Hubble’s Classification of Galaxies
The Accumulation of Information

Hubble now set out to derive distances to as many of the nebulae (now called 'galaxies') as he could.

(He did this using Cepheids where possible, but also by other means.)

He noted that the nebulae do not all look the same. What sorts of galaxies exist? Can they be classified in some useful way? What can we learn from this?
Three Main Types of Galaxies

1. **SPIRAL**
   of two kinds
   ‘Regular’
   the spiral arms come out right from the centre
the spiral arms start at opposite ends of a central ‘bar’ feature
2. Elliptical

they can appear *perfectly round* or somewhat *elongated*, with very smooth brightness (no spiral arms or structure)
...and 3. Irregular
Question: What is a Galaxy’s True Shape?

Both of these (‘thick cigar’ or ‘fat pancake’) will look *round*, if seen pole-on! It’s hard to determine!
Remember!

In observing any given galaxy, we have only one point of view – we can’t ‘move around’ and look at it from a different perspective!

Nor can we look for long-term changes (except in very limited ways, like noting the explosion of a single star as a supernova, or the periodic variability of Cepheids within a galaxy).
Hubble’s ‘Tuning Fork’ Diagram
In Cartoon Form (easier to read):
...and with Some Numbers

Ellipticals range from E0 (round) to E7 (elongated)
There are Important Differences!

*Elliptical galaxies* contain no obvious gas or young stars, and are at most moderately flattened.

*Spiral galaxies* contain a moderate amount of gas and young stars, and are *very flat*, presumably because of rotation (like our own Milky Way).

*Irregular galaxies* contain a lot of gas and young stars (an excellent example: the Large Magellanic Cloud) but have no obvious structure or symmetry.
This Prompts Obvious Questions

Is the ‘tuning fork’ indicative of an evolution of galaxies from one form to another? For instance:

- do galaxies *flatten out* as they evolve, so that ellipticals turn into spirals?
- or do galaxies *use up their gas* as they age, so that spirals turn into ellipticals?

To answer this, we need to know much more about the *physics* of galaxies (masses, in particular) – not just their appearance.