



ARCHY 483

Analysis of Stone Artefacts

Spring 2019

Lecture 1

Introduction to stone artefacts,
fracture mechanics, and artefact
anatomy

WHY



"...weapons of war, fabricated by a people who had not the use of metals. They lay in great numbers at the depth of about twelve feet, in a stratified soil, which was dug into for the purpose of raising clay for bricks... The situation in which these weapons were found may tempt us to refer them to a very remote period indeed, even beyond that of the present world..." John Frere, 1797

- The most durable and often numerous remains of past human activities
- Played a vital role in our day-to-day survival for 98% of human history
- Some of the most interesting questions of all are being answered directly through the analysis of stone artefacts (in conjunction with other archaeological materials).

Stone artefacts have been central to the study of:

- The use of symbols in communicating social, political, and ideological relationships or differences
- The role of social agency in technology and use
- The technological signatures of various mechanisms of trade and exchange
- Understanding markers of gender



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Spring 2019

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ARCHY 483 A Sp 19: Analyses Of Stone Artifacts

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Instructors



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[Contact details & office location](#)

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Office Hours: ??? and by appointment

TA Office location: Denny 4th floor TA loft

Course description

The aim of this course is to gain an understanding of stone artefact assemblages and acquire a foundation of basic lab skills, data collection and analysis skills, and a familiarity with interpretive frameworks to prepare you for advanced research (with all fingers intact, hopefully). All materials will be delivered in the class meetings, on the course canvas page, and on our [class Slack channel](#) (there is no textbook). This is a 6 credit course that will satisfy the [I&S requirement](#). It is a core course for the [UW Archaeological Science Option](#).

Learning objectives

What we are going to do today...

1. What are stone artefacts?

2. What are the mechanics of stone artefact production?

3. How to talk about stone artefacts?

**What are
stone
artefacts
?**

What is a...

- Geofact?
- Artefact?
- Tool?

A stone artefact is any piece of rock modified by human behaviour, whether intentionally or unintentionally:

- Finely worked shapes such as microliths and bifaces
- Discarded pieces removed during the process of artefact production and modification.

Without proper context it may be impossible to determine the difference between artefacts and naturally fractured stone.





K2953





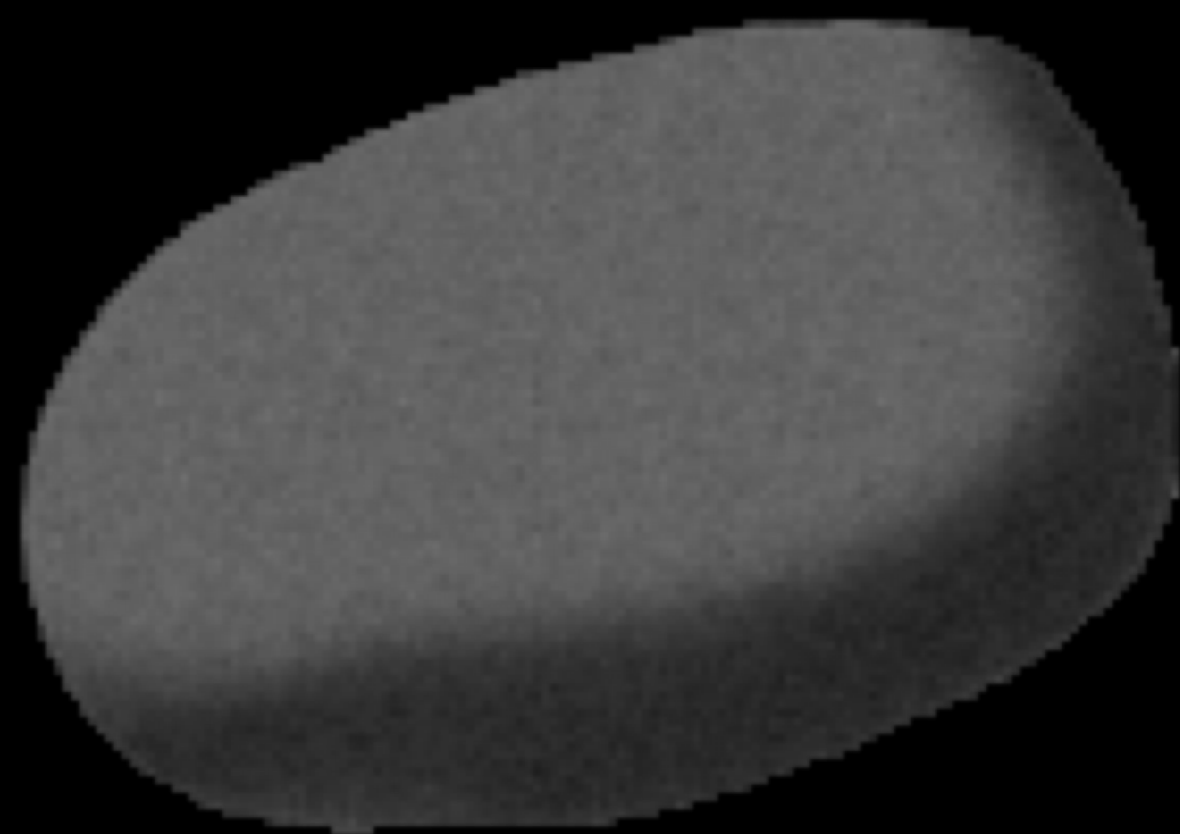




cm



cm



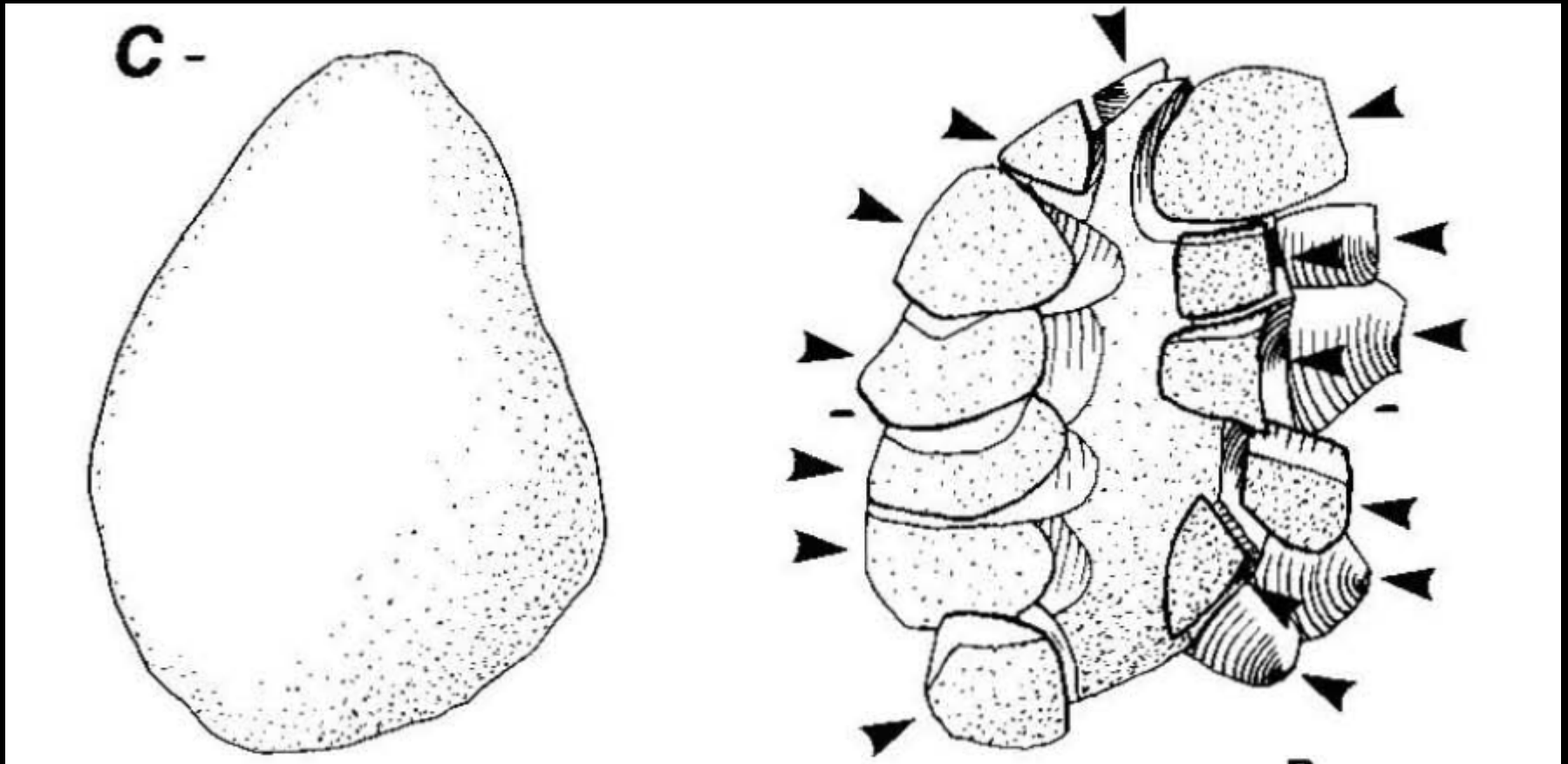


cm



**Stone
artefacts
and
fracture
mechanics**

detached pieces & objective pieces



- *Objective* pieces are stone items that have been hit, cracked, flaked, or modified in some way, and may include nodules, cores, bifaces, or flakes.
- *Detached* pieces are stone items that have been removed from objective pieces during the modification process (flakes, chips, spalls, blades, shatter).

Indenter: an object impacting force

- *Hard hammer percussion*: striking the nucleus at high velocity with a hard indenter such as a hammerstone
- *Soft hammer percussion*: soft indenter such as a piece of wood, bone or antler
- *Pressure flaking*: slowly applying pressure through a process called dynamic loading
- *Indirect percussion*: striking a positioned punch



“Flint Jack”, real name Edward Simpson (or Edward Smith) (c. 1812 - c. 1875) was an infamous Victorian forger of stone tools in the UK

Jacques Tixier was a French archaeologist well-known for his experimental knapping skills and his research in Qatar and Lebanon




Don Crabtree (1912 – 1980), pioneering experimental archaeologist and flintknapper.

Crabtree's Law: “the greater the degree of final finishing applied to a stone artifact, whether by flaking, grinding, and/or polishing, the harder it is to conclude the lithic reduction process which produced the stone artifact.”







**1970s Eccentric hair pin set. Don
Crebtree knapper**

OBSIDIAN DREAMS

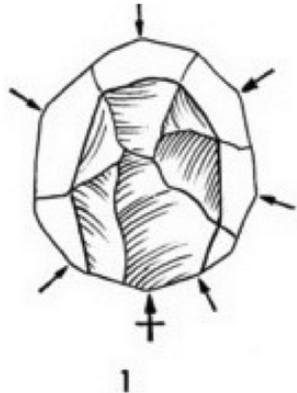
Jeannie Binning

**Western
Lithics**

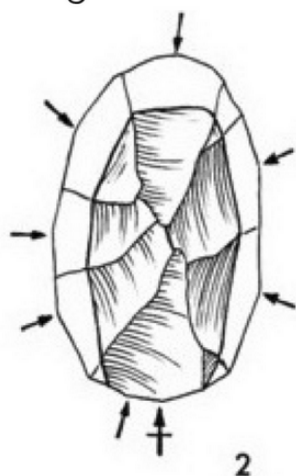


François Bordes (1919 - 1981) was a French archaeologist and geologist. He concluded that there were four Neanderthal cultures based on stone tool assemblages. Bordes wrote many books which include the Old Stone Age and A Tale Of Two Caves and many articles under the name Francis Carsac.

