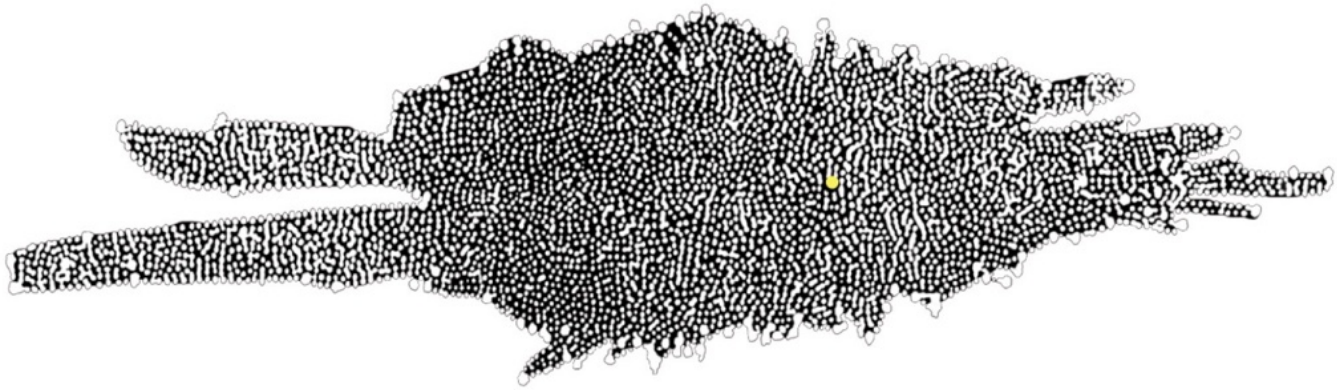
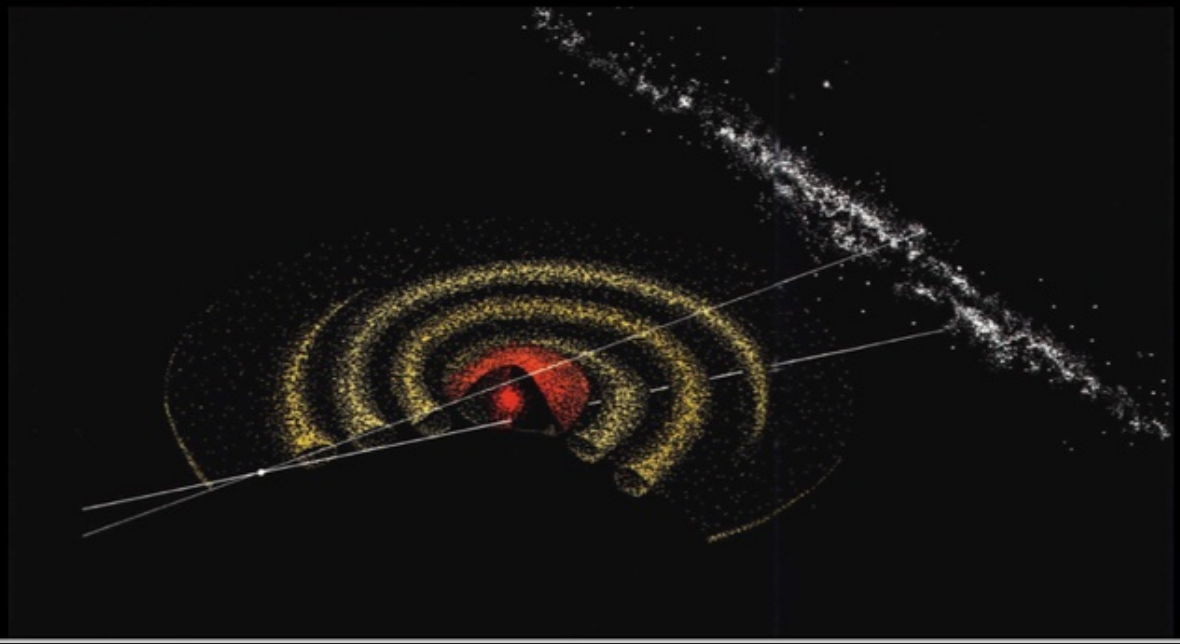

L'eredita' di Albert Einstein
vista da un astronomo
G. Gavazzi - MIB

contesto storico

- per tutto l‘800 l'astronomia e' concentrata sul sistema planetario (Sole, Pianeti, Luna, meteoriti, Comete), con le stelle fisse a rappresentare un mero sfondo.
- Eccezioni:
- ‘700
- 1755: Immanuel Kant (1724-1804) publica *Allgemeine Naturgeschichte und Theorie des Himmels*.
- 1771: Charles Messier (1730-1817) pubblica il *Catalogue des Nébuleuses et des Amas d'Étoiles*.
- William Herschel (1738-1822) e suo figlio John (1792-1871) determinano la struttura 3-D della Milky Way (1784).




