

L'eredita' di Albert Einstein vista da un astronomo

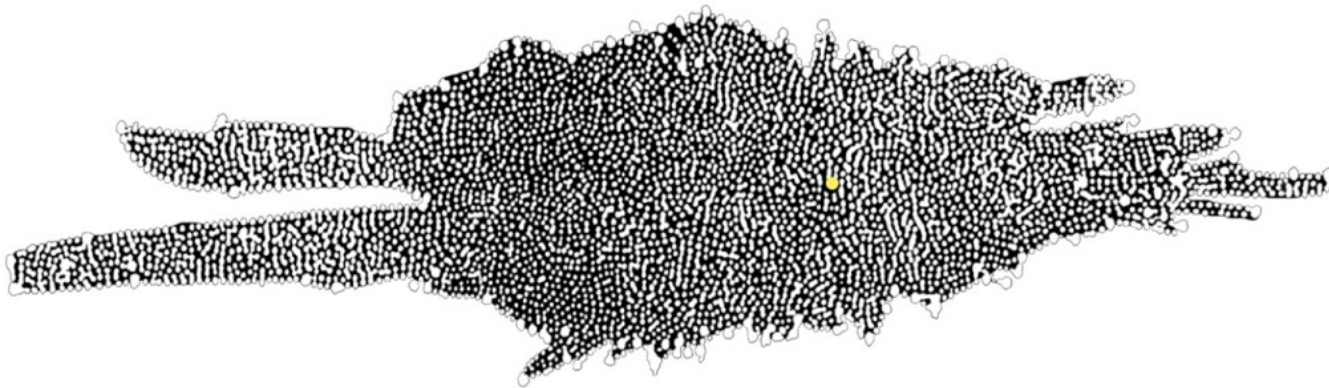
G. Gavazzi - MIB

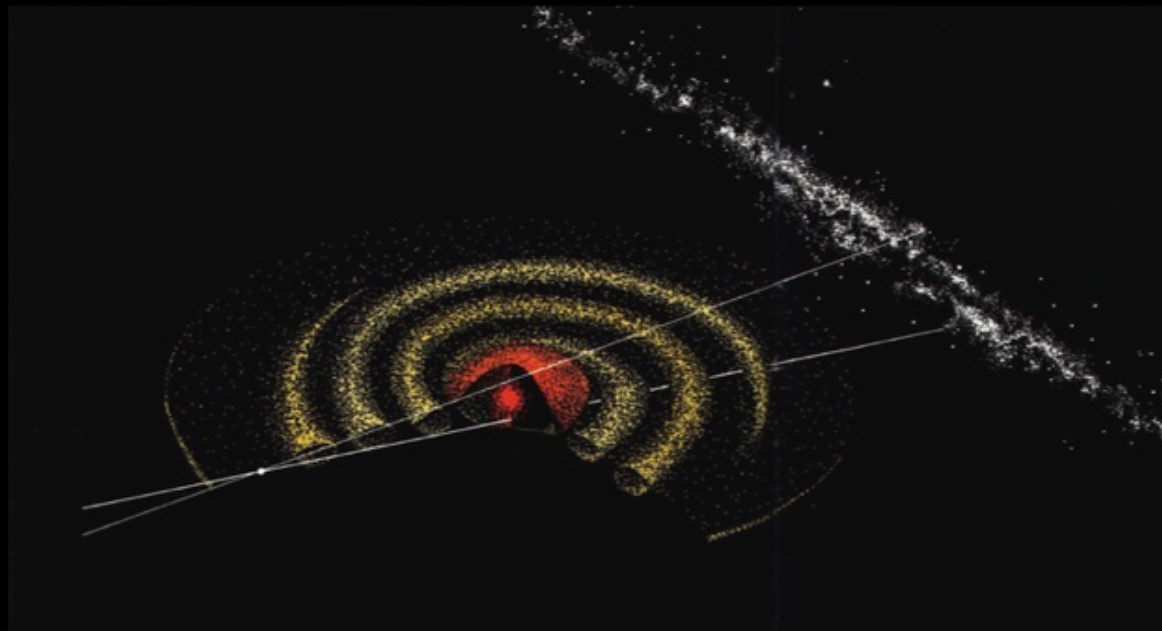




contesto storico

- 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) pubblica *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).