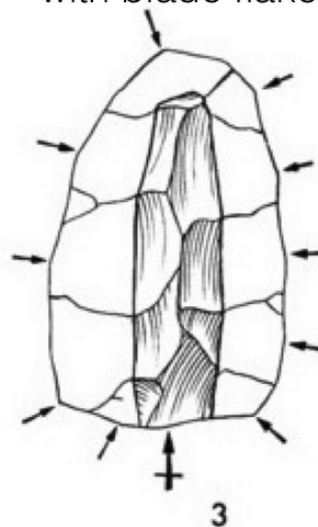
Classic



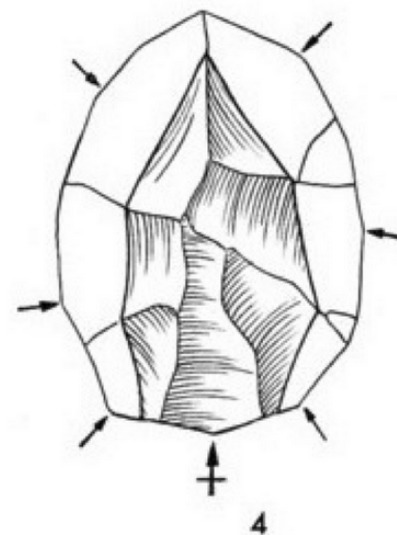
Elongated Classic



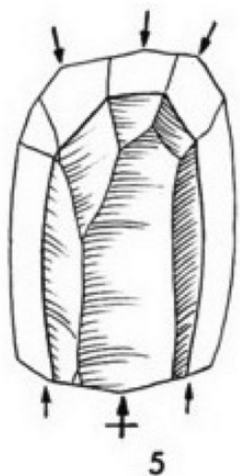
Elongated Classic with blade flake



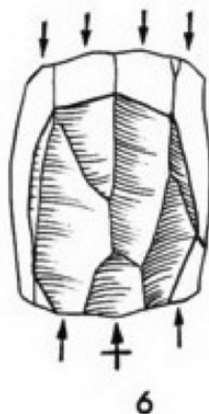
Elongated Classic with Levallois point



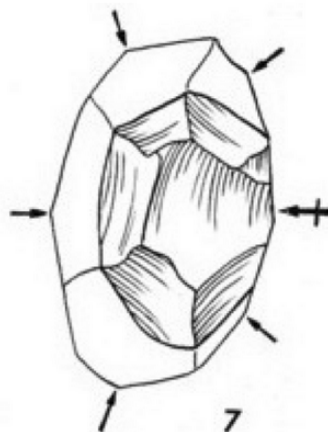
Long with parallel preparation



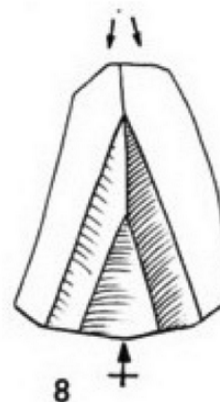
Short with parallel preparation



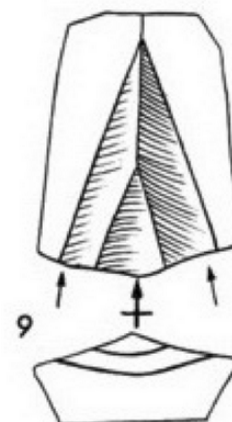
Victoria West



Point type A



Point type B





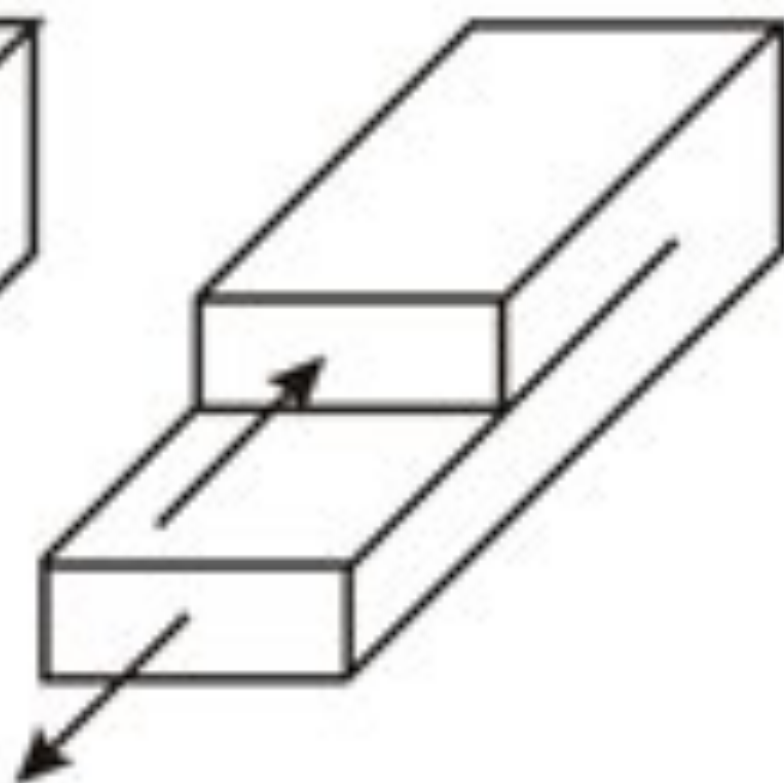
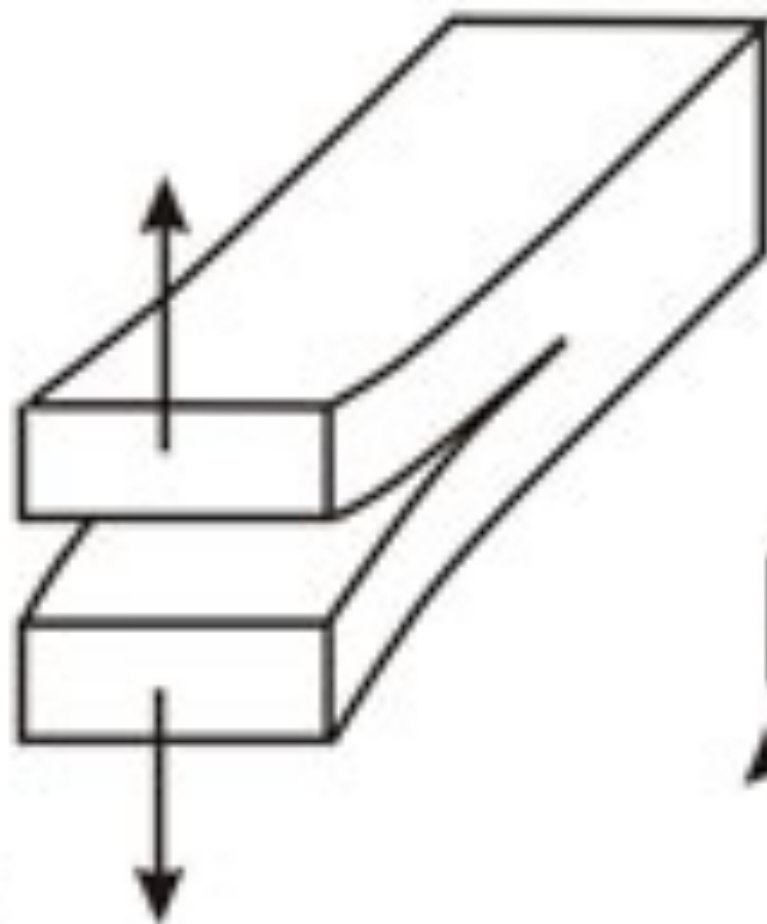


When the indenter contacts the nucleus...

- Force is directed into the nucleus using both an inward and outward motion
- This creates both 'opening' and 'shearing' stresses in the nucleus
- Fracture occurs when stresses within the nucleus reach a critical threshold and break the molecular bonds holding the nucleus together.