milky way

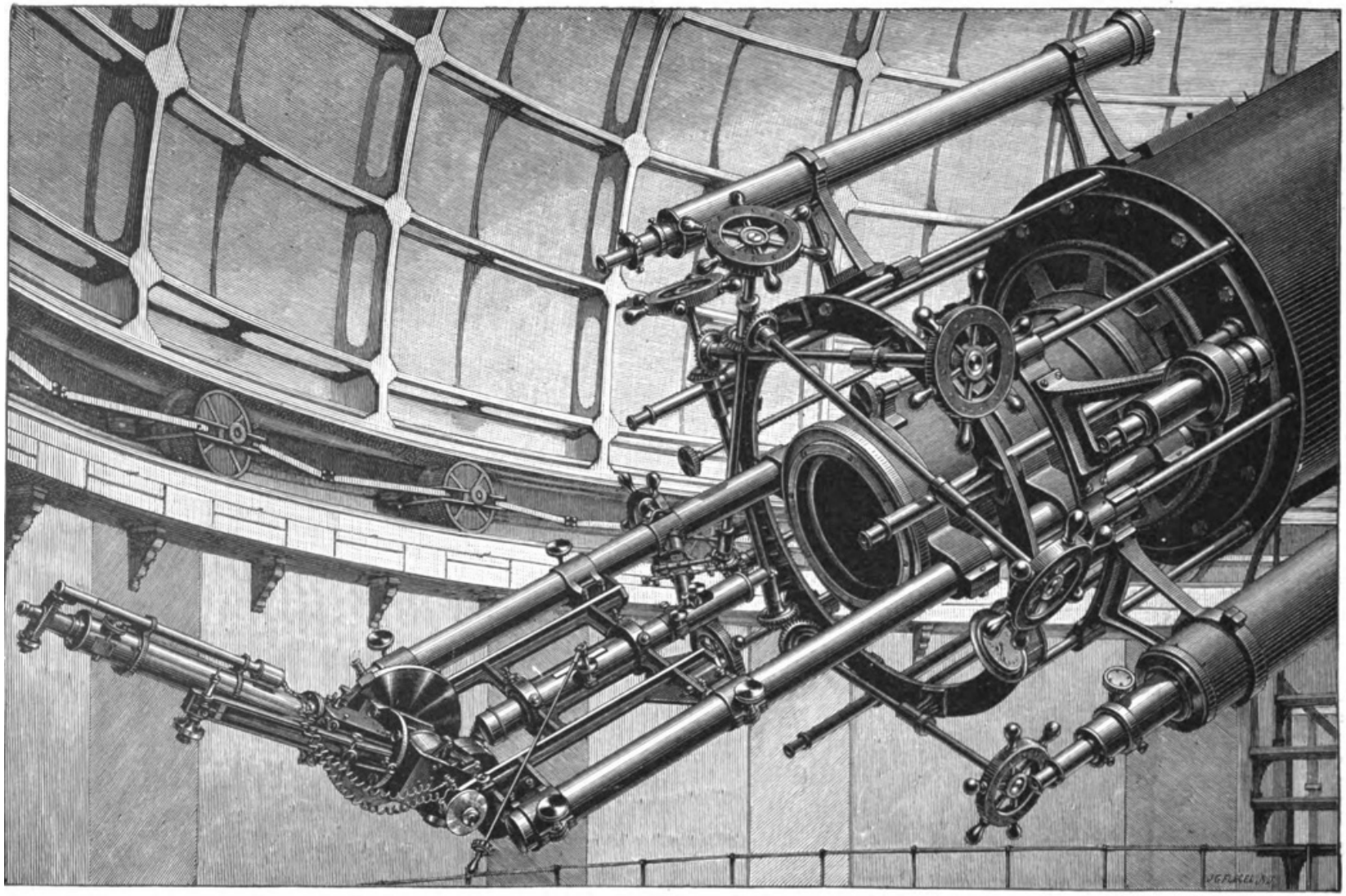


Nebulae

M101

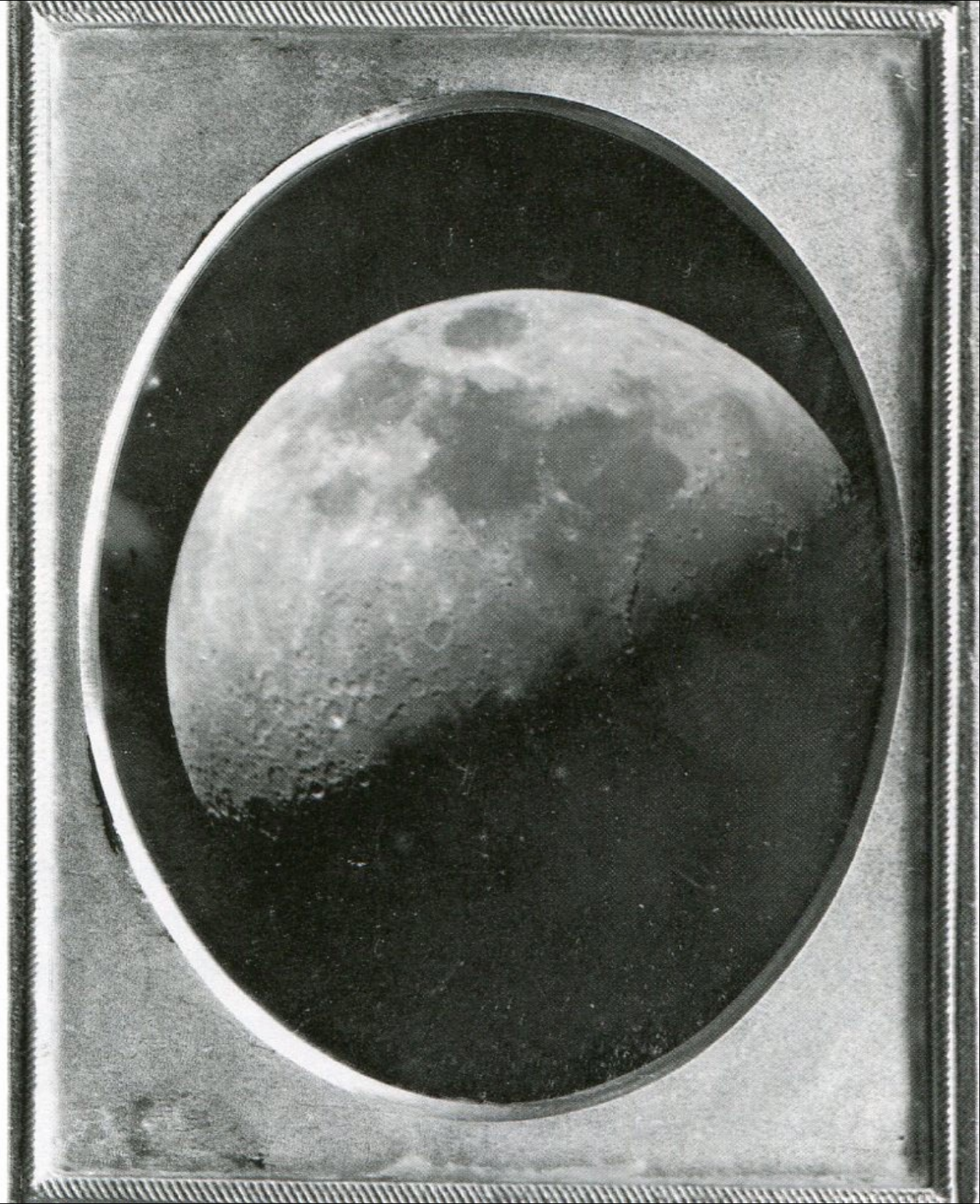
M42

‘800
inizio del 1800: spectroscopia solare da Joseph von Fraunhofer.



Lo Spettroscopio stellare del Lick Observatory nel 1898

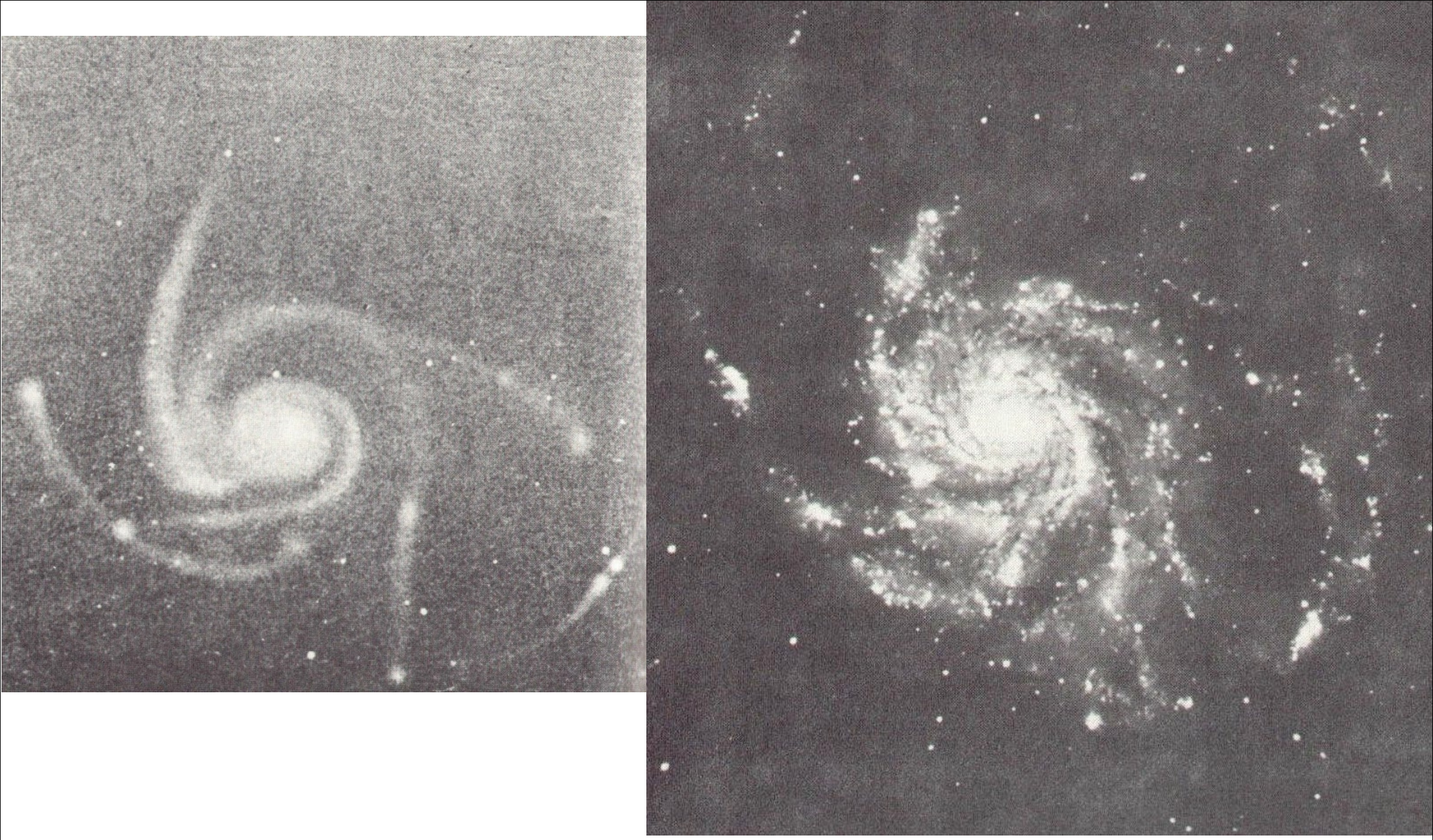
1839: Louis Daguerre cerca di footografare la Luna.