Nebulae

M101

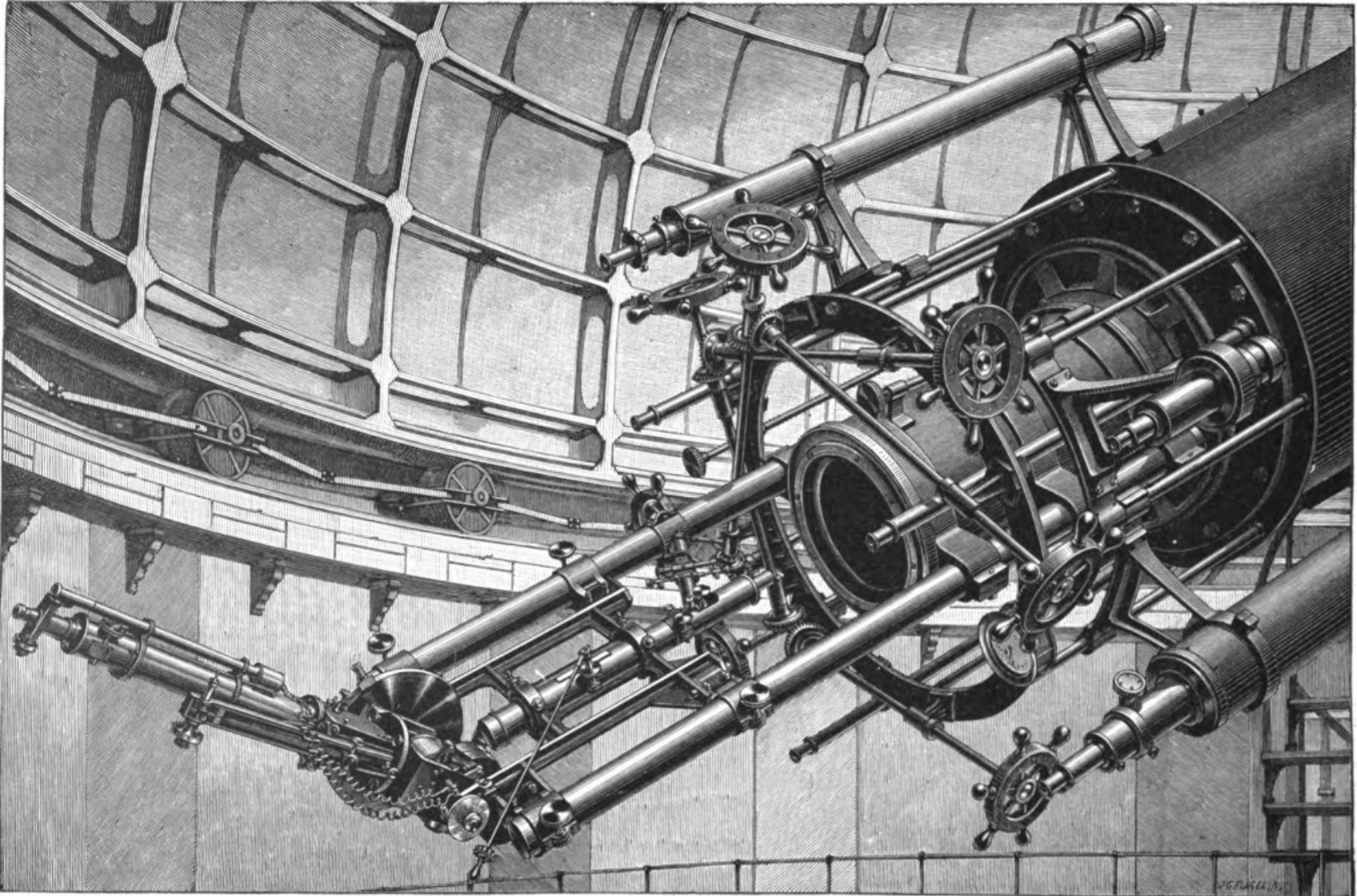


M42



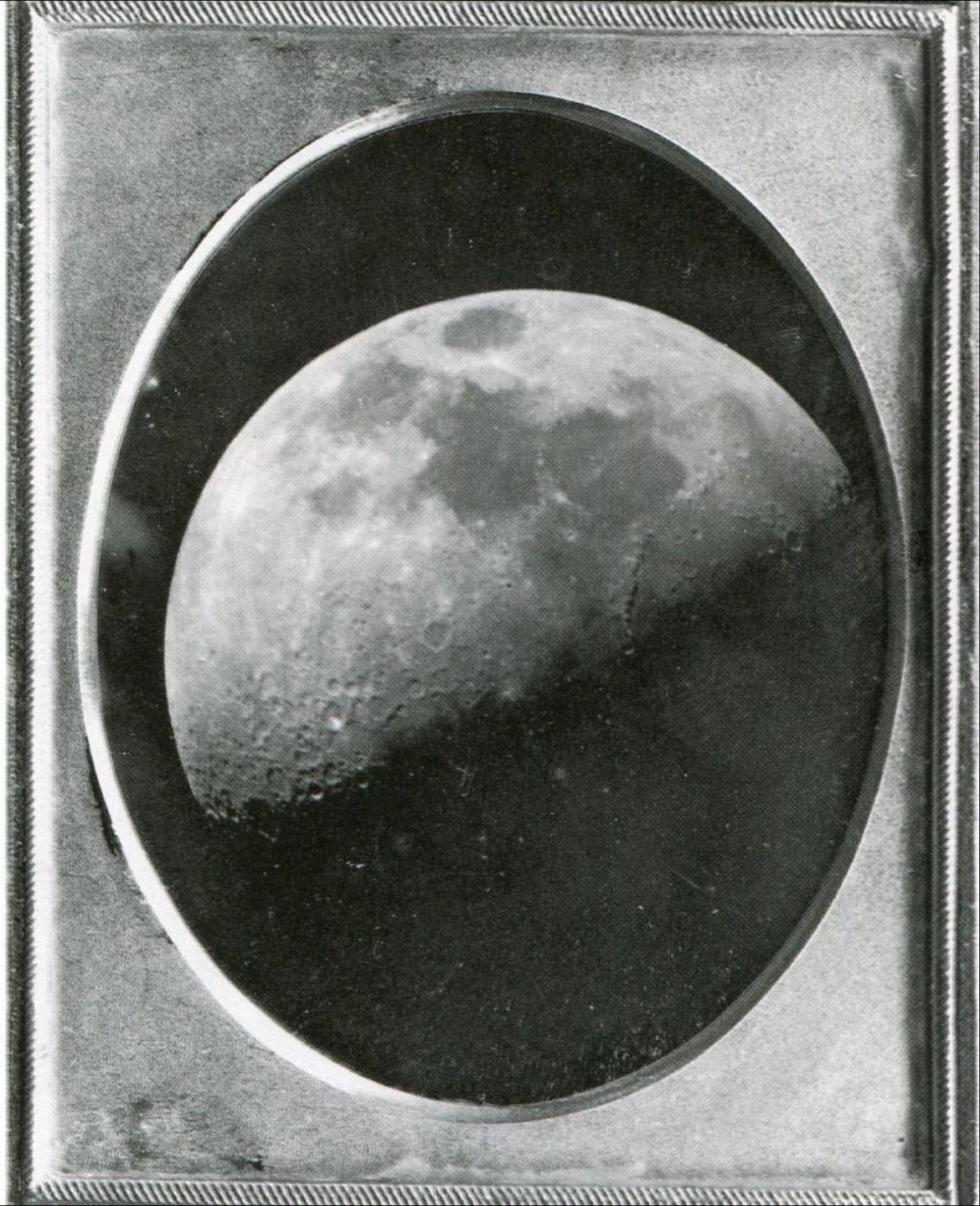
'800

inizio del 1800: spettroscopia solare da Joseph von Fraunhofer.



Lo Spettroscopio stellare del Lick Observatory nel 1898

1839: Louis Daguerre cerca di fotografare la Luna.