Opening Force

Shearing Force



A

Direction of Force

Platform

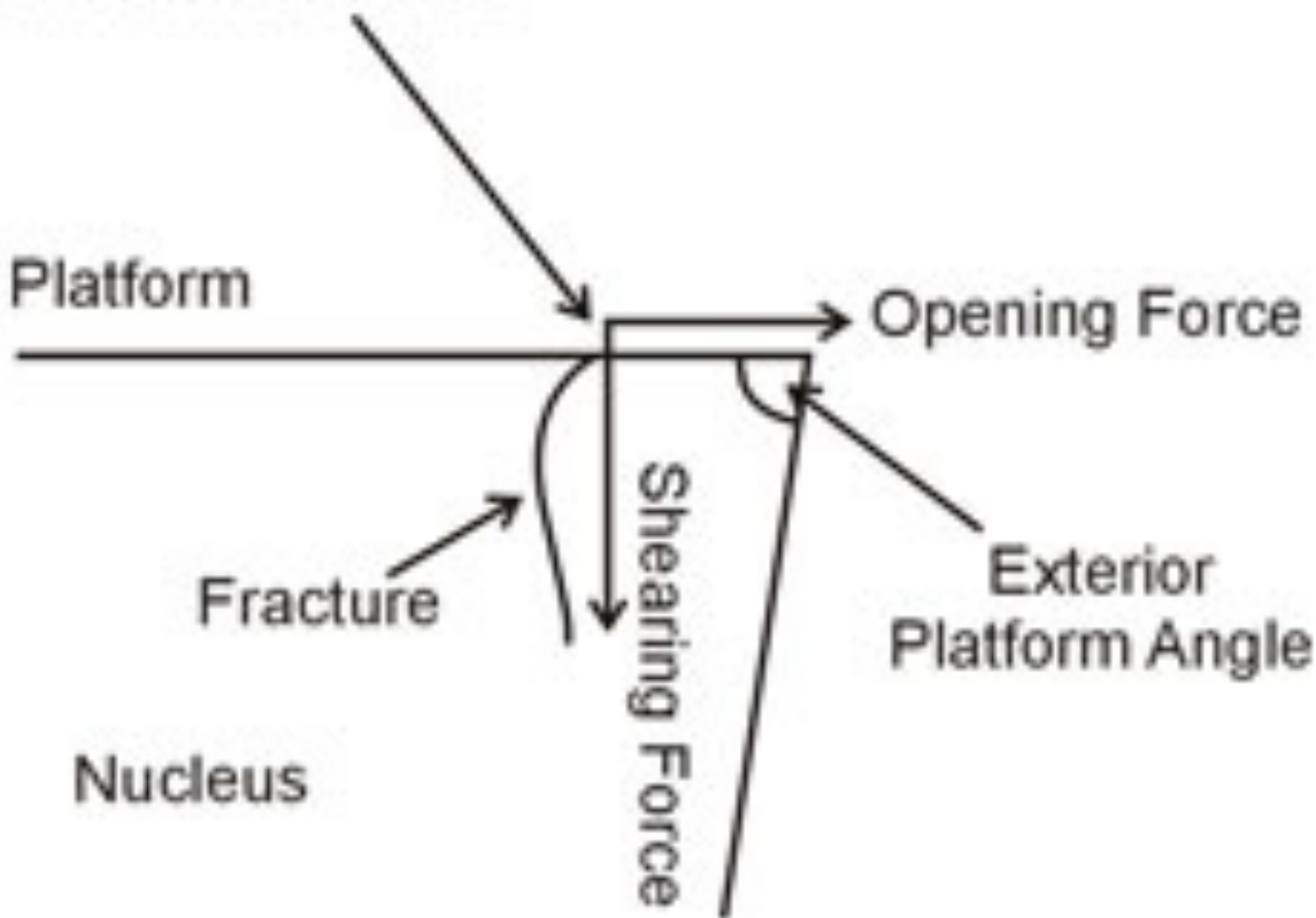
Opening Force

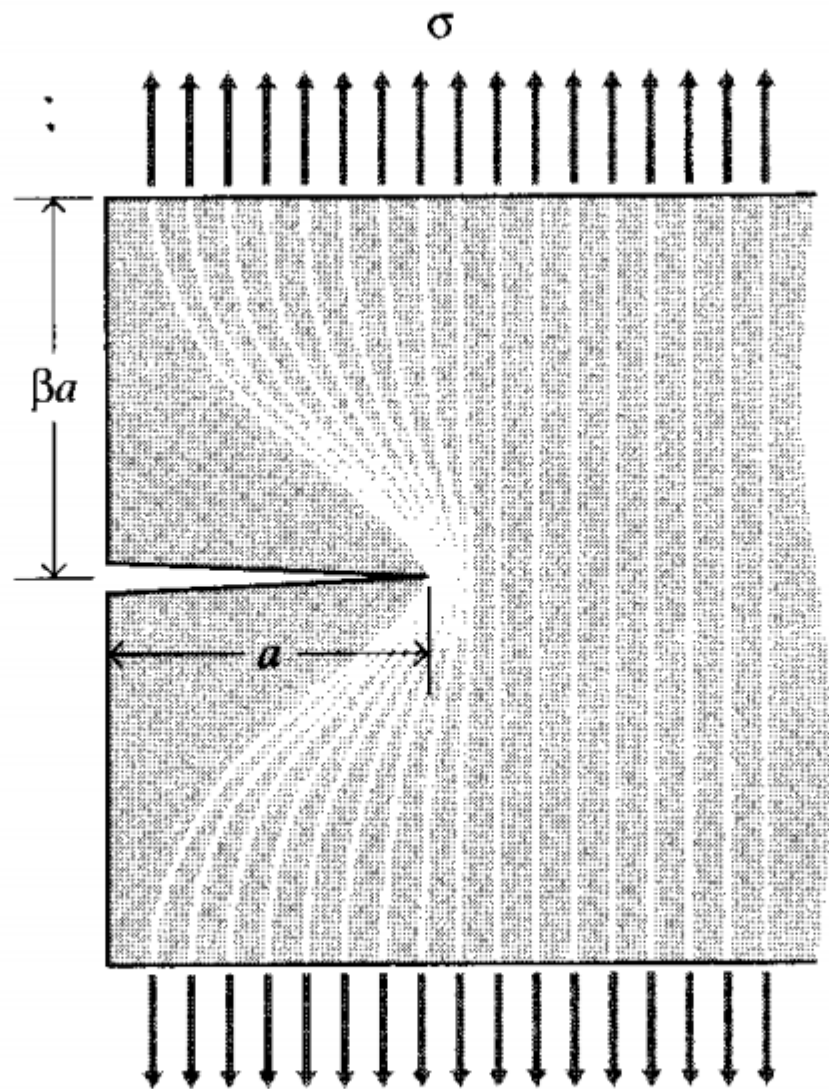
Fracture

Exterior
Platform Angle

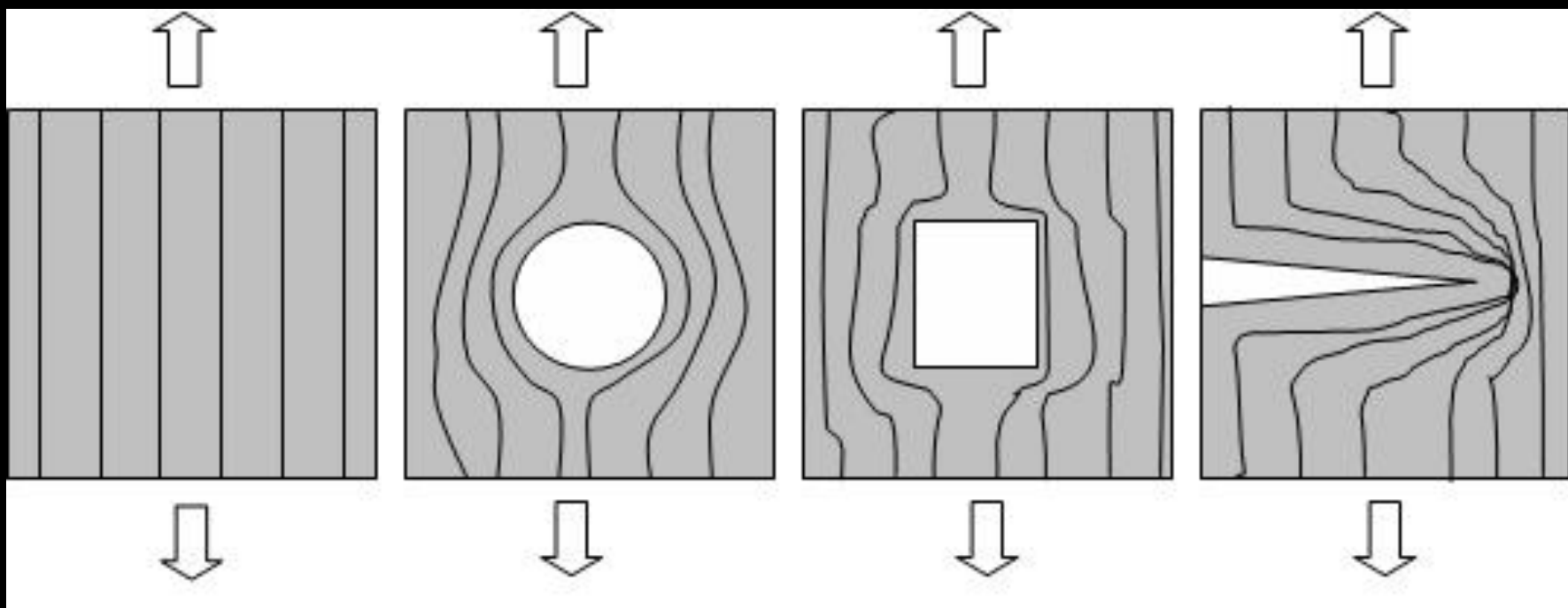
Nucleus

Shearing Force

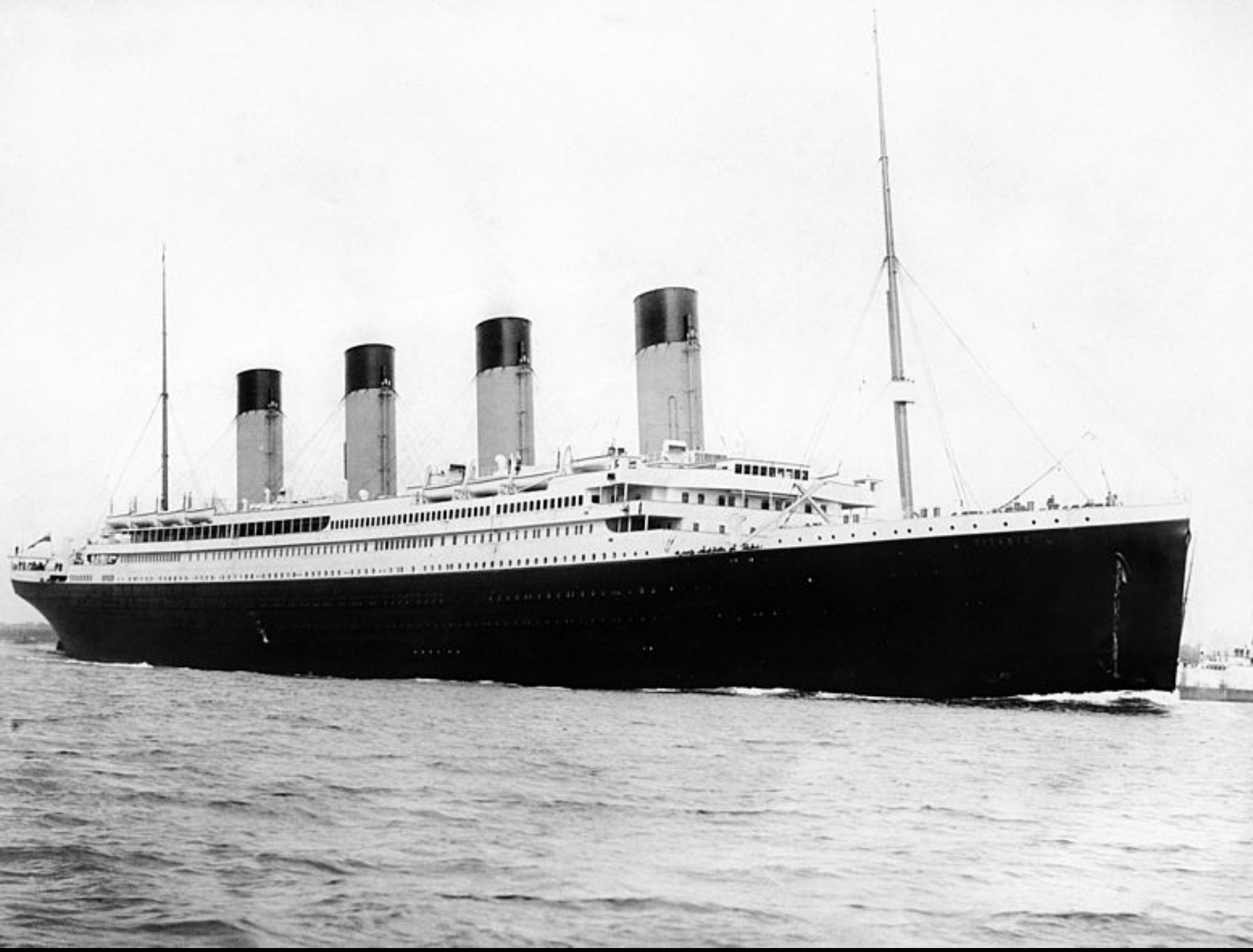




Alan Arnold Griffith FRS.





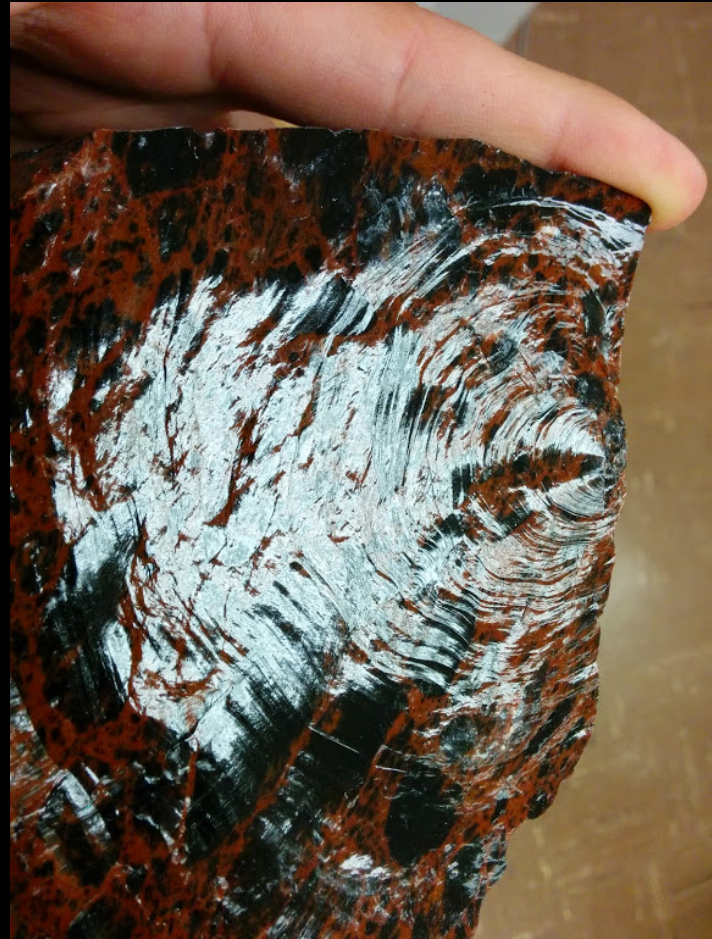




Titanic: impure steel
becomes brittle at low
temperatures

Comet: stress
concentrates at sharp
corners

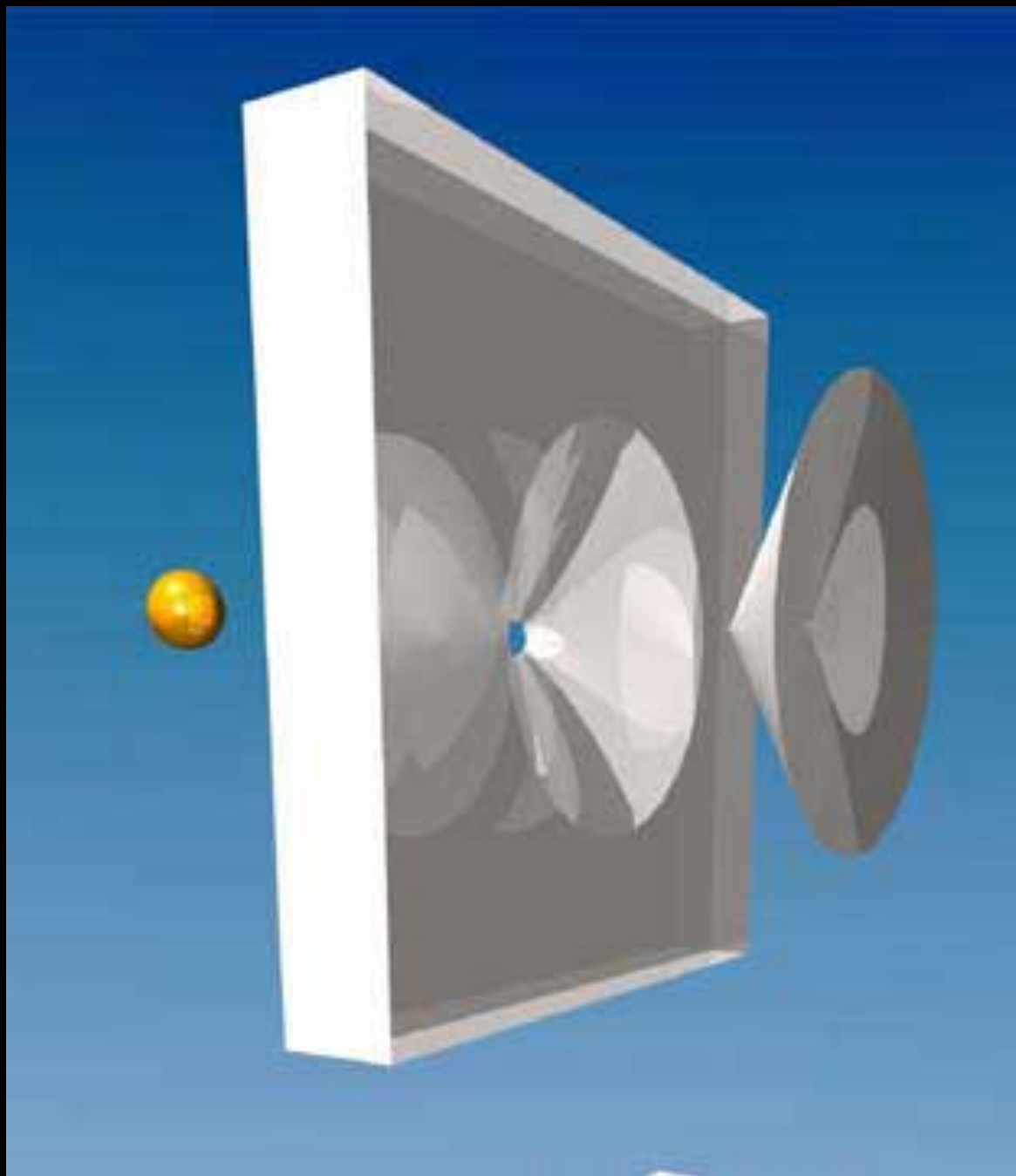
The most common form of fracture is known as *conchoidal fracture*, which begins from pre-existing flaws in the surface of the nucleus close to the point of impact and creates what is known as a *Hertzian cone*