John Adams Whipple, Luna, 1851, Daguerreotype

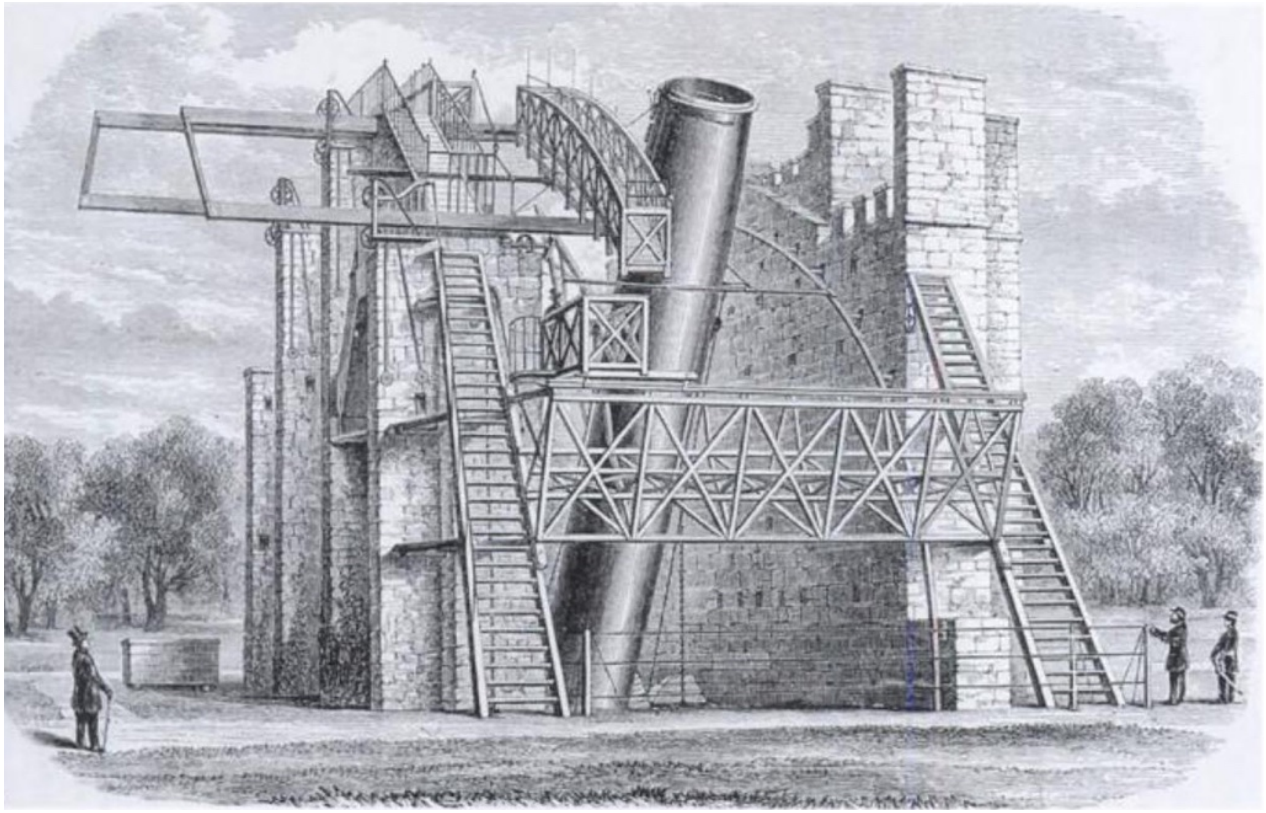
Fig. 51. — La nébuleuse d'Andromède, vue dans un grand télescope.

M31 in un disegno preso verso la fine del '800 (Flammarion, 1882) e in una foto moderna.



(sinistra) M101 in un disegno del 1851 di S.Hunter preso al telescopio di Lord Rosse da 72" (destra) in una fotografia presa da Ritchey nel 1910.

1845: Earl of Rosse (1800-1867) costruisce il 72” (1.8m) reflector



1888: John Dreyer pubblica il New General Catalogue of Nebulae and Clusters of Stars (NGC).
Jacpbus Kapteyn (1851-1922), Henry Russell (1877-1957) sono gli astronomi di riferimento verso la fine del secolo.

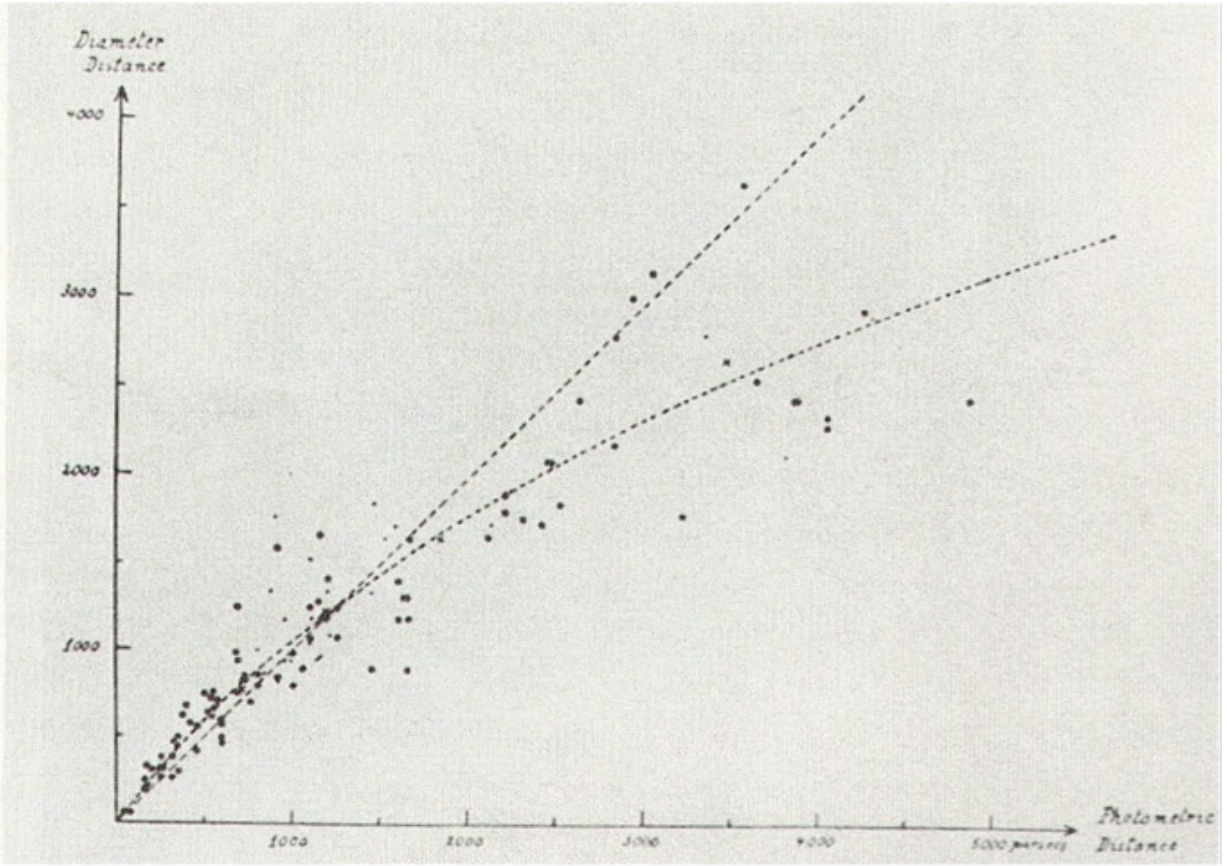
Carte du ciel (1887-1940)

