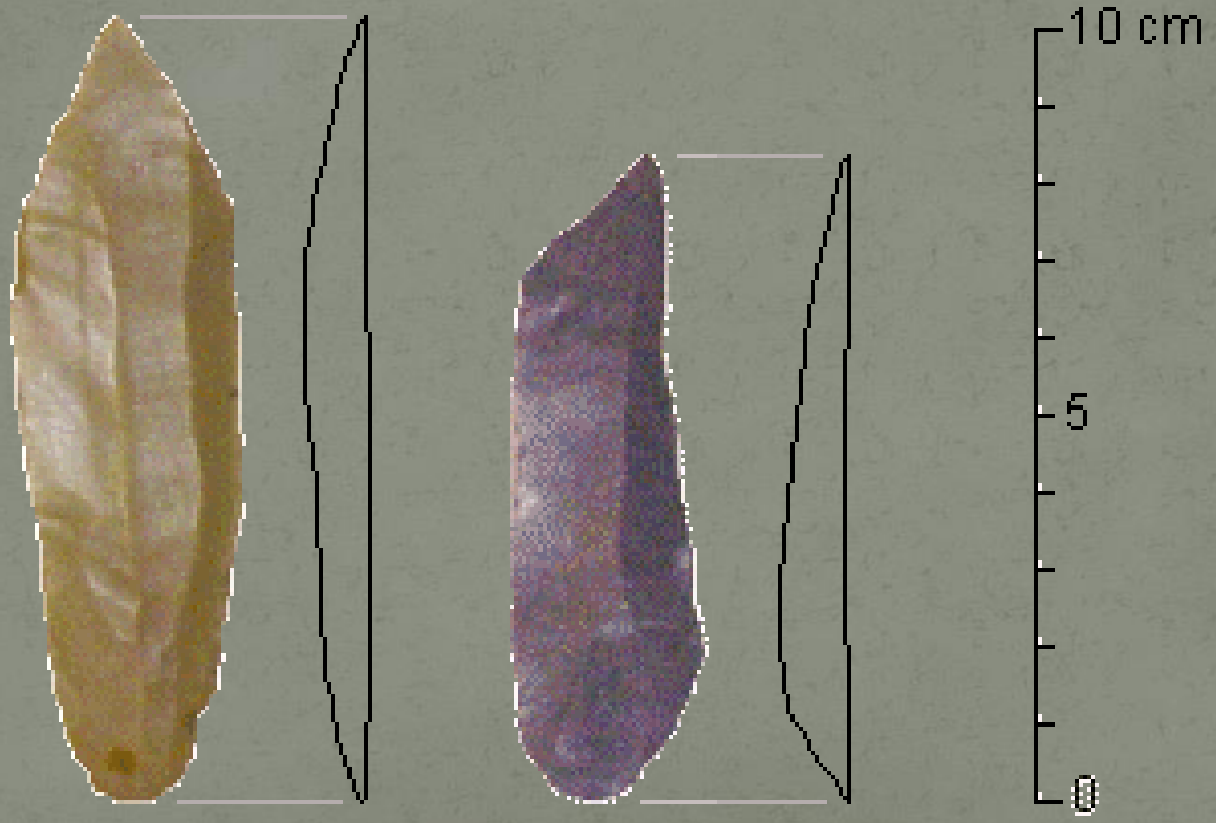
Making stone tools

- A distinction is made between flakes and blades
  - Blades are simply long, narrow flakes
  - Blades can be removed by direct or indirect percussion
  - Blades were invented rather late in the Paleolithic period
  - Two kinds of blades can be identified, hard hammer and soft hammer blades

Flakes



Blades



Making stone tools

- Tools are often separated as core tools or flake tools
  - Another distinction is made between unifacial tools or bifacial tools
  - Bifacial tools are often pointed implements like projectile points
- Tools are often intentionally shaped to a specific form by secondary flaking
  - The technique for further shaping flakes, blades, and other pieces into specific form is called retouching
  - Blades are commonly retouched into a variety of shapes