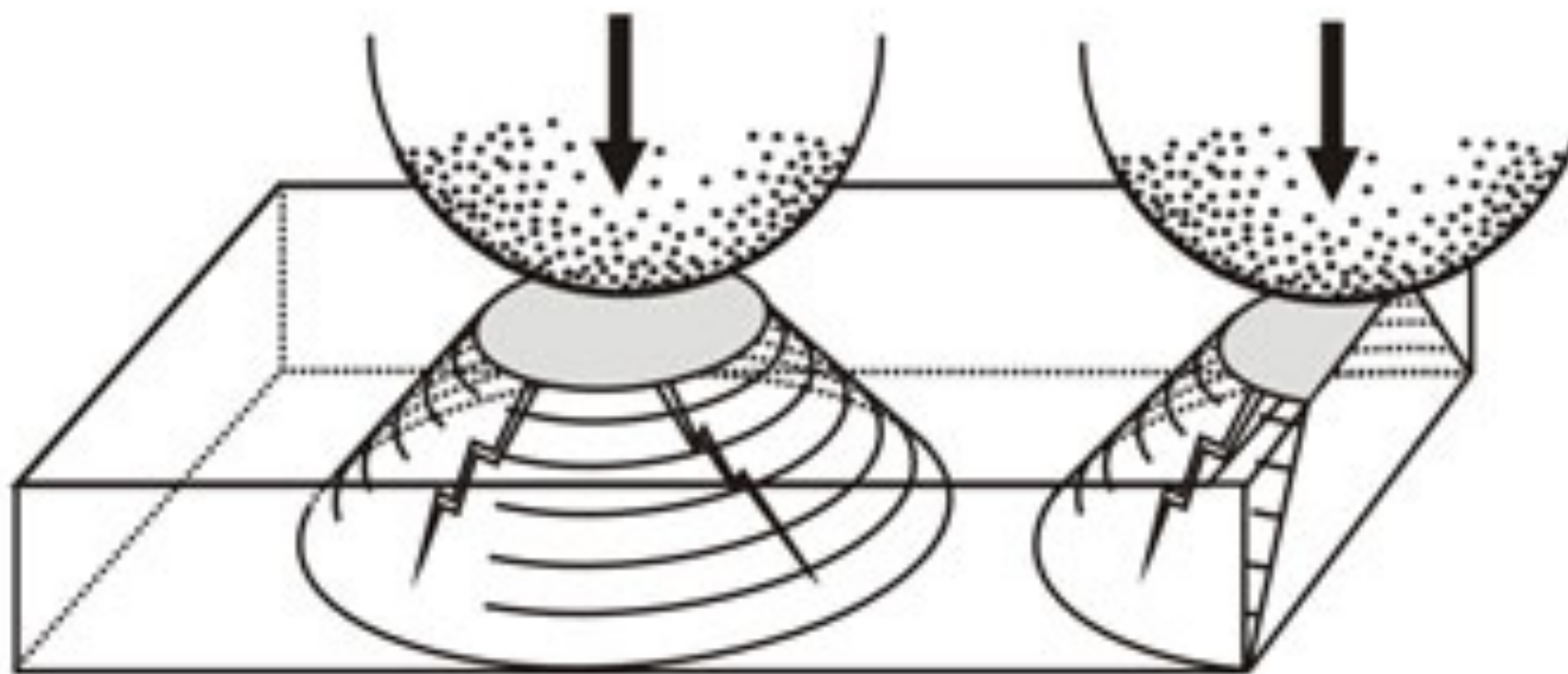


Conchoidal: resembling the shape of a scallop shell



Pioneering research into electromagnetic radiation (proved the existence of airborne electromagnetic waves) and contact mechanics







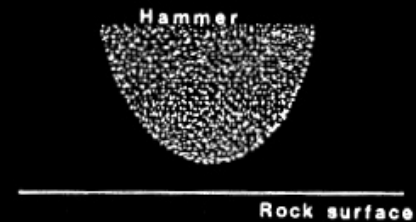
INITIATION



PROPAGATION

TERMINATION

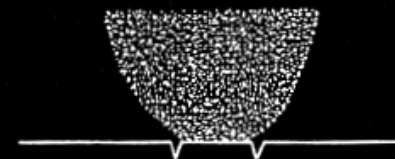
1



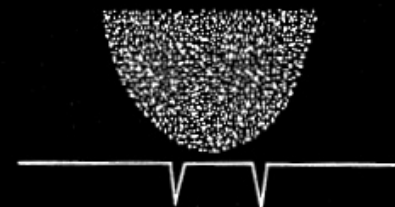
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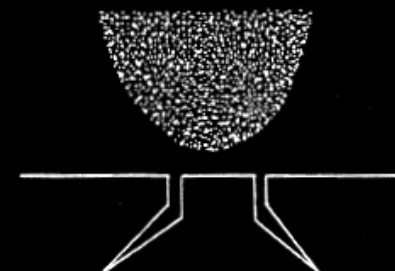
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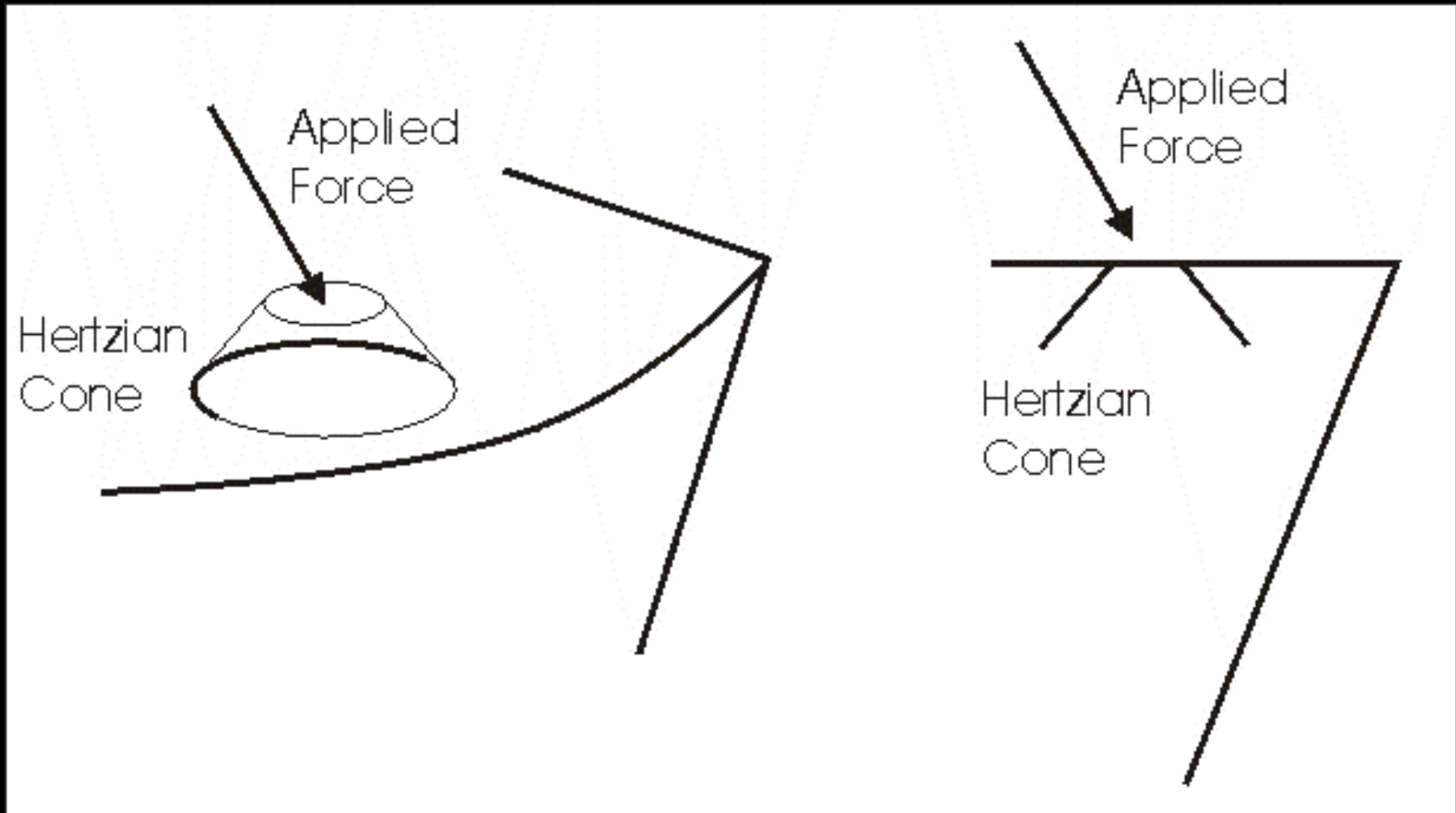
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5



1. Strike causes Hertzian cone to form on the platform surface



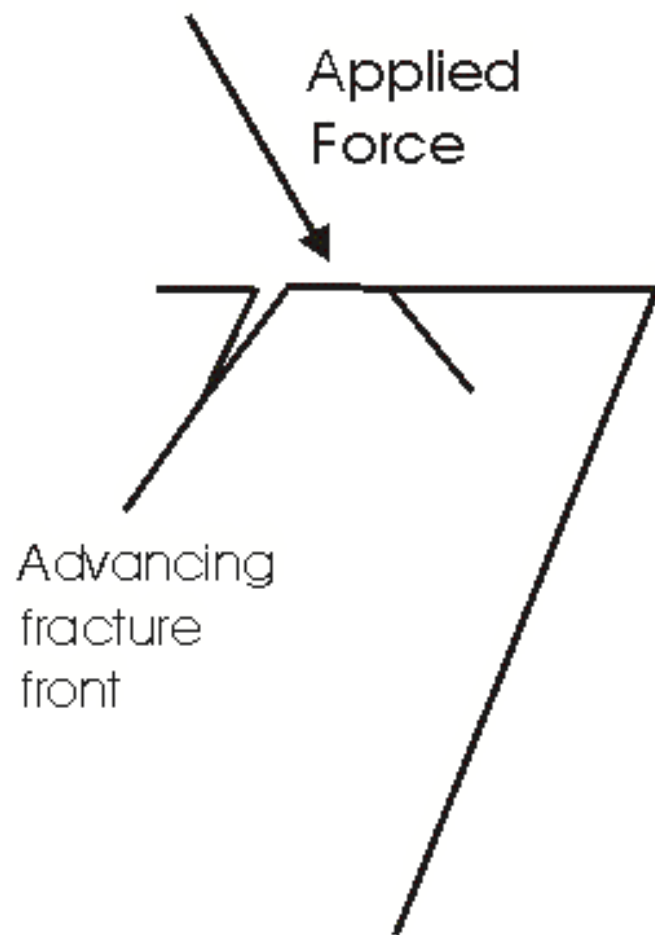
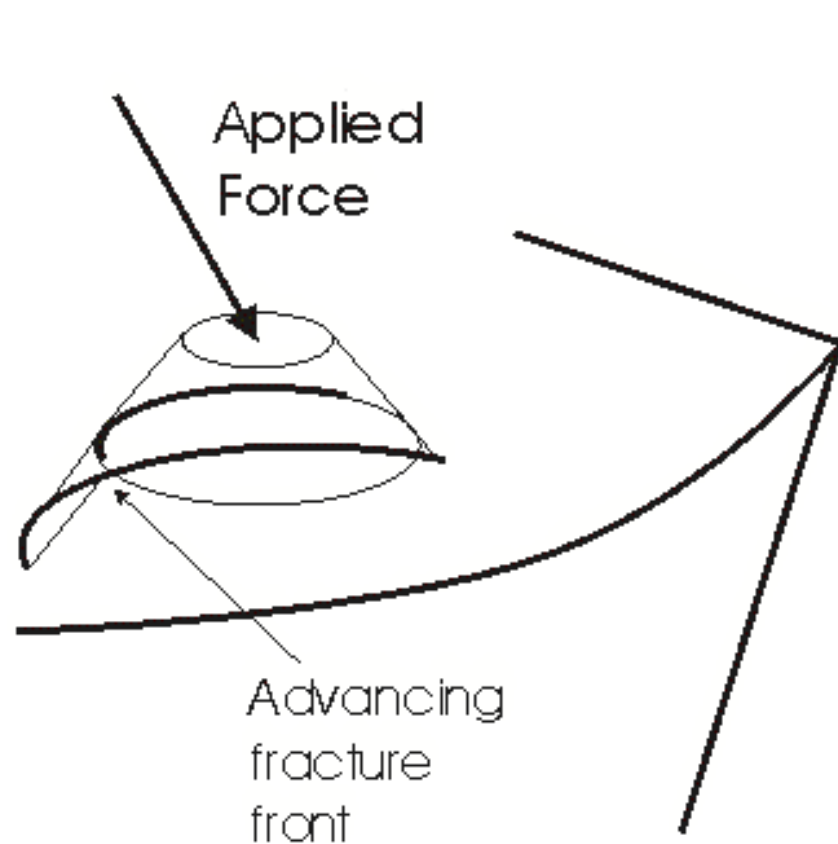