- survey astrografica mai completata, ha interessato 20 osservatori.
- progettata per coprire tutto il cielo con 22000 lastre da 2.1°×2.1° (13 cm×13 cm)
- esposizioni da 6 min (11 mag)
- Alcuni *credono che questa sia la storia di come i migliori osservatori Europei del 19o secolo hanno perso la leadership nella ricerca astronomica*
- Cf: Palomar sky survey (1949-1958)

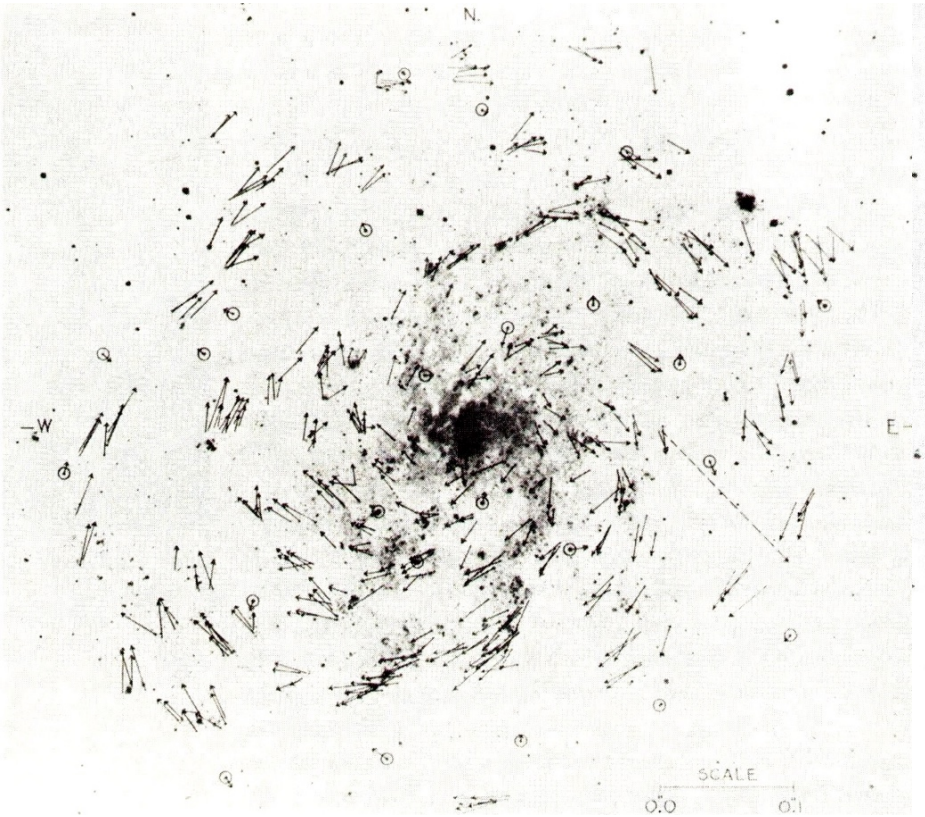
‘900
1912: Vesto Slipher (1875-1969) ottiene il primo spettro di M31 e nel ’14 ha spettri di 14 nebulose a spirale.

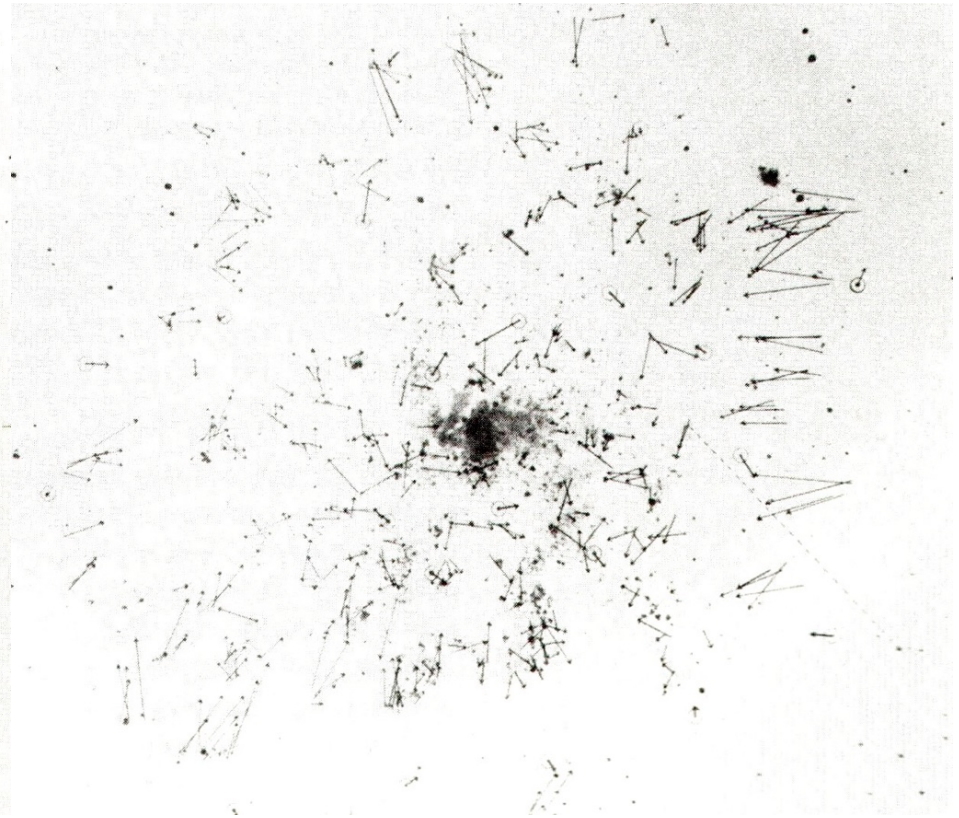
1920, Washington DC: Ha corso Grande Dibattito sulle dimensioni della MW tra Harold Shapley (1885-1972) e Herber Curtis (1872-1942).

A comparison of the distances of open clusters determined from apparent magnitudes and spectral type (abscissa) with those determined from angular diameters (ordinate). The dotted straight line indicates the expected relation if no absorption is present. The dotted curve gives the relation for a general absorption of $0^{m}.7$/kpc. (Courtesy of the *Publications* of the Astronomical Society of the Pacific, *42*, 214, 1930)