John Adams Whipple, Luna,
1851, Daguerreotype

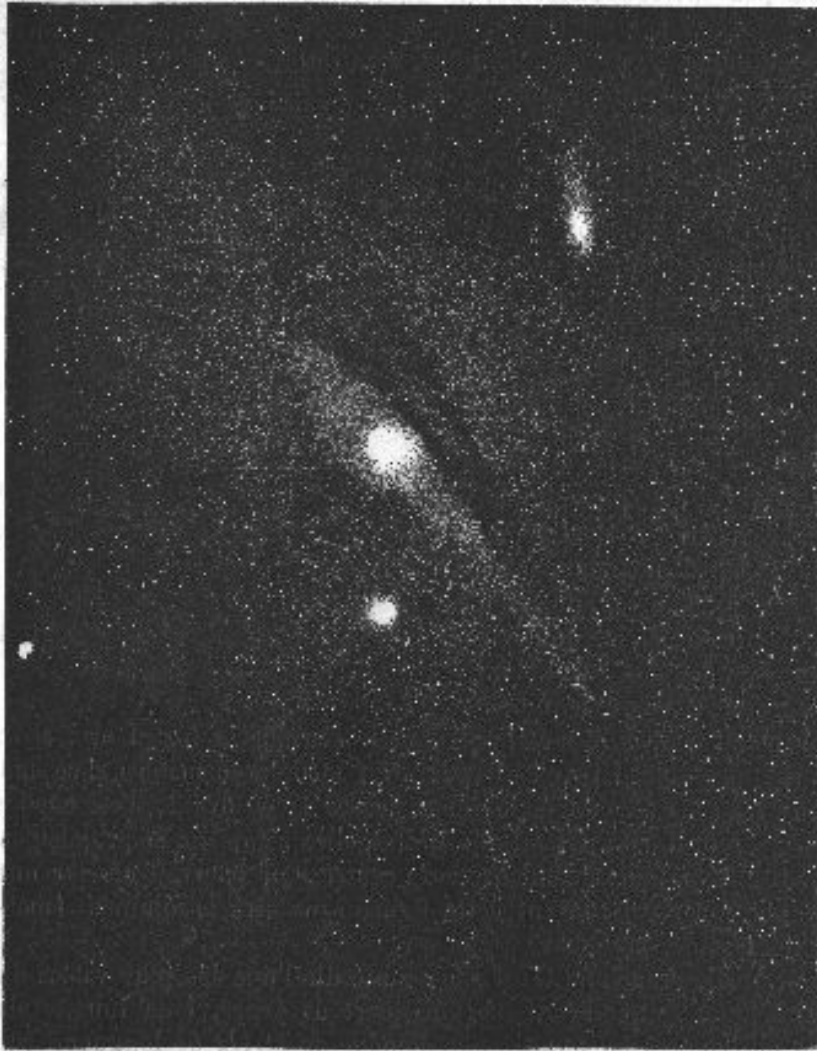