2. The applied force creates a tensile stress on the inner side of the Hertzian cone

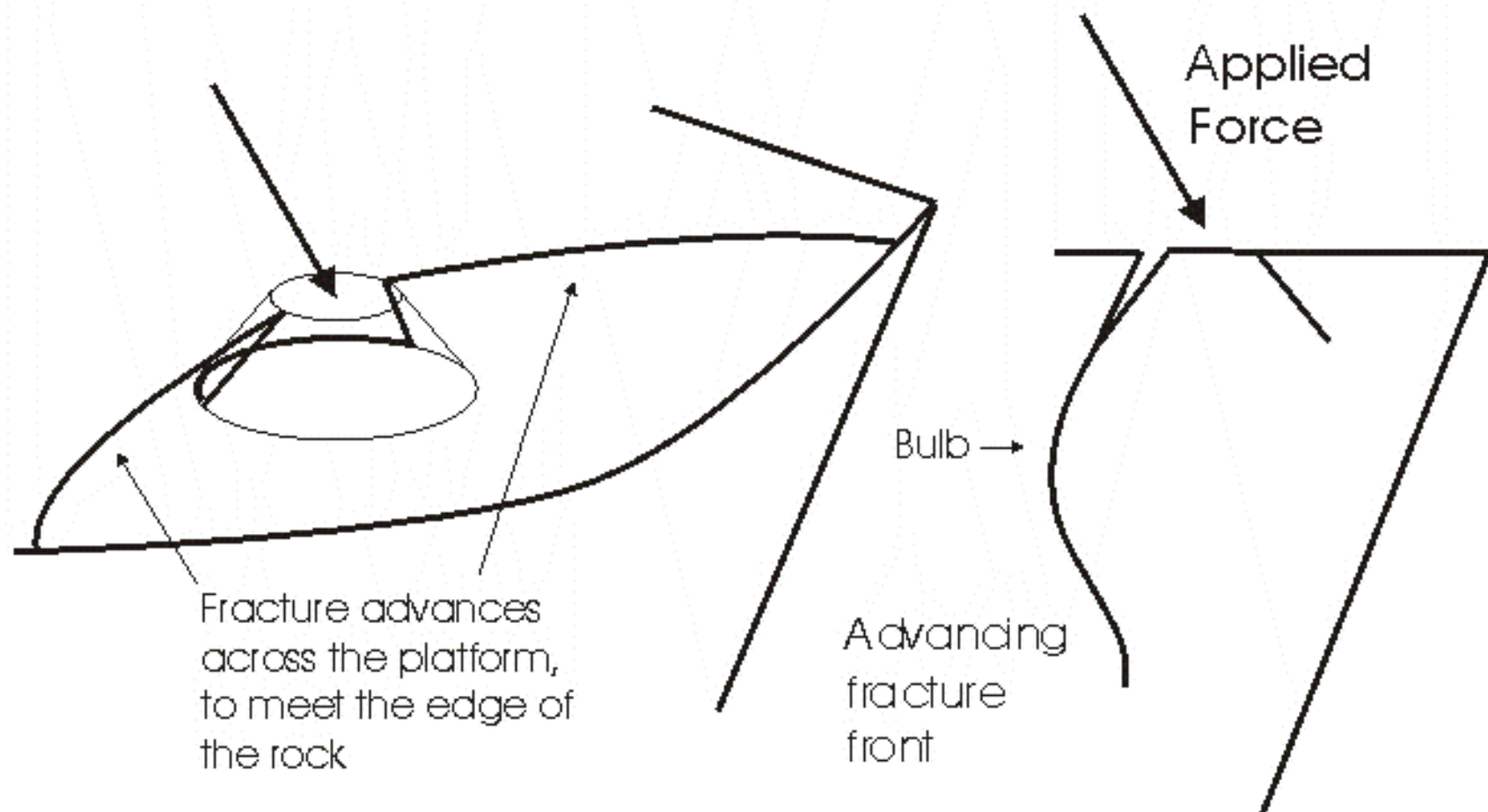
The cone wants to peel away from the main body of the rock...

... so the fracture advances into the rock, from the inner side of the cone.



3. However...

- For reasons that we don't completely understand, the advancing fracture turns back toward the surface of the rock
- This creates a “bulb”: a convexity in the fracture surface
- The fracture also propagates laterally out from the Hertzian cone, along the platform surface



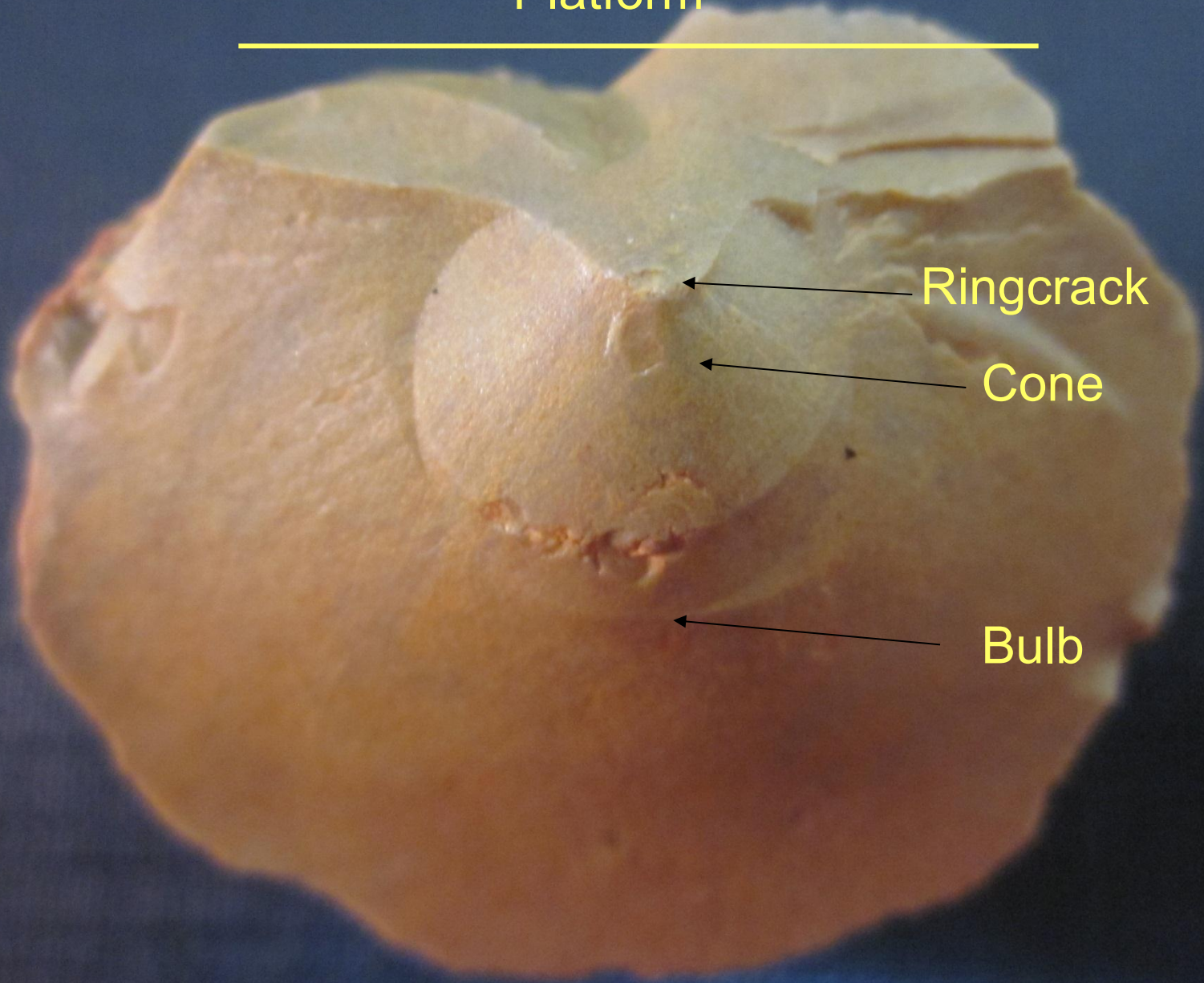
Flake anatomy

Platform

Ringcrack

Cone

Bulb



Ringcrack



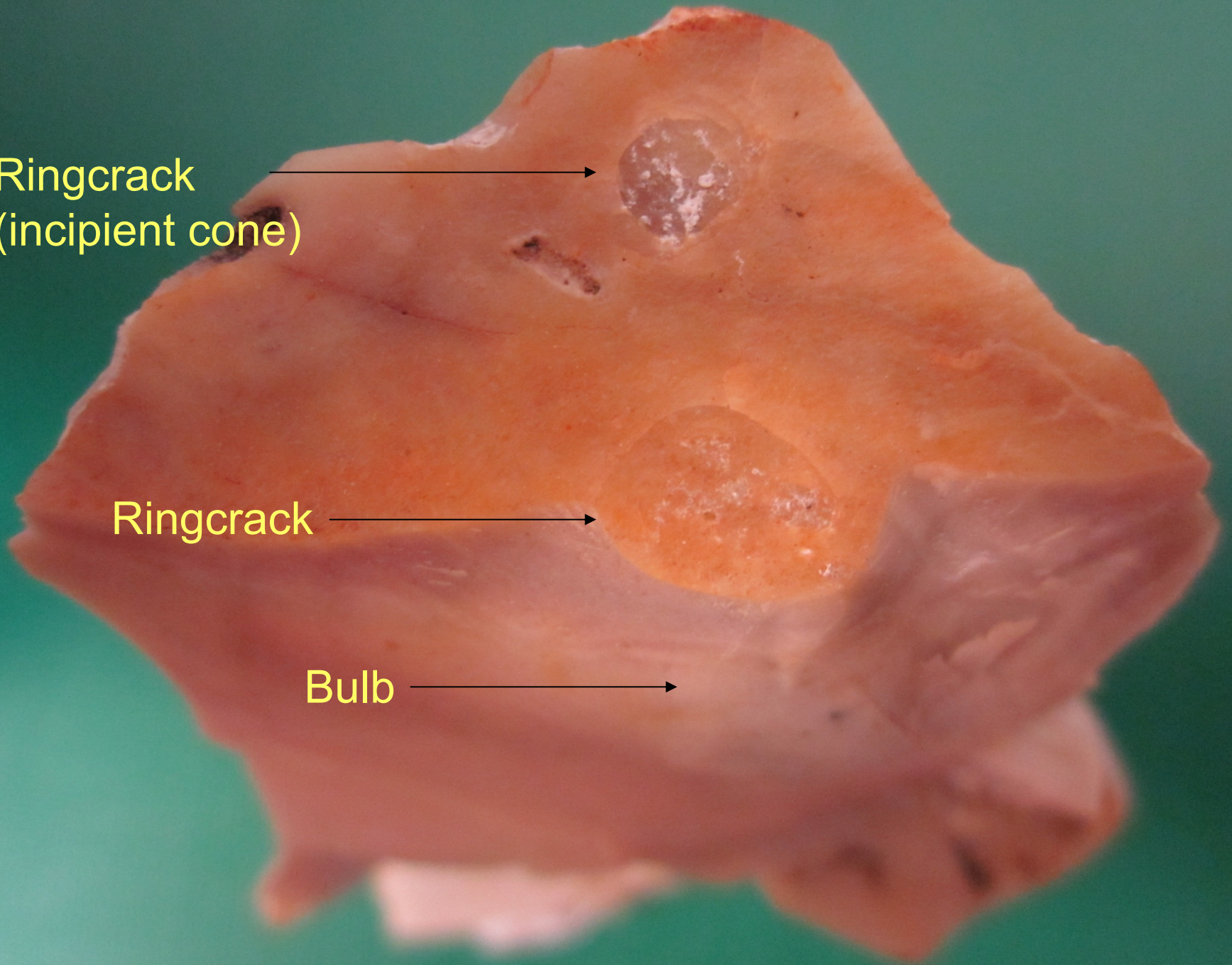
Cone

Bulb

Ringcrack
(incipient cone)

Ringcrack

Bulb



Bending initiations

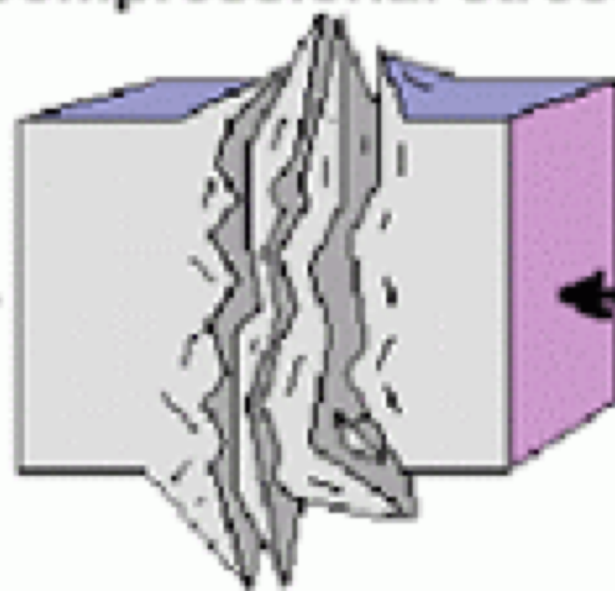
Instead of a fracture propagating from a Hertzian cone, it propagates from a pre-existing flaw at some distance away from the point of contact.