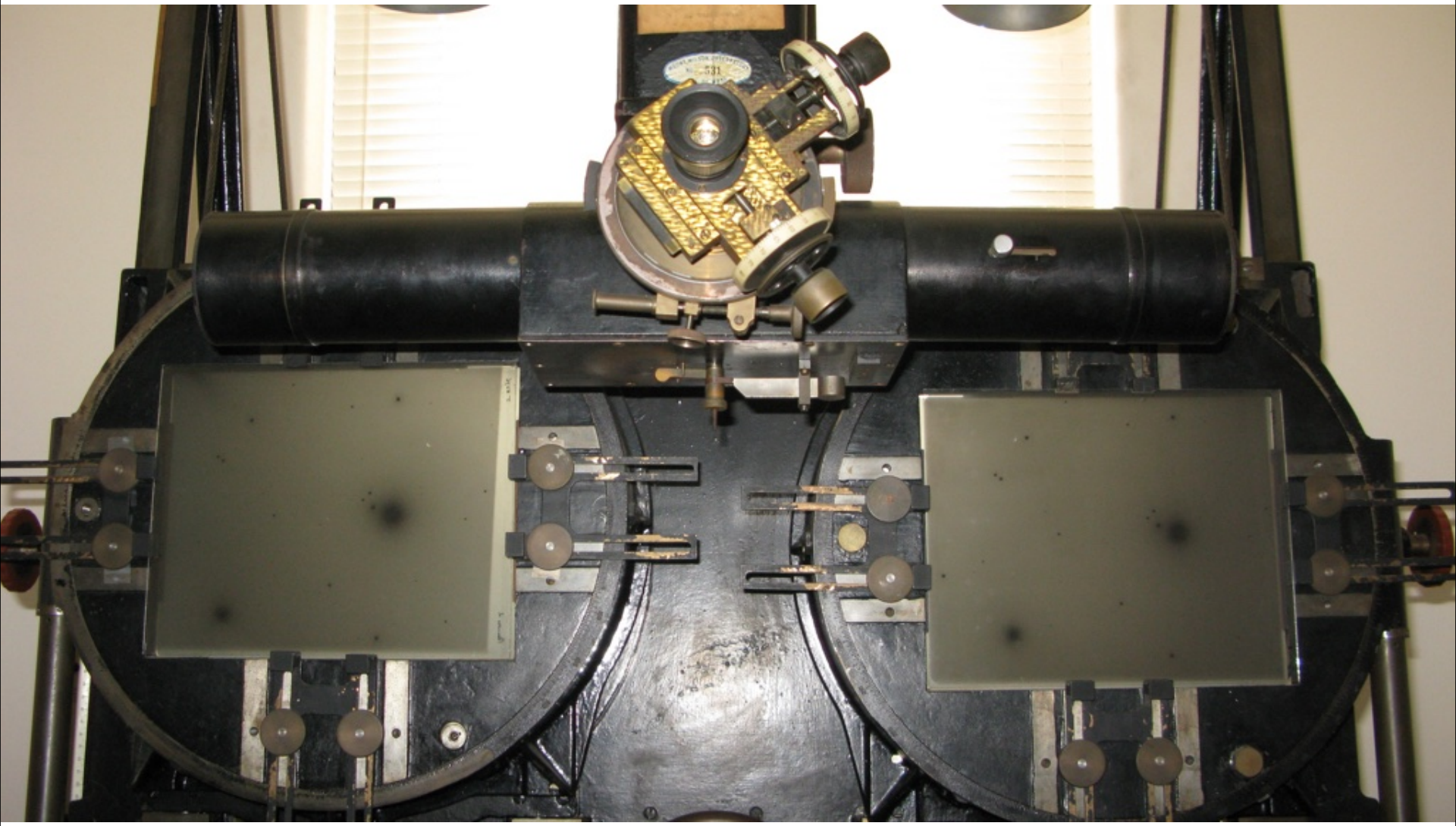


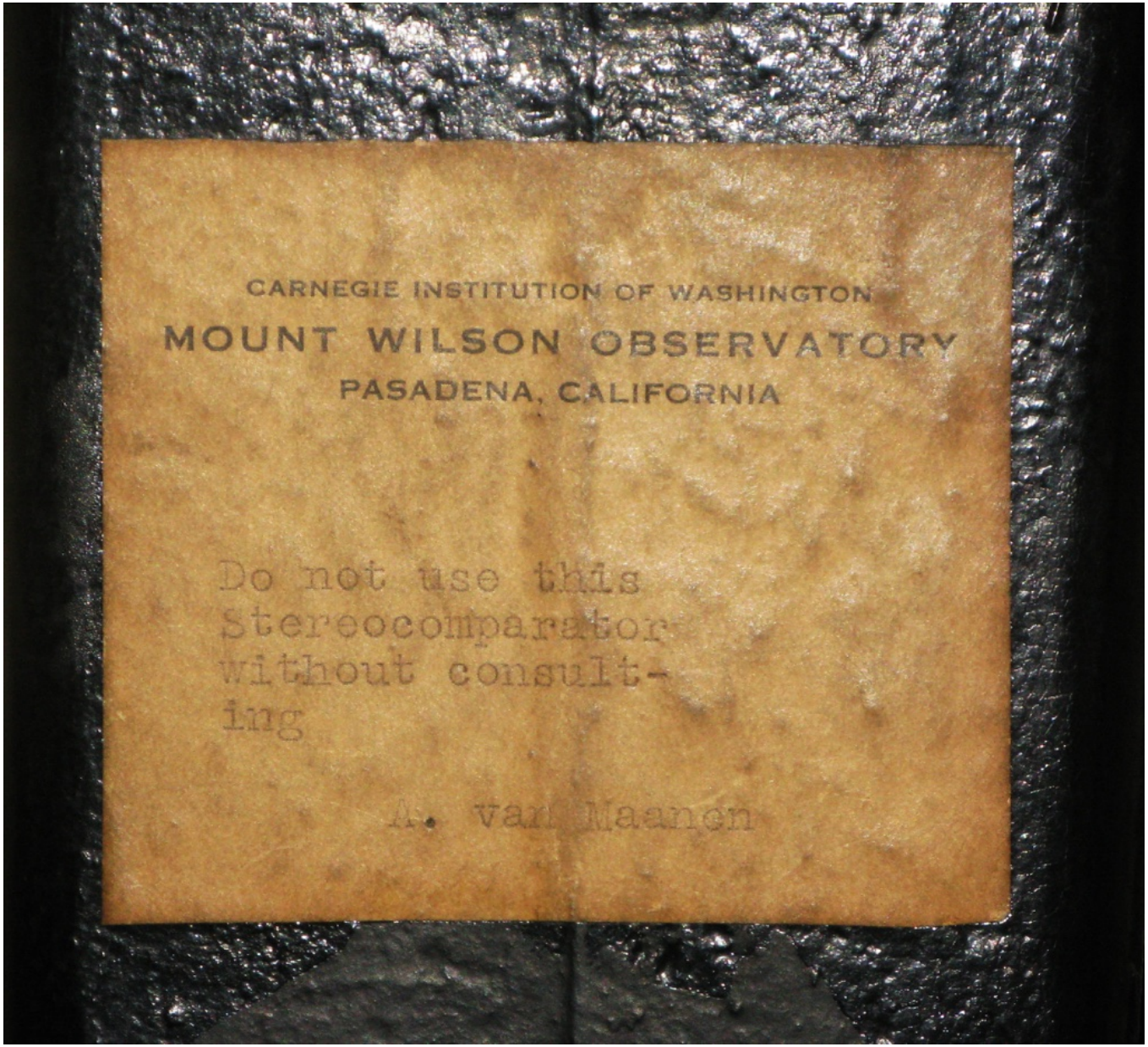
1915-23: Adriaan van Maanen (1884-1946) trova rotazione in 12 nebulose a spirale confermando la tesi di Shapley che appartengano alla MW.





Il moto proprio delle stelle di M33 secondo Van Maanen (1923, sinistra) e Lundmark (1926, destra). Le frecce indicano la direzione e l'intensita' del moto