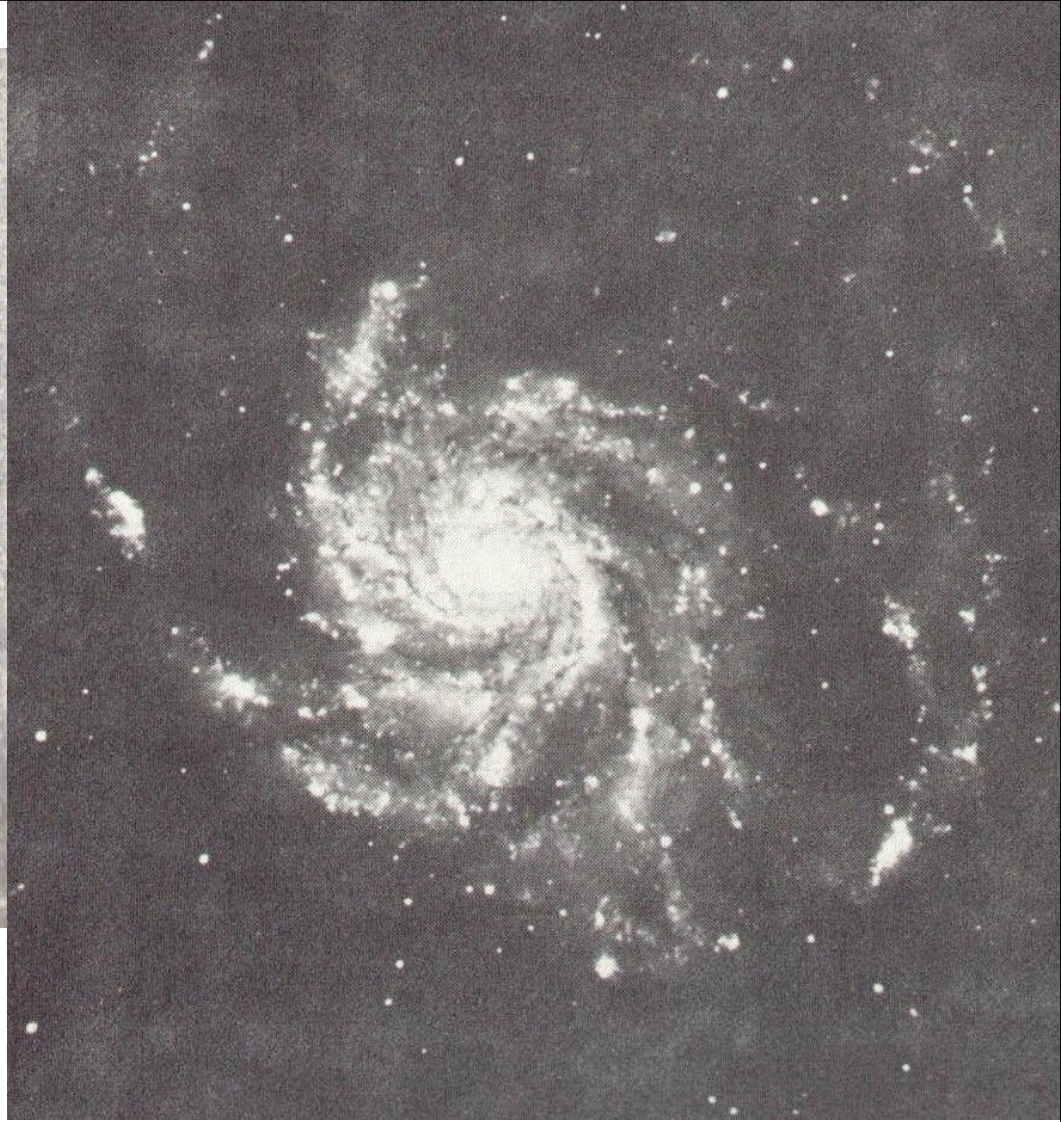
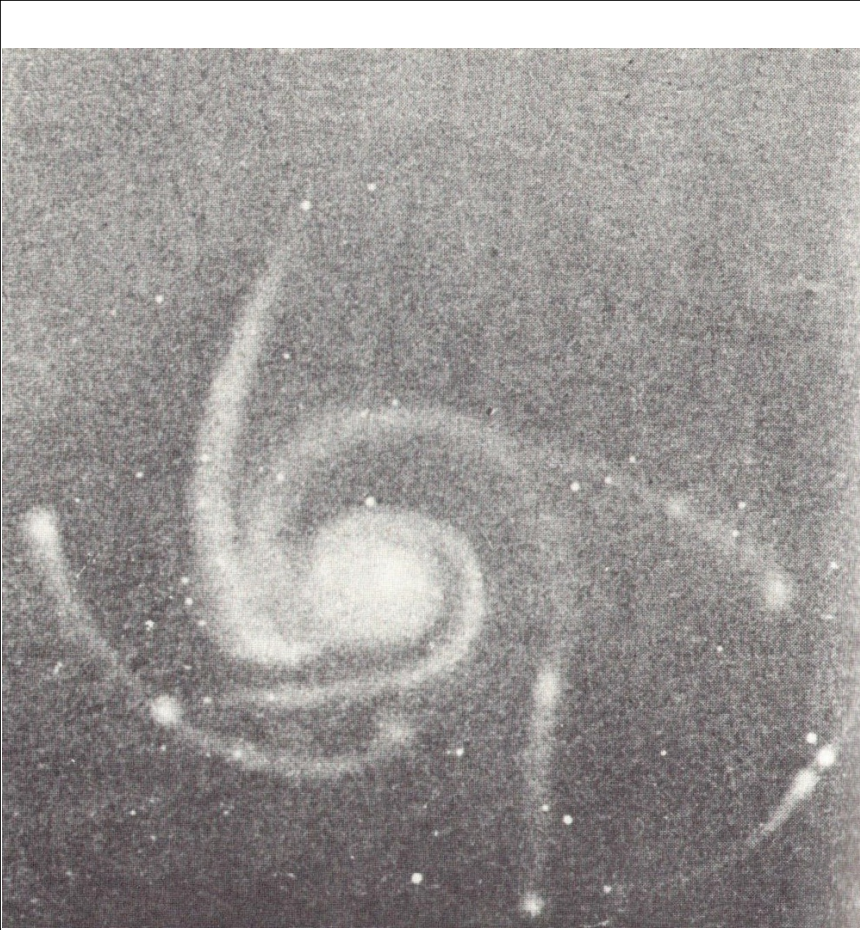