The force of the hammer creates a tensile stress across the platform: if there is a large enough flaw in the surface, this can concentrate the stress to a degree that a fracture begins to propagate.

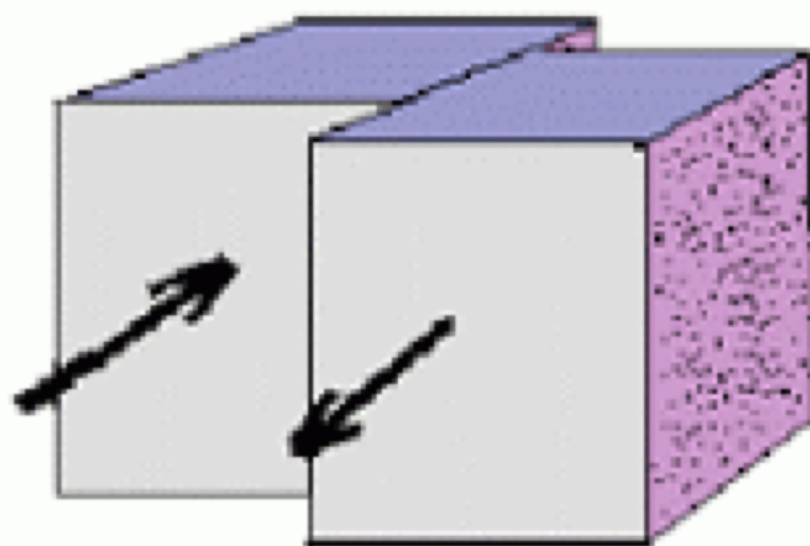
tensional stress

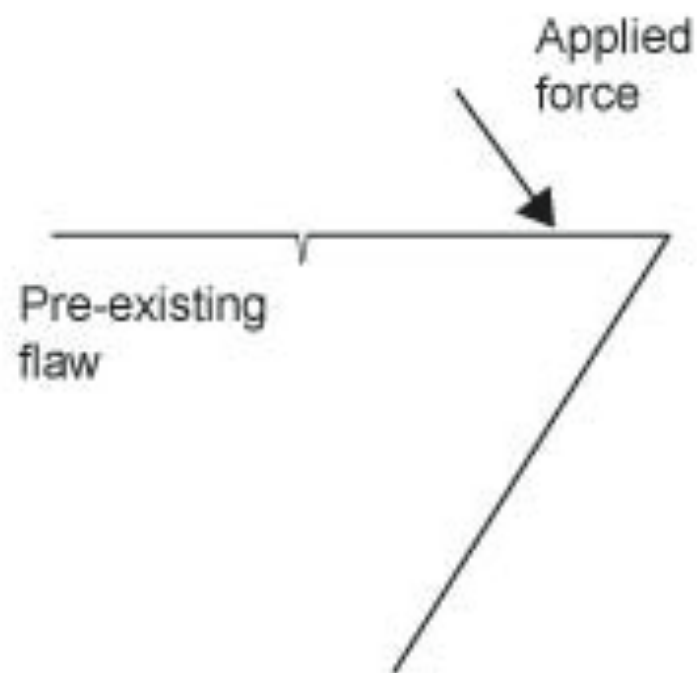
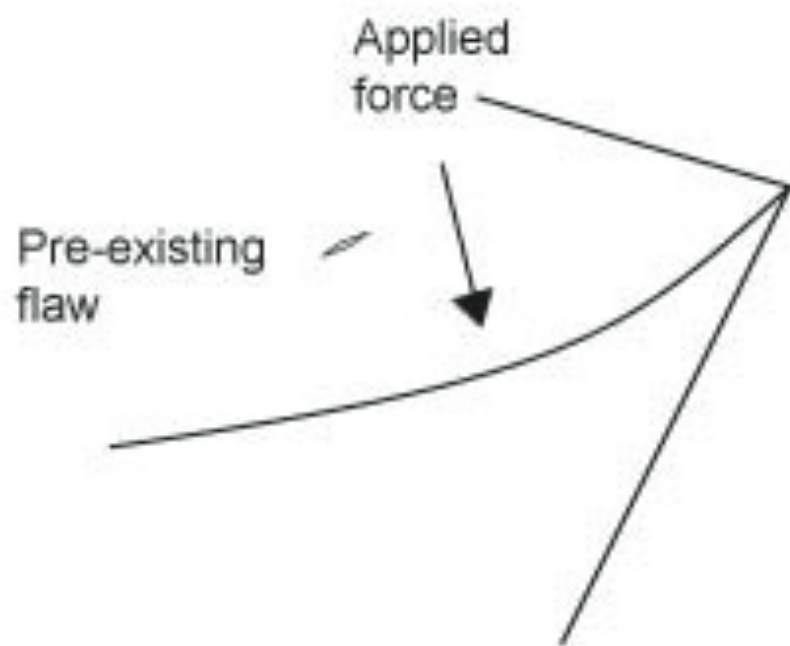


compressional stress



shear stress

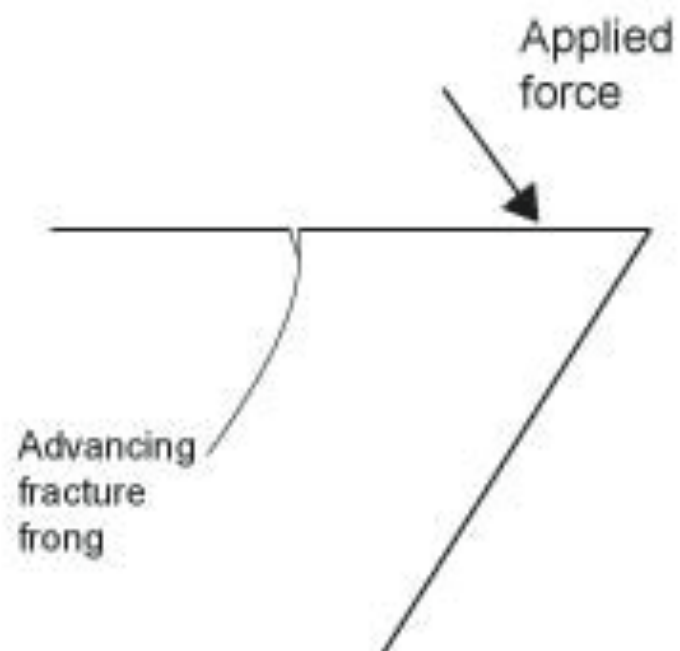
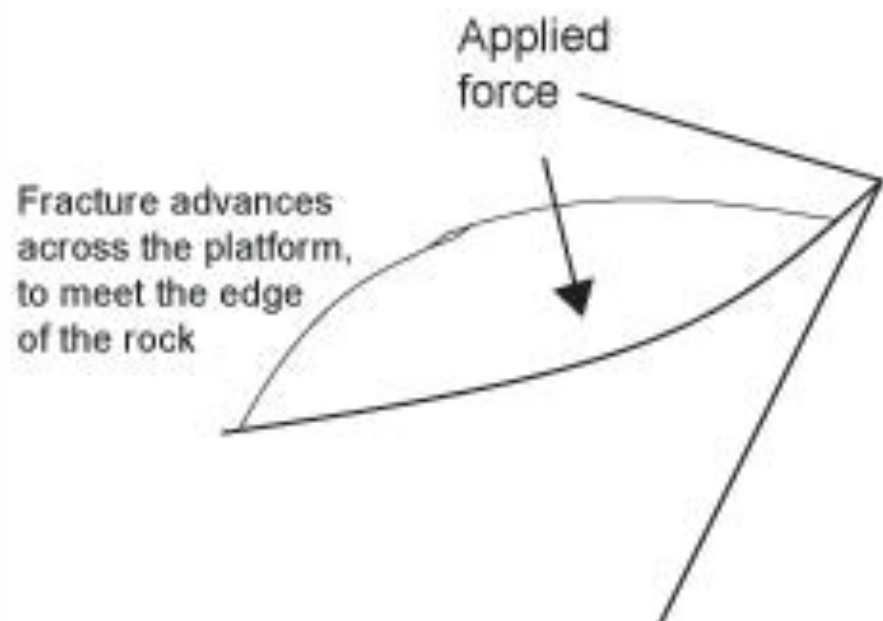


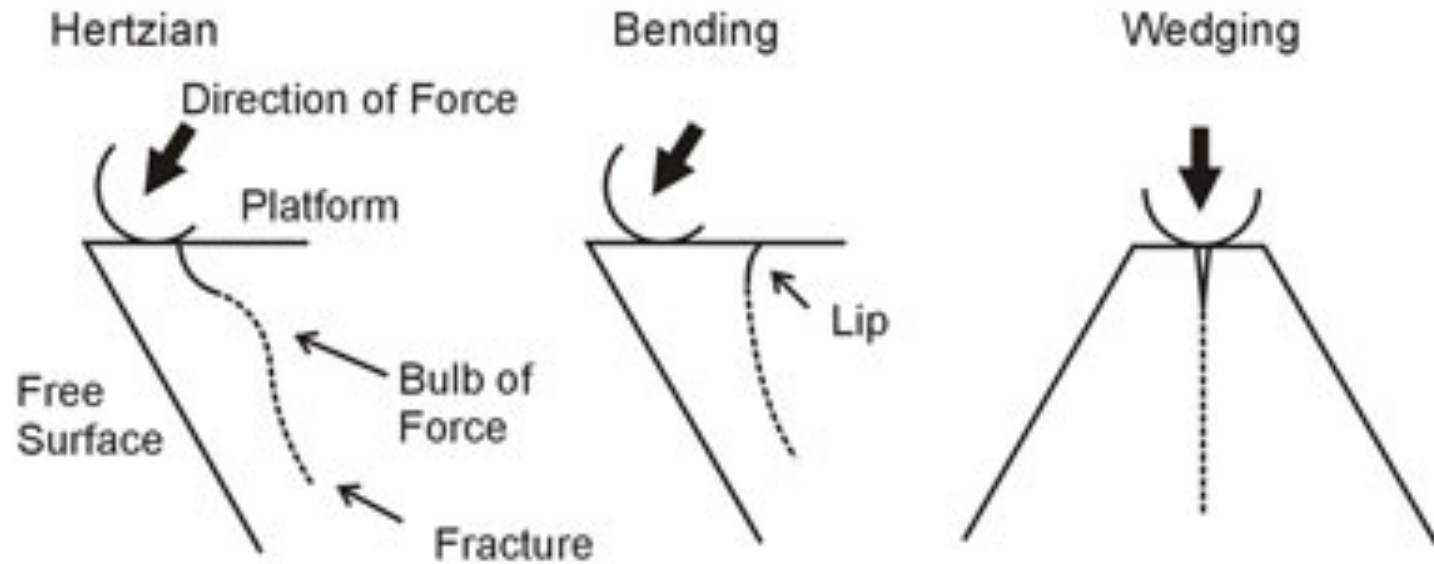


Bending initiated fractures usually start propagating at around 90 degrees to the platform surface.