Making sense of stone tools

- There are many ways to study the results of prehistoric stone tool production
  - Experimental studies are common
  - Typology is the conventional approach to classifying stone tools
  - Studies of the process of making stone tools often involve a concept or method known as a chaine operatoire.
  - Microwear analysis is one of the more effective techniques used for studying how lithic artifacts were used

Making sense of stone tools

- After the stone artifacts have been cleaned and numbered, the process of sorting, classifying, measuring and analysis begins
  - The initial sorting is often based on the basic technological types of core and flake and tools
  - It is often necessary to draw stone tools in order to illustrate the characteristics of the artifact and the details of manufacture and use
  - Today, the combination of laser and photo technology is used

Making sense of stone tools

- Typology
  - A hand axe is a large core tool with a distinctive shape that is pointed at one end and rounded at the other
    - Functionally, the hand axe was an all-purpose implement
    - Stylistically, there are distinctive types of hand axes that show regional differences in East Africa
    - Hand axe production changed over time as soft hammer flaking was incorporated into the process
  - The set of stone tools from a site is known as a lithic assemblage
    - Assemblages of lithic artifacts from a particular time period are characteristic of archaeological cultures

Making sense of stone tools

- Artifact types have changed over time
  - The Acheulean assemblages of the Lower Paleolithic are characterized by hand axes and their close relatives
  - The Middle Paleolithic assemblage is distinguished by a multitude of flake tools, scrapers, burins, points, along with a few hand axes and other bifacial tools
  - Blade technology characterizes the Upper Paleolithic, after 40,000 years ago.

Making sense of stone tools

There are striking differences between the artifact types in the New World and the Old World

- Most artifacts in the early prehistory of the New World were bifaces (A term describing a flaked stone tool in which both faces or sides are retouched to make a thinner tool)
- They were largely in the form of projectile points for spears and later for the bow and arrow
- Most of the unifacial (A term describing a flaked stone tool in which only one face or side is retouched to make a sharp edge) artifacts from the Archaic and Woodland periods are irregular in appearance
- Flakes predominate in the New World industries