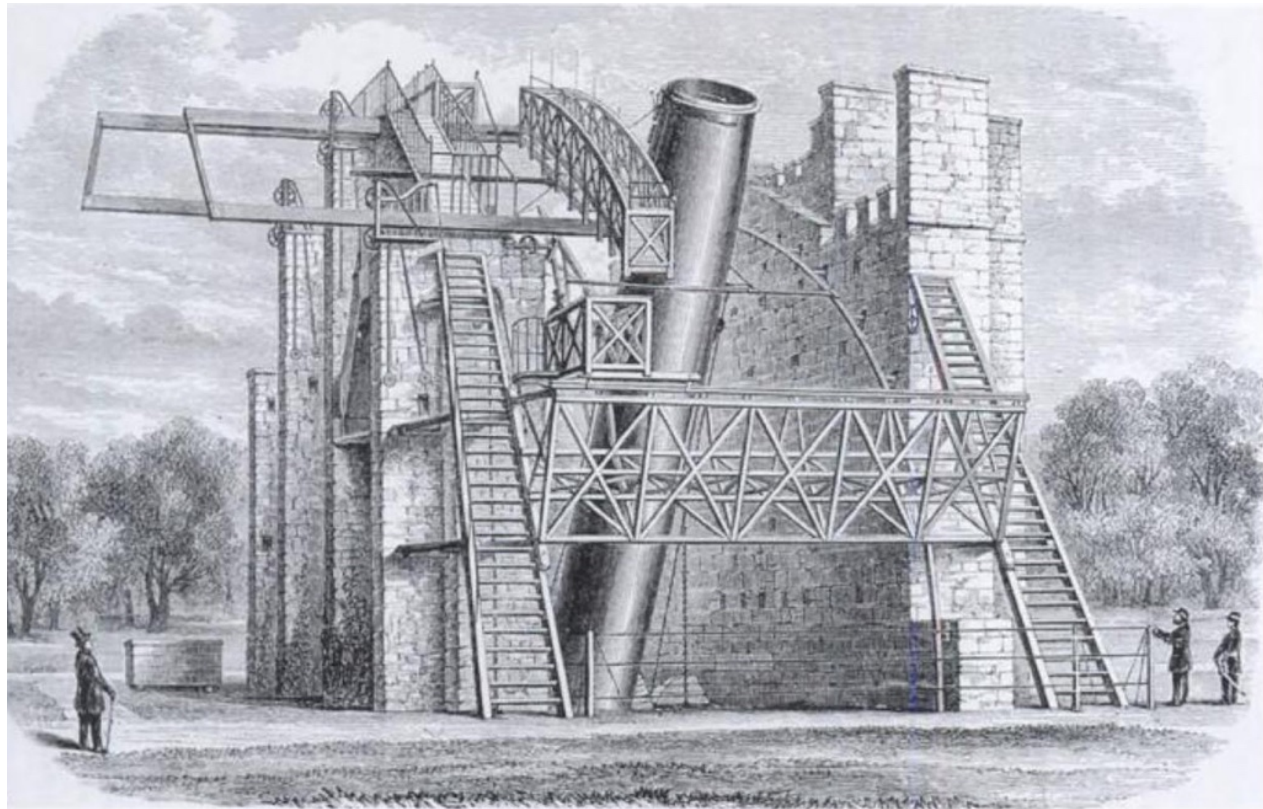
Fig. 51. — La nebulosa d'Andromeda, vista con un grande telescopio.