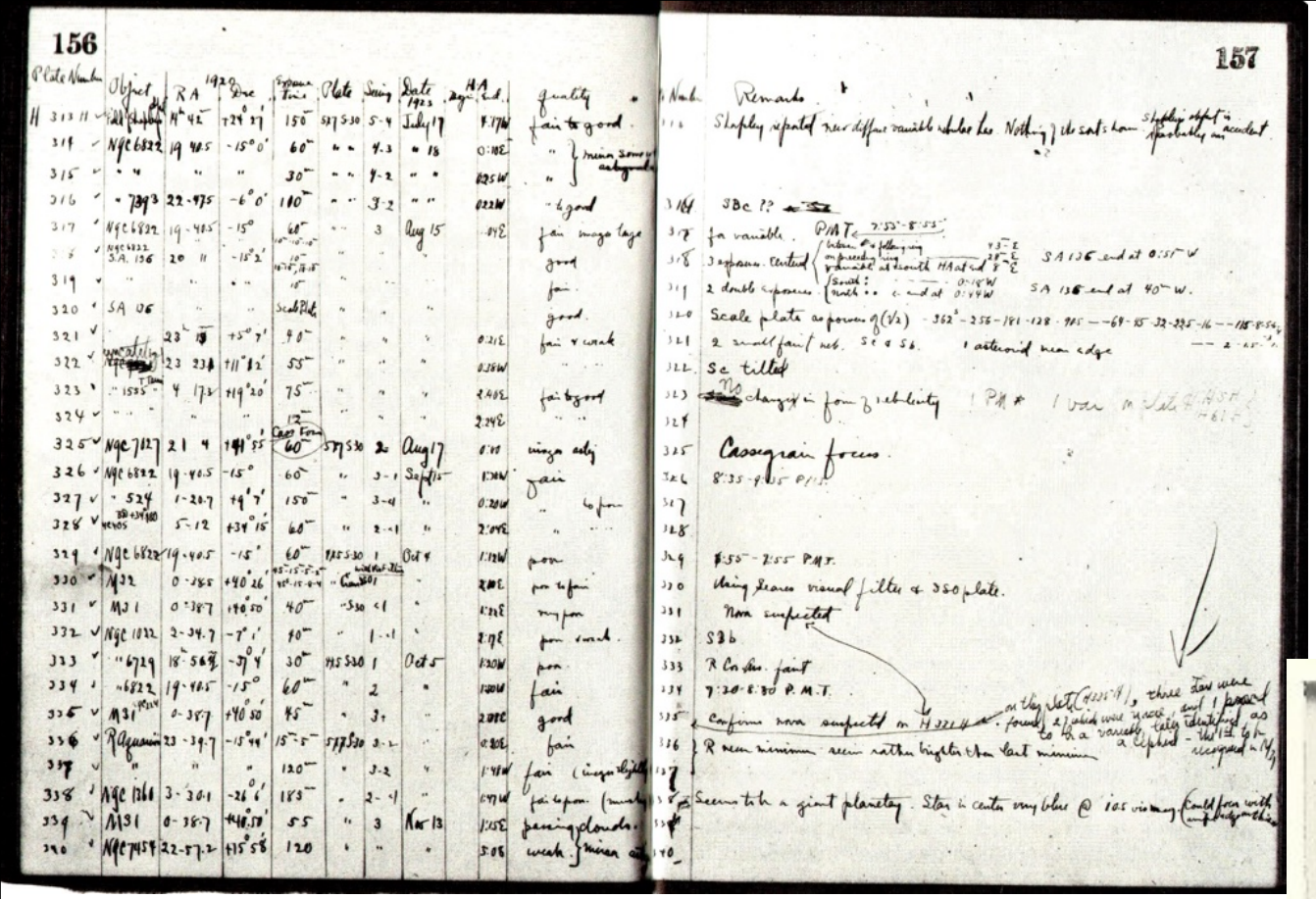

CARNEGIE INSTITUTION OF WASHINGTON
MOUNT WILSON OBSERVATORY
PASADENA, CALIFORNIA
Do not use this
Stereocomparator
without consult-
ing
A. van Maanen

Nota Biografica

- **Einstein Albert** (1879-1955)
- 1900 laureato @ Zürich Polytechnic
- 1905: PhD "A New Determination of Molecular Dimensions."
- 1905: effetto Fotoelettrico
- ” moto Browniano
- “ relativita' speciale
- “ $E=mc^2$
- 1917 : relativita' generale
- 1921: Premio Nobel

- **Hubble Edwin**(1889-1953)
- 1910: Master in giurisprudenza
- 1917: PhD: “Photographic Investigations of Faint Nebulae”
- 1919-1953 @ Mt. Wilson Observatory (George Ellery Hale)
- 1923: Cefeide in M31
- 1929: 46 redshift
- 1936: “the realm of nebulae”

1931 incontro all'oculare del 100”@ Mt. Wilson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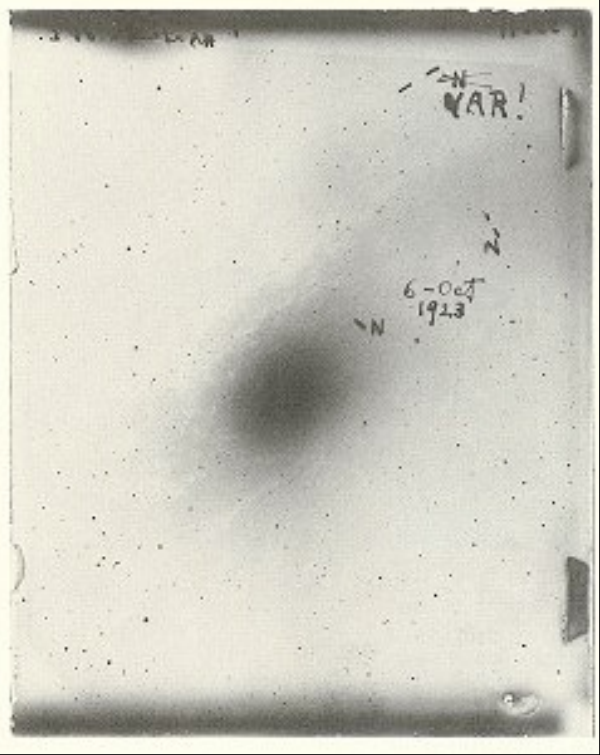
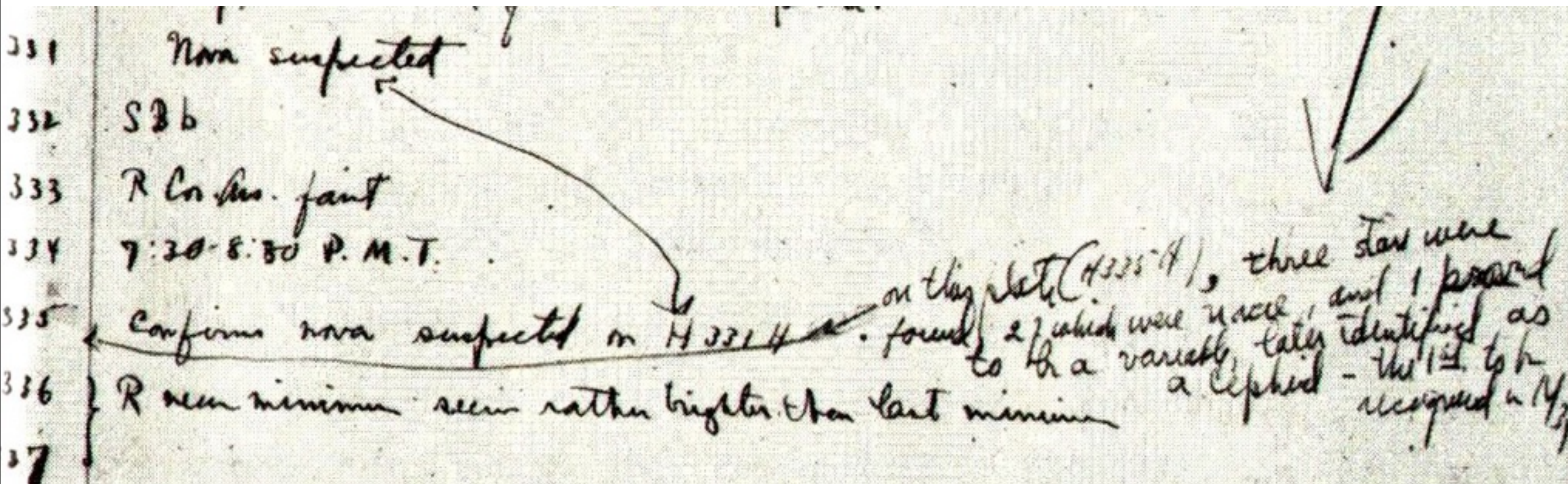
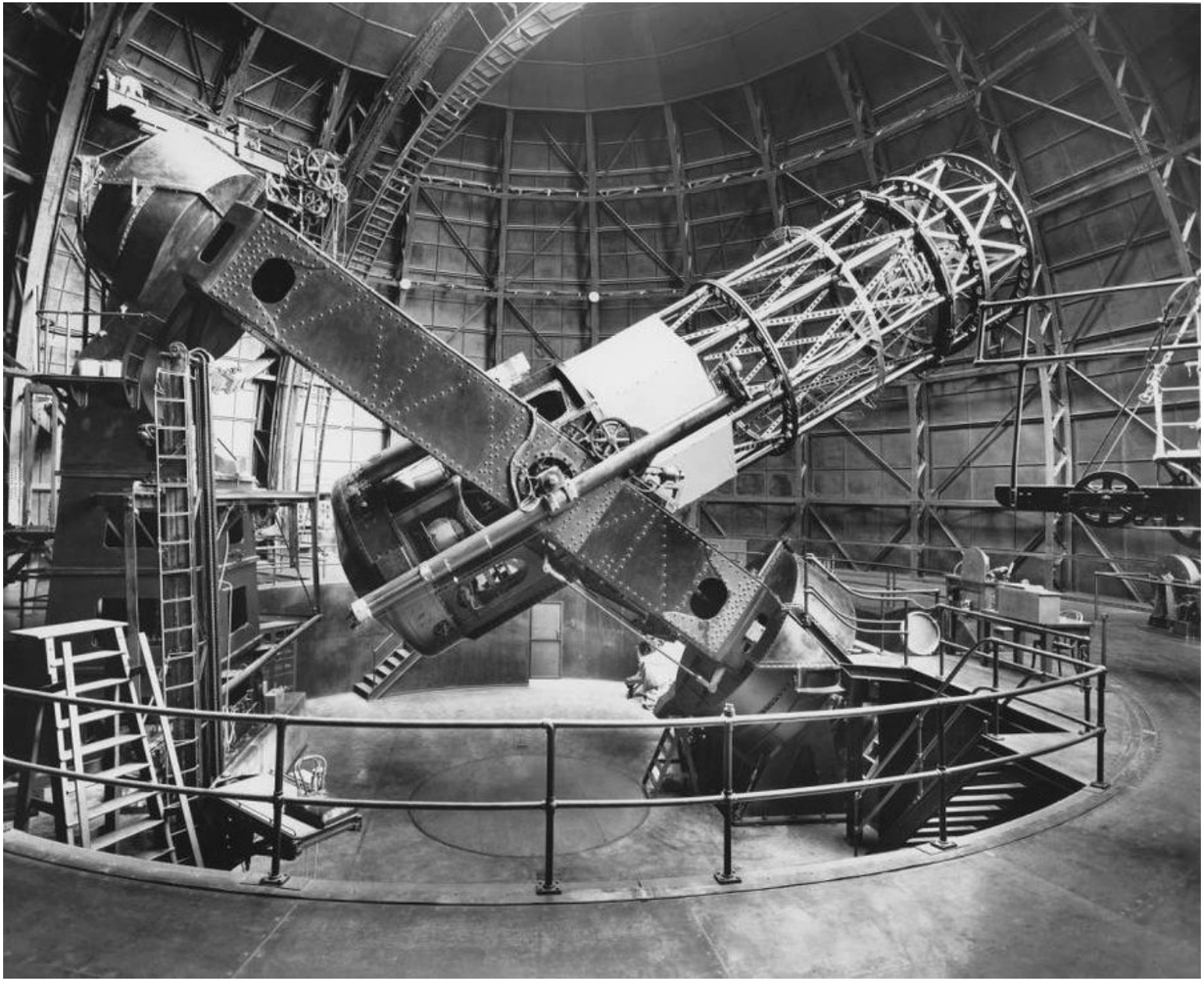
Log book del 5-6 ottobre 1923 quando Hubble scopre una cefeide in M31. (destra) la lastra della scoperta