Usually, the fracture will deviate inward, to follow the free surface of the core, leaving the fracture surface with a pronounced curve and 'lip' at its proximal end.

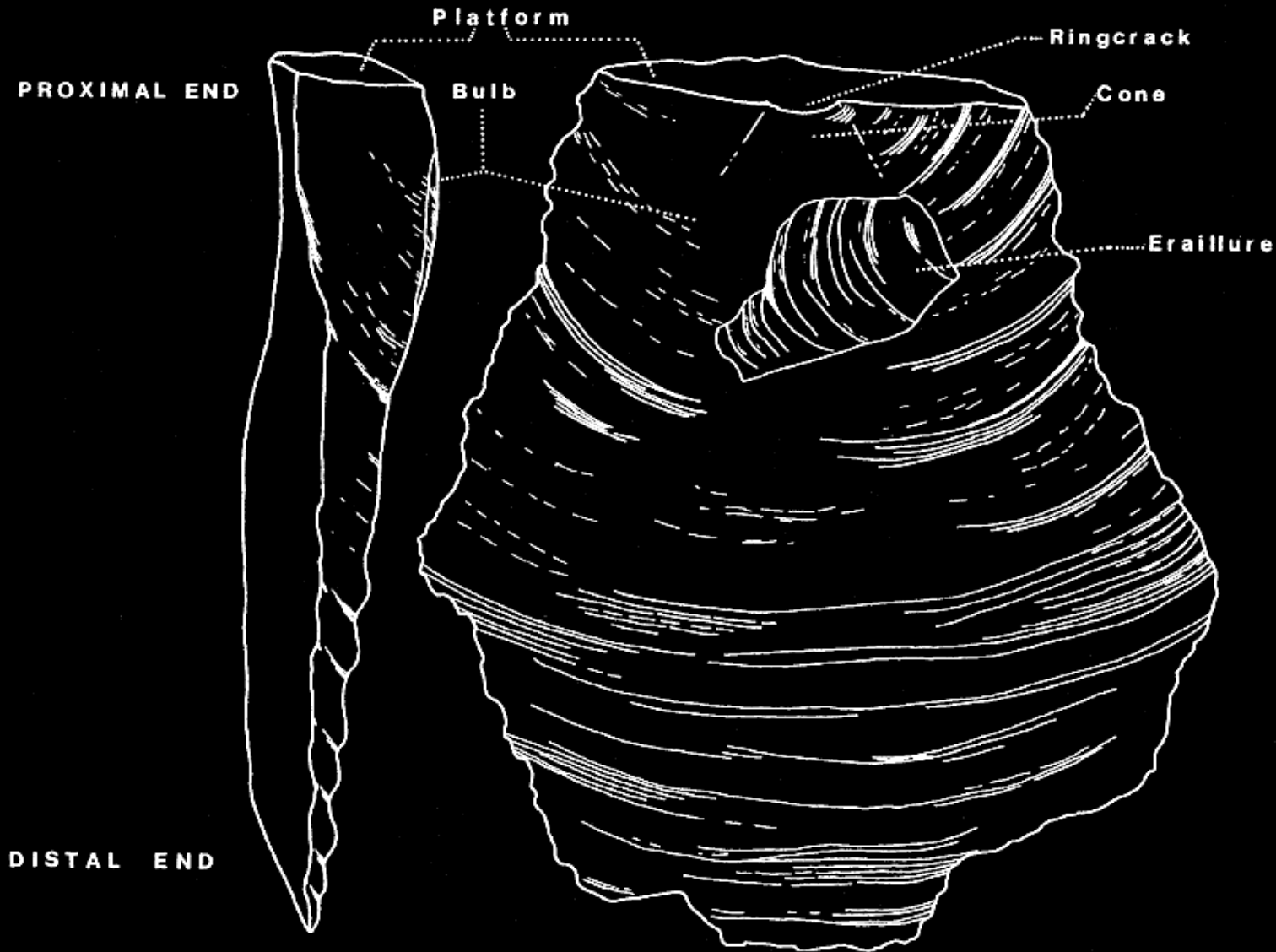
Bending fractures do not have a Hertzian cone, although the applied force can sometimes leave an incipient cone in the platform surface.



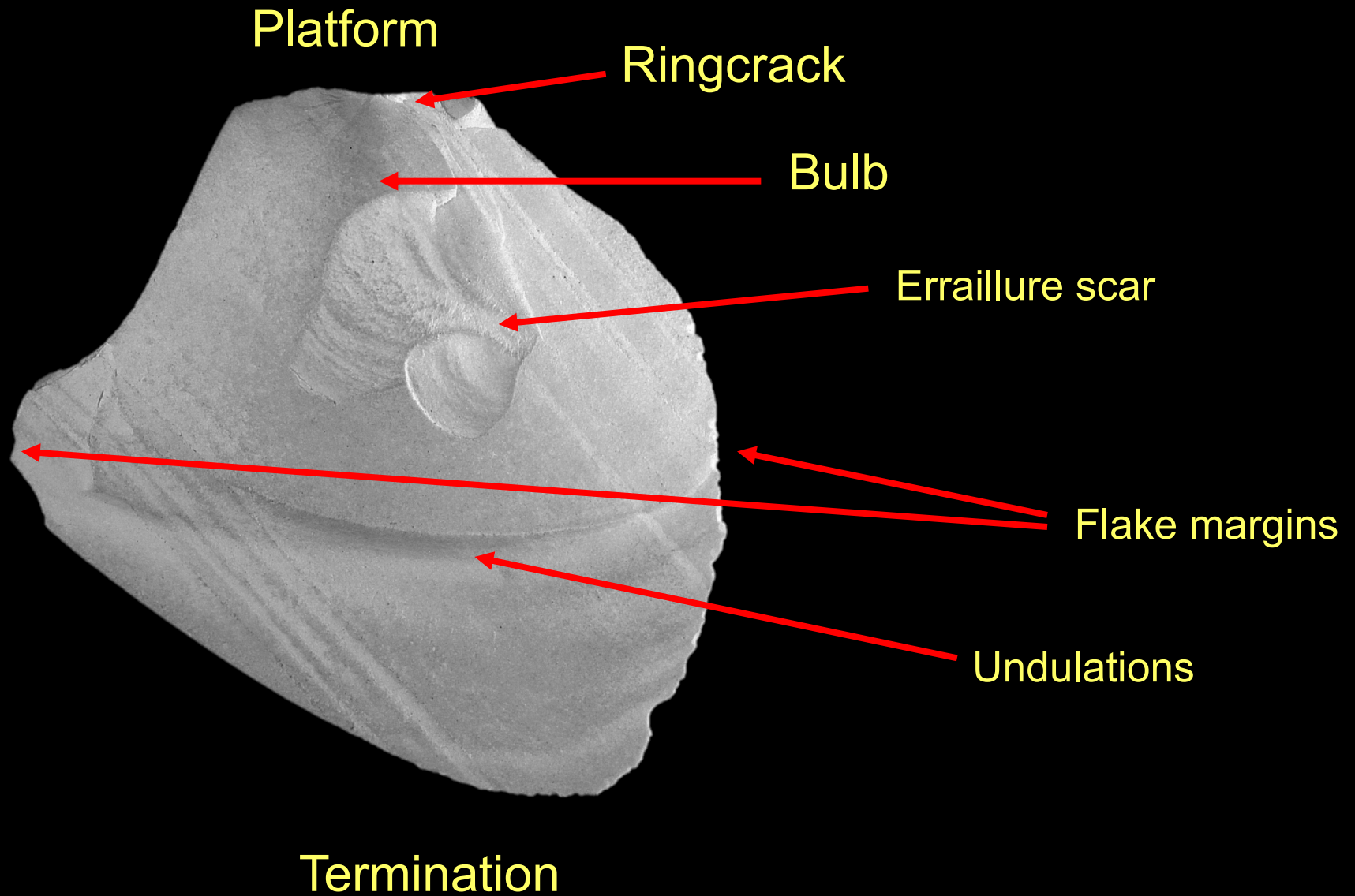


Wedging initiations: rare and difficult to identify, sometimes produced by bipolar flaking

Fracture surface features: Initiation and Propagation

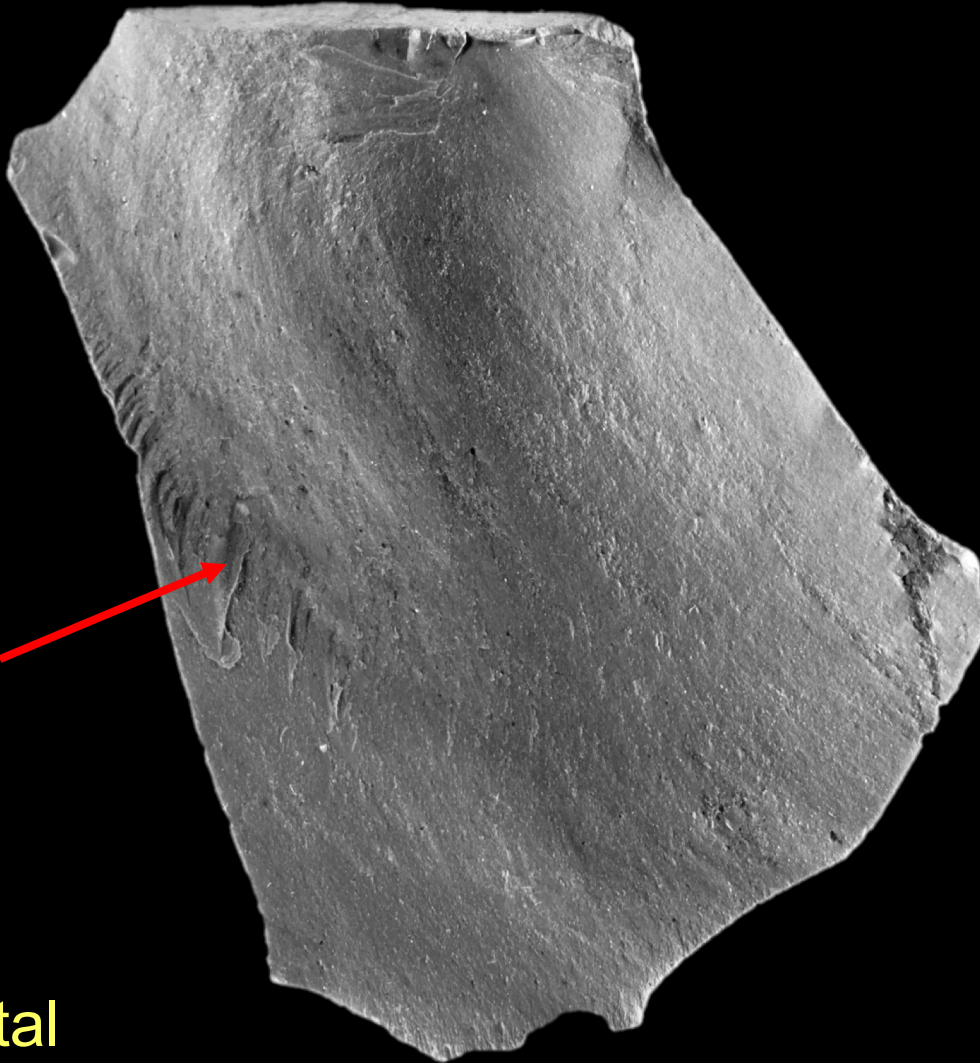


Flake features



Platform

Proximal



Striations

Distal

Striations are caused by the fracture changing direction, and splitting into several separate parallel fracture fronts.

Striations run in the direction of fracture propagation.



Undulations in the fracture surface.