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)

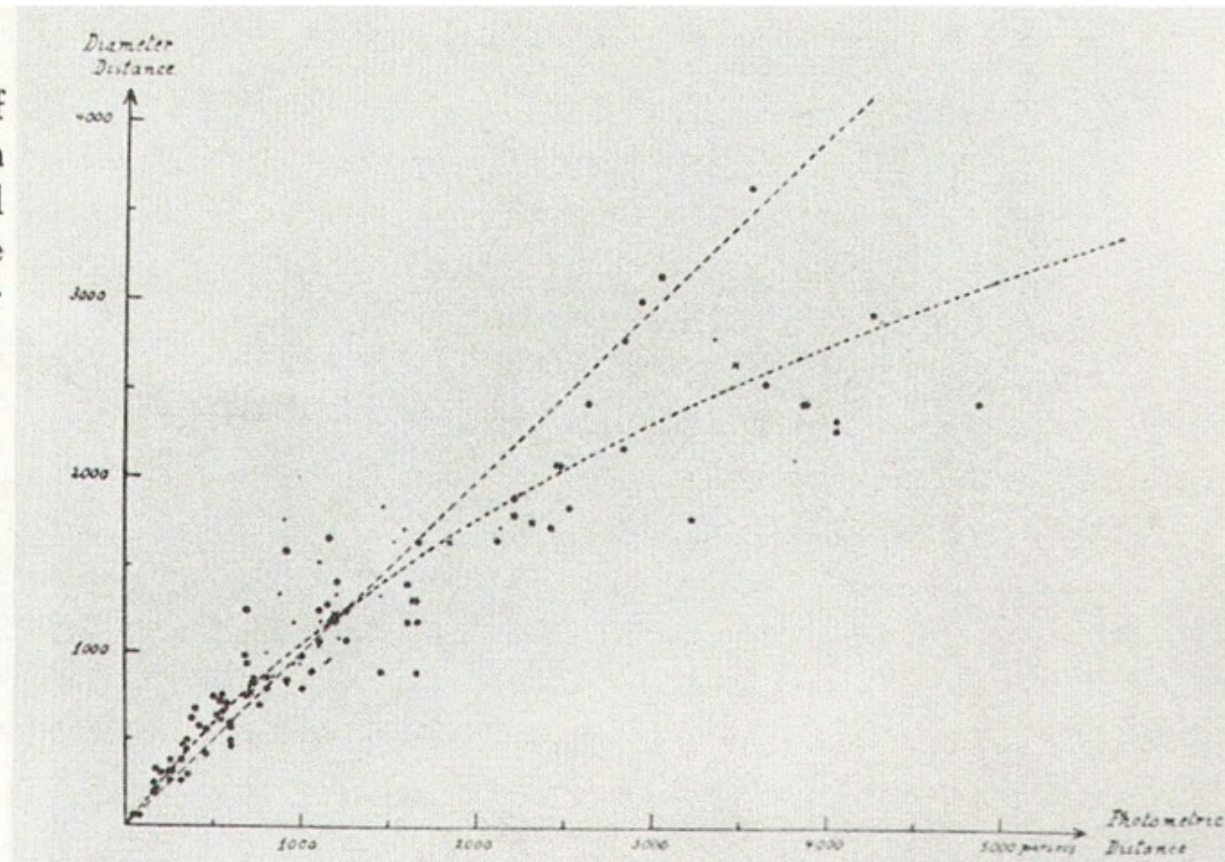
- survey astrografica mai completata, ha interessato 20 osservatori.
- progettata per coprire tutto il cielo con 22000 lastre da $2.1^{\circ} \times 2.1^{\circ}$ (13 cm $\times$ 13 cm)
- esposizioni da 6 min (11 mag)
- *Alcuni credono che questa sia la storia di come i migliori osservatori Europei del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