331 Nova suspected
332 SBb
333 R Cor. Aus. faint
334 7:30-8:30 P.M.T.
335 Confirms nova suspected on H331H.
336 R near minimum seems rather brighter than last minimum

On this plate (H335H), three stars were found, 2 of which were novae, and 1 proved to be a variable, later identified as a Cepheid - the 1st to be recognized in M31

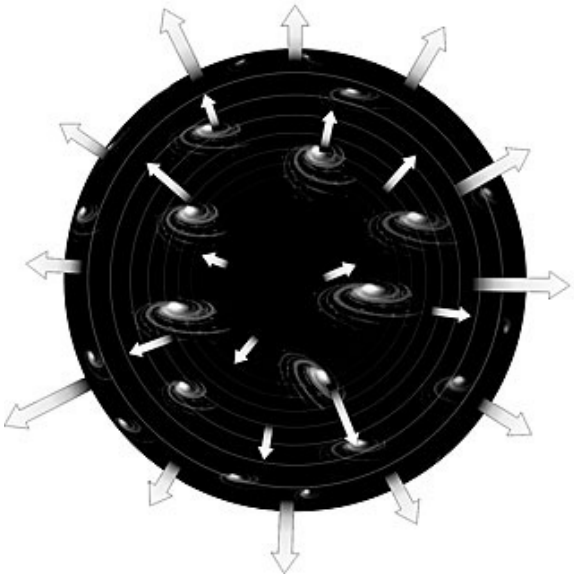


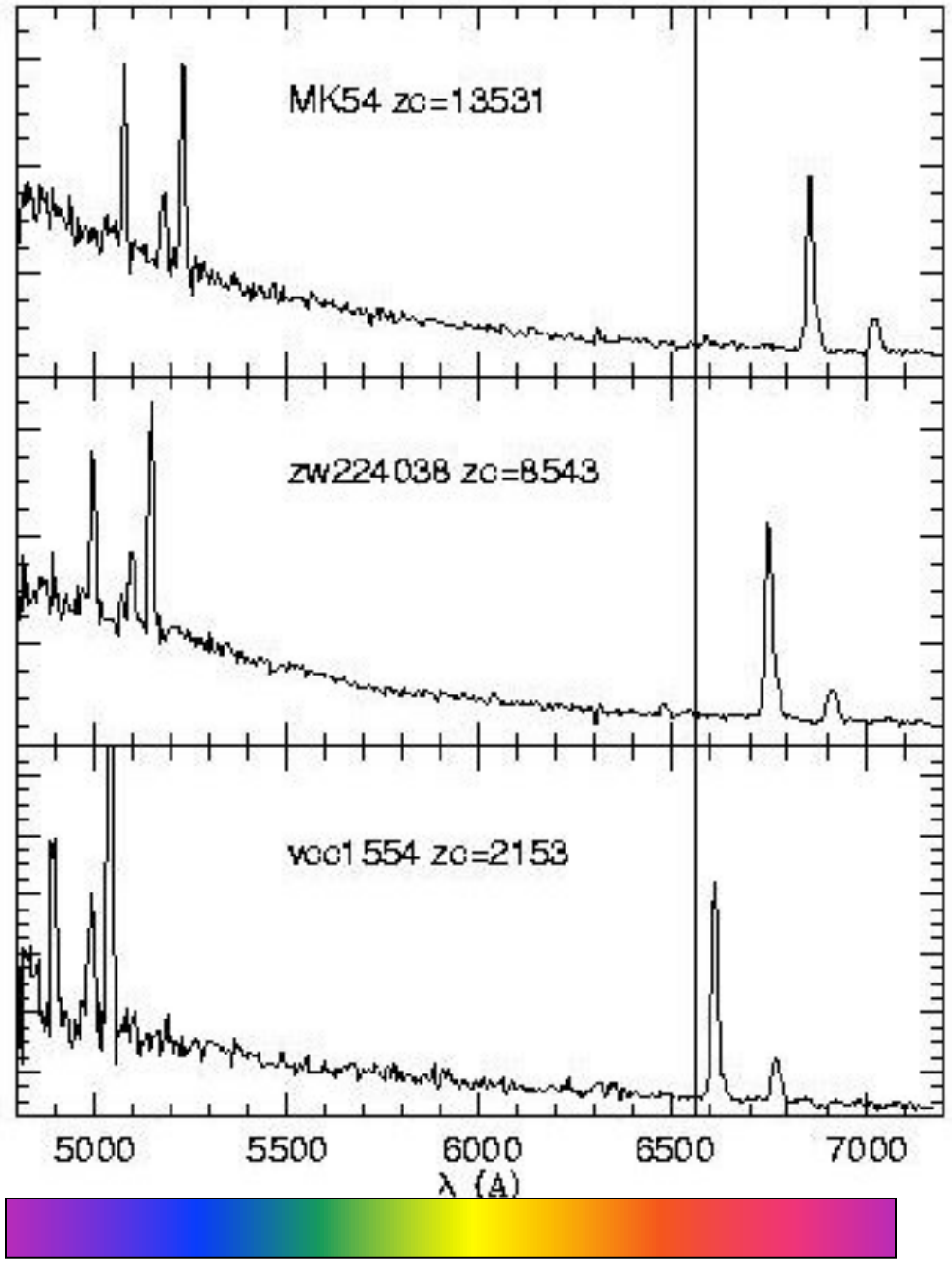
Il telescopio Hooker da 100” @ Mt Wilson divento' operativo nel 1917