Caused by the fracture changing direction as it propagates

The undulations appear as concentric ripples which emanate from the point of initiation

Ventral



Positive
fracture
surface

Dorsal



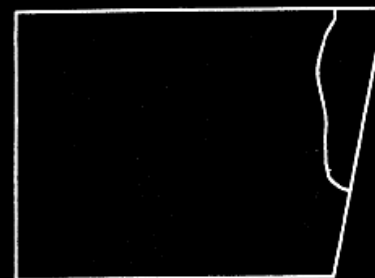
Negative
fracture
surfaces
(flake scars)



INITIATION



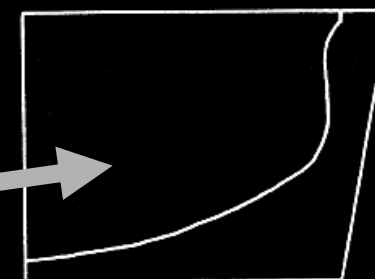
FEATHER



HINGE



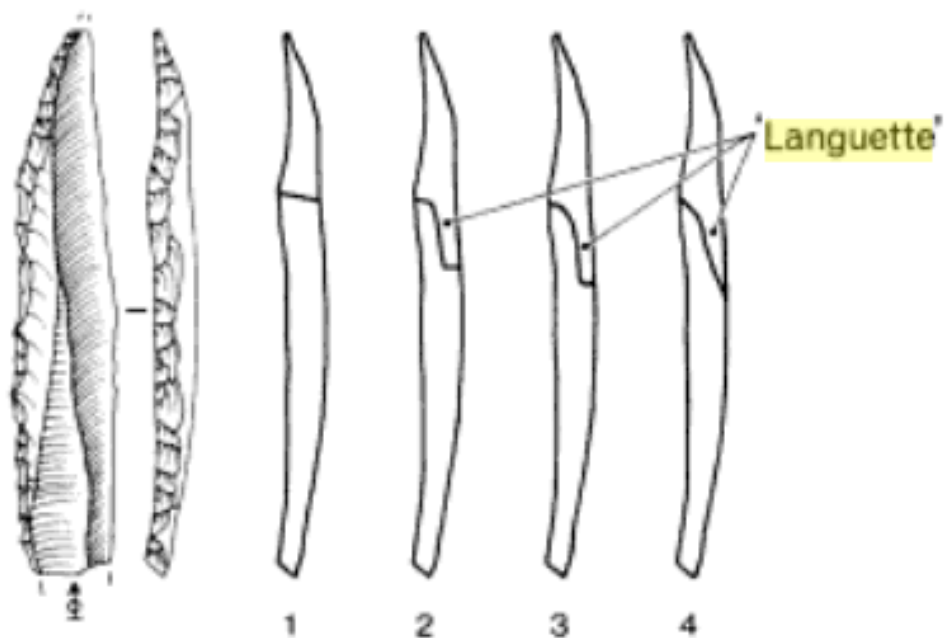
STEP



OUTREPASSE

PROPAGATION

TERMINATION



37 Various types of **termi-**
nation on bending fractures:

1. snap,
2. step,
3. hinge,
4. feather.

Inflexed



FINIAL

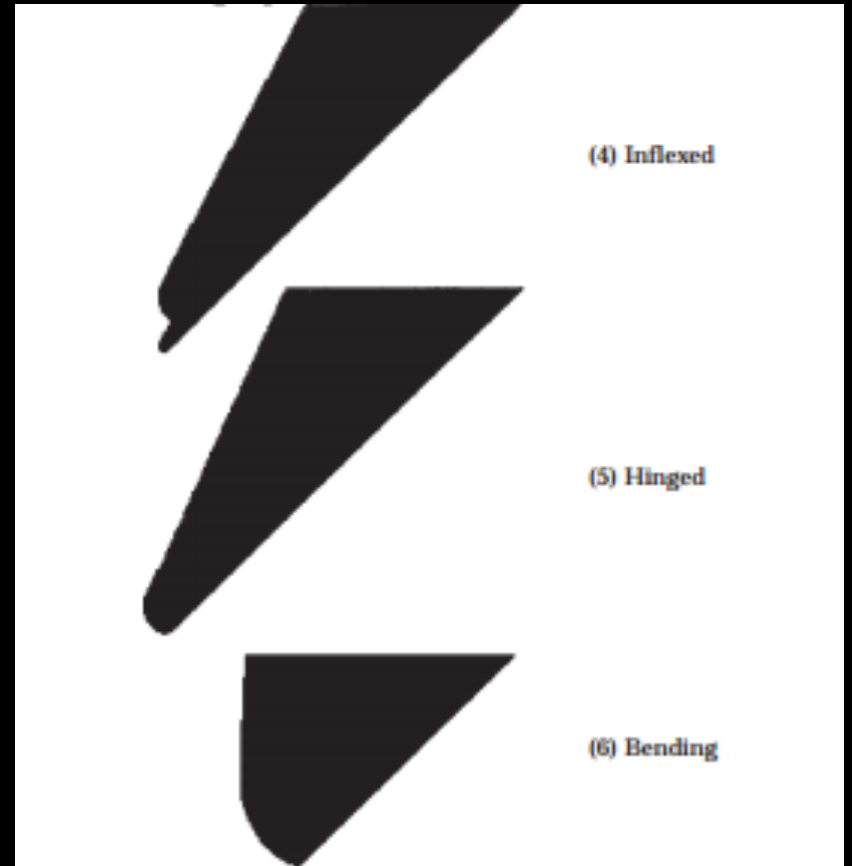
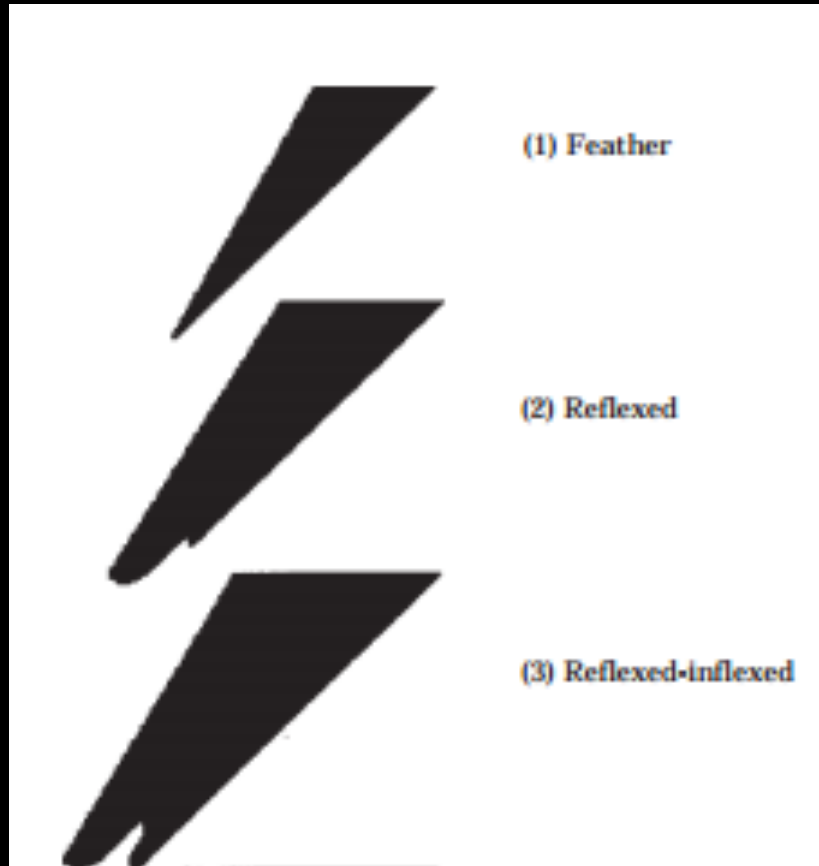
Reflexed



Pseudo bifurcation

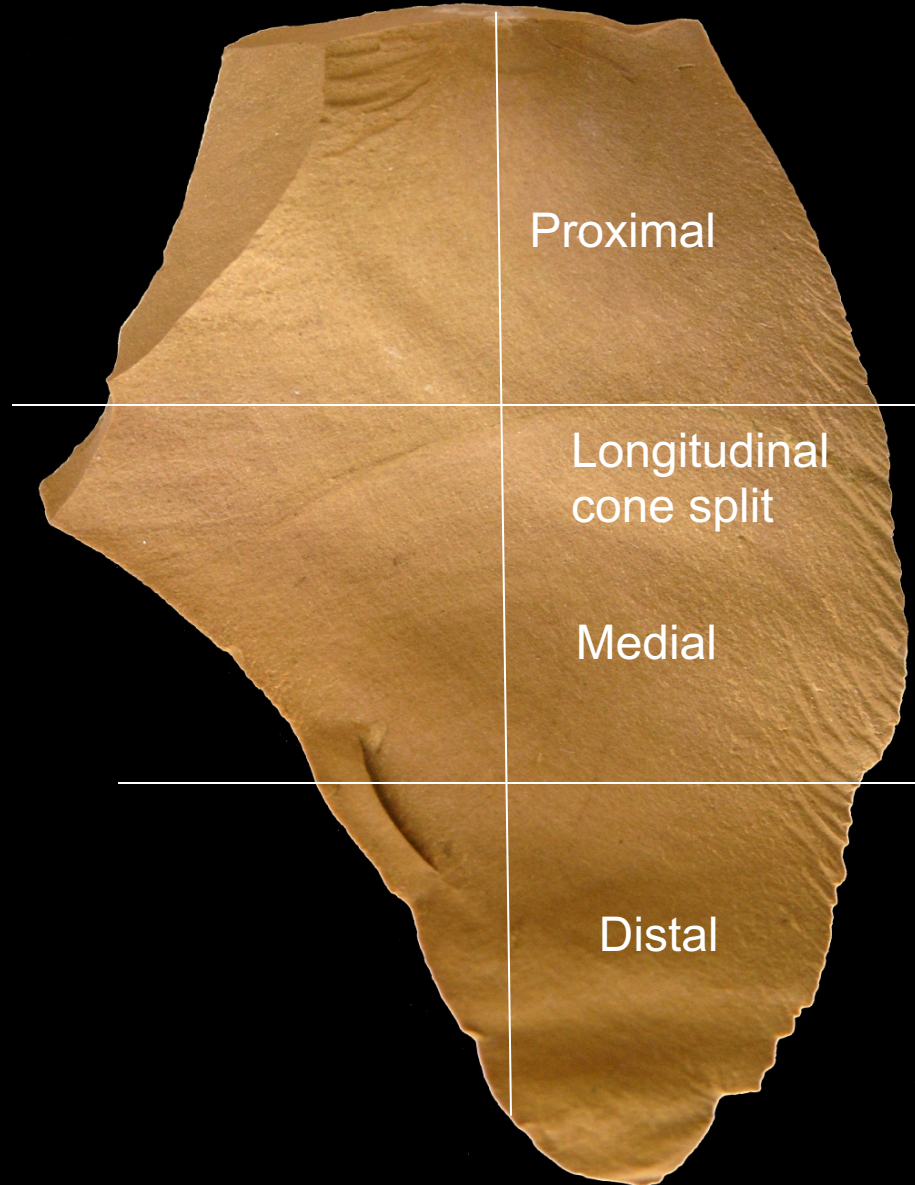


Determined by platform thickness and angle?



Flake fragments

- Proximal fragment - platform is present (or partially intact)
- Distal fragment – termination is present
- Medial fragment – neither the platform or the termination are present, but you're still confident it's a flake
- Longitudinal cone split – break has divided the flake longitudinally, and through the middle of the cone. Consequently, half of the cone and the bulb are present.



Flake fragments

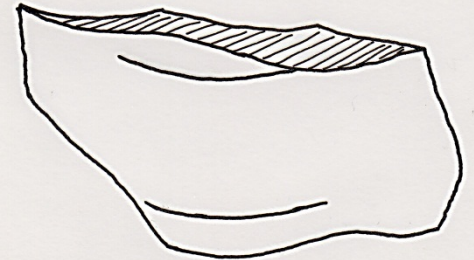


Complete

Proximal →



Medial →



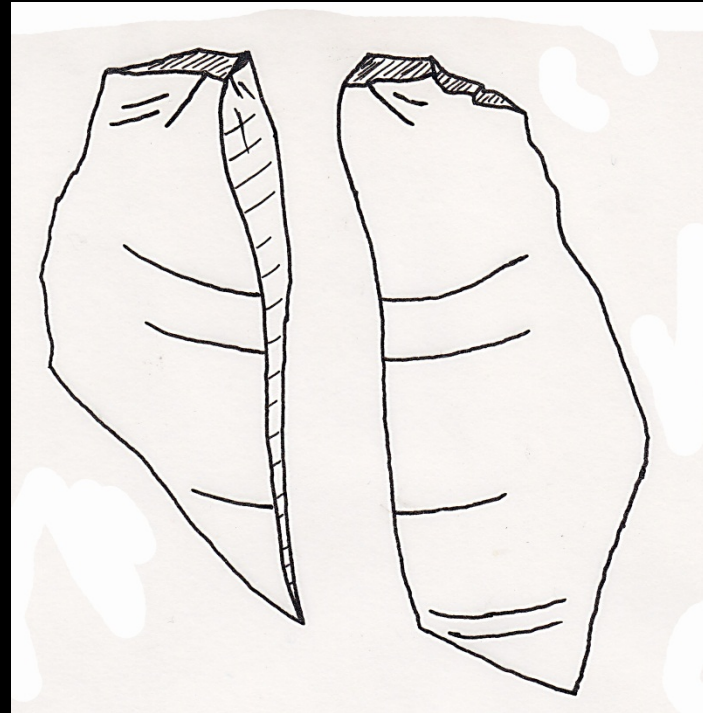
Distal →



Flake fragments



Complete



↑
LCS Right

↑
LCS Left

Summary

Why study stone artefacts?

What are stone artefacts?

What are the mechanics of stone artefact production?

How to talk about stone artefacts?