'900

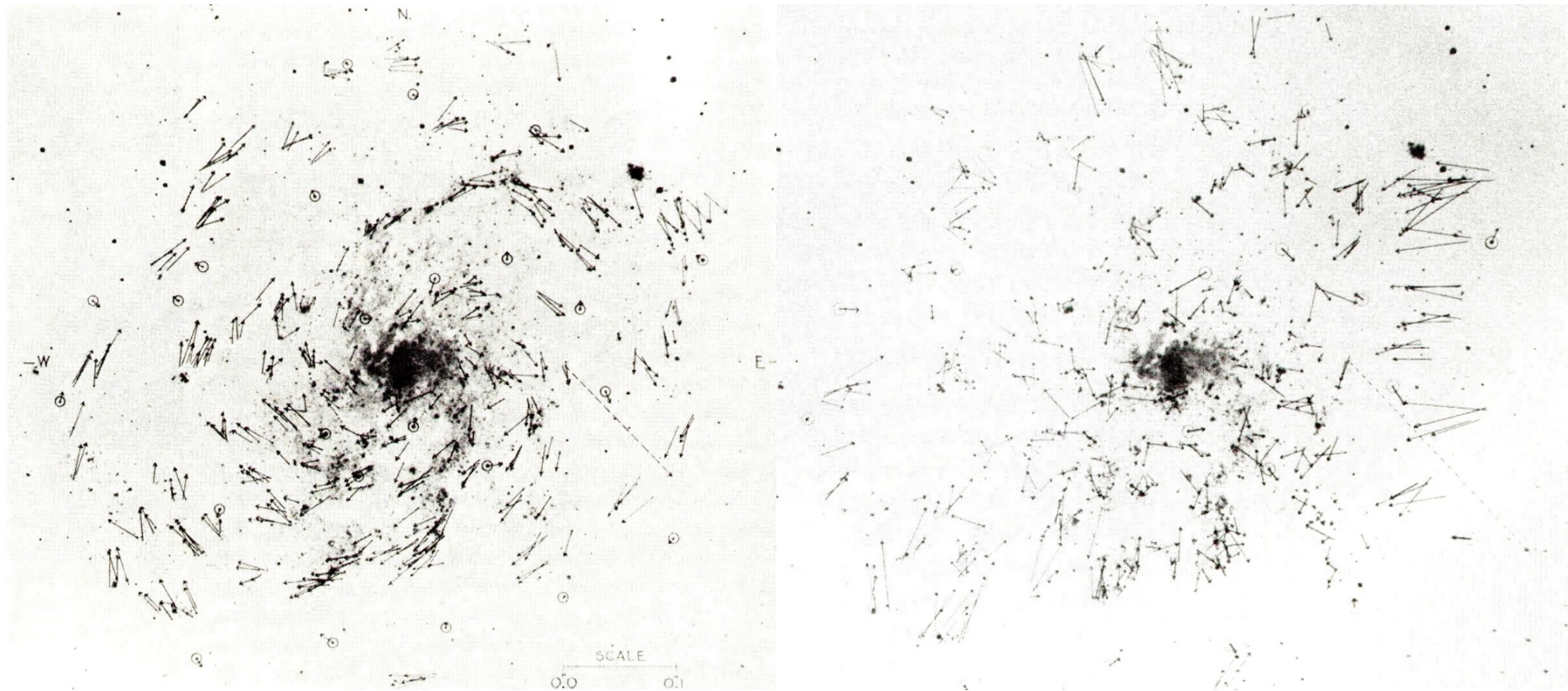
1912: Vesto Slipher (1875-1969) ottiene il primo spettro di M31 e nel '14 ha spettri di 14 nebulose a spirale.

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

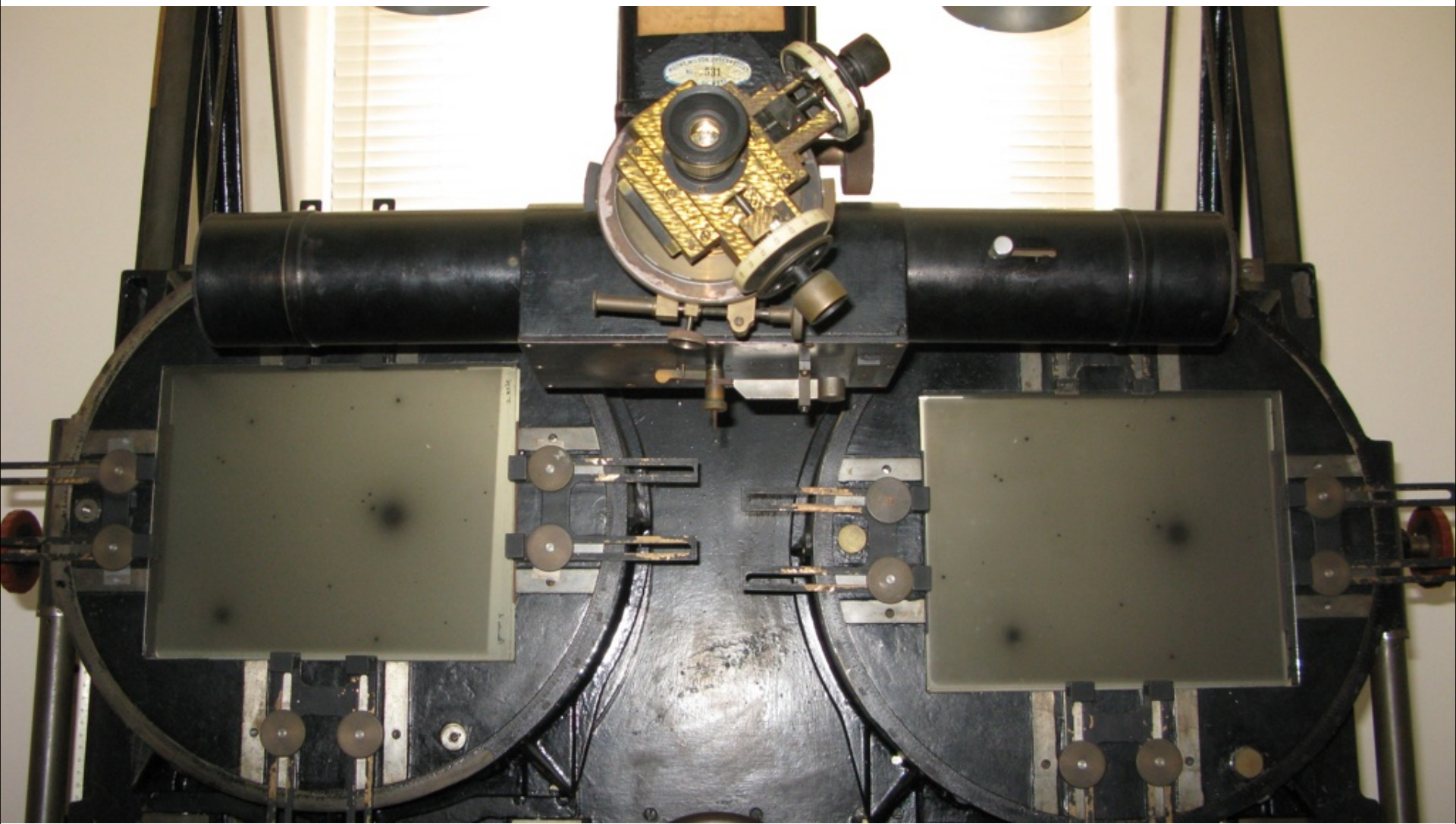
A comparison of the distances of open clusters determined from apparent magnitudes and spectral type (abscissa) with those determined from angular diameters (ordinate). The dotted straight line indicates the expected relation if no absorption is present. The dotted curve gives the relation for a general absorption of $0^m7/\text{kpc}$. (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