Albert Einstein (sinistra), Edwin Hubble (centro), e Walter Adams (destra)
(1931, oculare del 100”@ Mt. Wilson)

Redshift

nell'universo in espansione le galassie recedono le une dalle altre.
L'effetto Doppler produce uno spostamento delle righe spettrali verso le lunghezze d'onda maggiori (redshift).
Dal redshift si ricava la velocita' di recessione

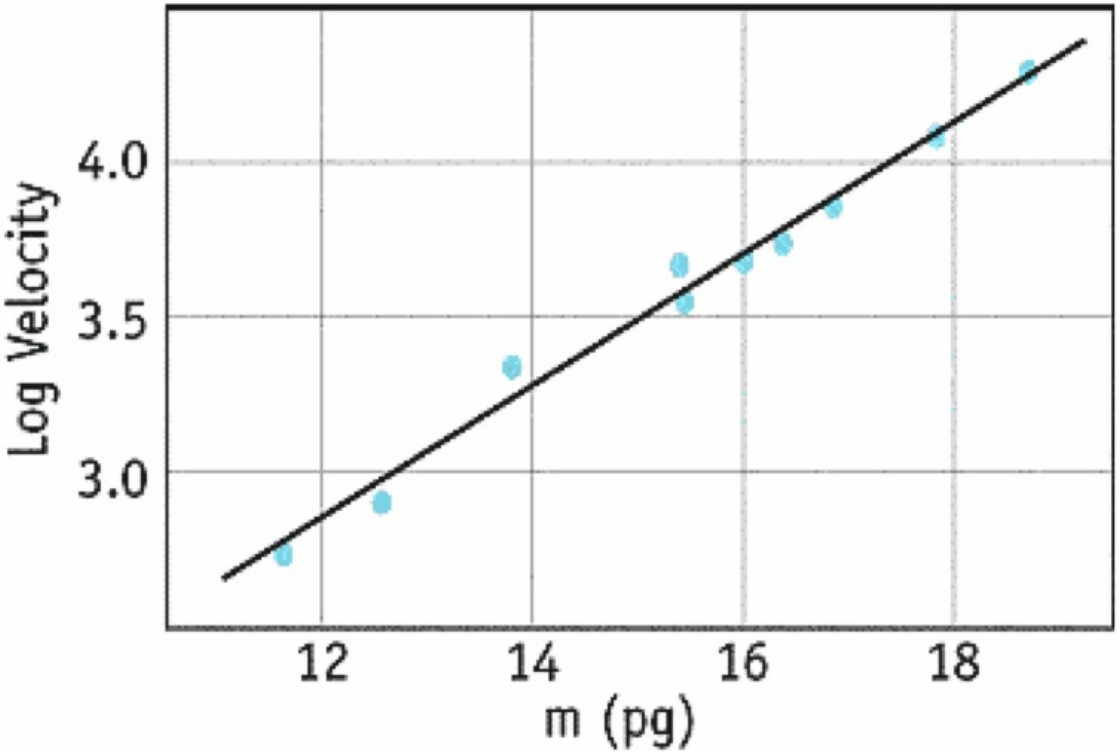




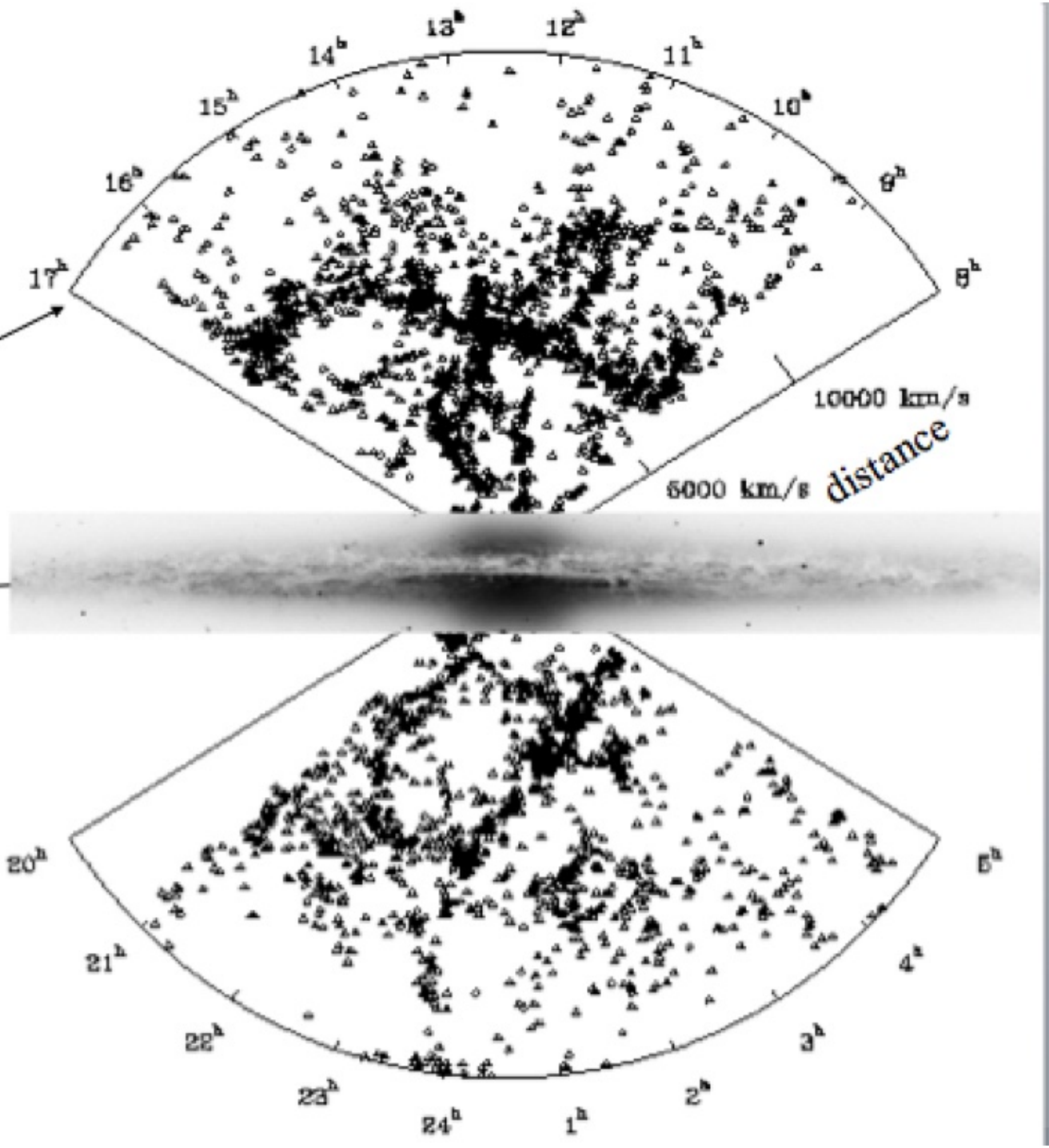
Dist = Vel/H_o

H_o=70 km/sec Mpc

Legge di Hubble



3-D Distribution of Galaxies in the Universe



600 M Ly

CFA survey
Approx 1980