Making sense of stone tools

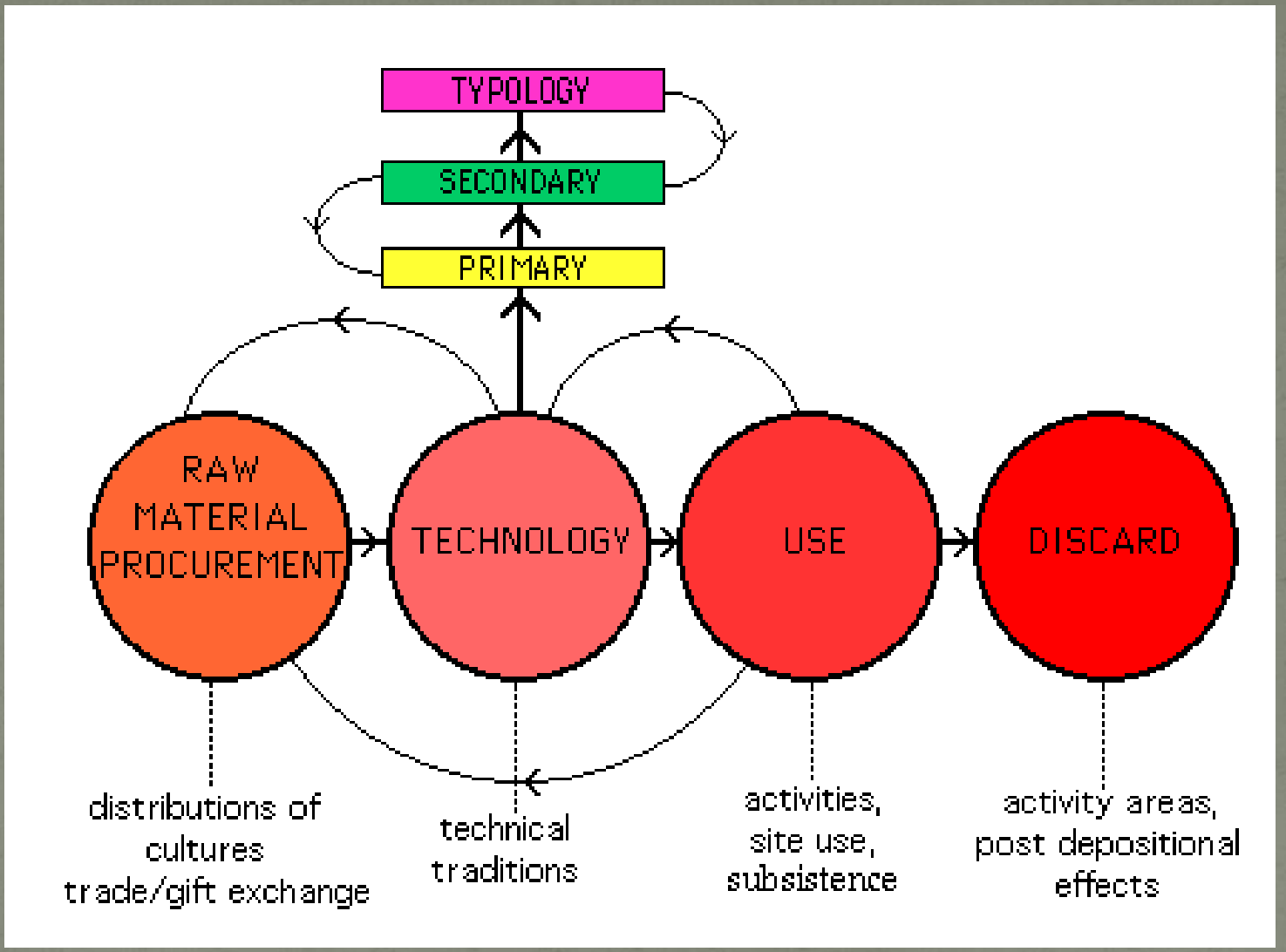
- Chaîne Opératoire
  - The French term, operational sequence, refers to the steps in the process of production.
    - The chaîne opératoire is defined by the different stages of production from the acquisition of raw material to the final abandonment of the objects
    - Such studies focus on the waste material, on refitting, on human motor abilities and skills, knowledge, and experience as well as the end products of the process (tools).

Making sense of stone tools

The life history of a lithic artifact involves four major stages: the procurement of raw material, the technology used to make the tool, function, and discard.

- Technology can be divided into primary reduction, secondary reduction, and typology.

- Studying the operational steps provides more awareness of the relationship among the components in the sequence
  - Choices that are made in one stage affect decisions in another
  - There is a distinction between expedient and curated tools
    - Expedient tools include so-called formal unifaces, blades, and flake tools. The common thread linking these tool forms is that each was made relatively quickly and required relatively little technological sophistication


TYPOLOGY
SECONDARY
PRIMARY
RAW MATERIAL PROCUREMENT
TECHNOLOGY
USE
DISCARD
distributions of cultures trade/gift exchange
technical traditions
activities, site use, subsistence
activity areas, post depositional effects

Making sense of stone tools

- Refitting
  - A technique for reassembling the scattered pieces of stone, pottery, or bone at an archaeological site to study patterns of manufacture and disposal.
- Microwear analysis
  - Microscopic studies of damage and polish on the edges of stone artifacts to reveal the materials that were worked.
  - It involves the use of microscopes to study the edges of the stone tools
    - This kind of analysis began in the second half of the 20th century
    - Experimental studies allowed researches to characterize polishes specific to certain kinds of materials and activities
    - Stone tools were often used to make other tools of bone, antler, wood, and other materials