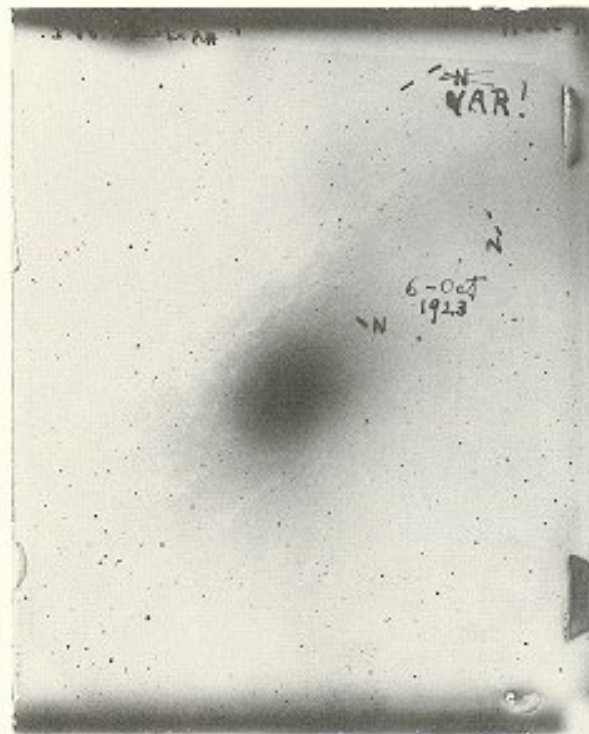
- **Einstein Albert** (1879-1955)
 - 1900 laureato @ Zürich Polytechnic
 - 1905: PhD "A New Determination of Molecular Dimensions."
 - 1905: effetto Fotoelettrico
 - " moto Browniano
 - " relativita' speciale
 - " $E=mc^2$
 - 1917 : relativita' generale
 - 1921: Premio Nobel
- **Hubble Edwin**(1889-1953)
 - 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

Plate Number	Object	RA	Dec	Equinox	Plate	Size	Date	Mag.	HA	Quality	Remarks
H 313 H	M 42	19 42	24 27	150	57530	5-4	July 17	17.7W	0.18E	fair to good	
314	M 6822	19 40.5	-15° 0'	60"	"	4-3	" 18	0.18E	"	main zone	
315	"	"	"	30"	"	4-2	"	0.25W	"	background	
316	"	19 40.5	-6° 0'	100"	"	3-2	"	0.22W	"	good	
317	M 6822	19 40.5	-15°	60"	"	3	Aug 15	0.18E	"	fair image large	
318	M 6822	19 40.5	-15° 2'	100"	"	"	"	"	"	good	
319	"	"	"	"	"	"	"	"	"	fair	
320	SA 06	"	"	Scale Plate	"	"	"	"	"	good	
321	"	23 23	+5° 7'	90"	"	"	"	0.21E	"	fair + weak	
322	"	23 23	+11° 12'	55"	"	"	"	0.26W	"	"	
323	"	4 17	+19° 20'	75"	"	"	"	0.40E	"	fair to good	
324	"	"	"	12"	"	"	"	2.24E	"	"	
325	M 6822	19 40.5	-15°	60"	57530	2	Aug 17	0.18E	"	image only	
326	M 6822	19 40.5	-15°	60"	"	3-1	Sept 11	0.20W	"	fair	
327	"	19 40.5	-15°	60"	"	3-4	"	0.20W	"	to fair	
328	"	19 40.5	-15°	60"	"	3-1	"	2.24E	"	"	
329	M 6822	19 40.5	-15°	60"	57530	1	Oct 4	0.18W	"	poor	
330	M 32	0 28.5	+90° 26'	100"	"	"	"	2.01E	"	poor to fair	
331	M 31	0 38.7	+18° 50'	40"	"	3-1	"	0.21E	"	very poor	
332	M 6822	19 40.5	-15°	60"	57530	1	Oct 5	0.18W	"	poor to good	
333	"	19 40.5	-15°	60"	"	2	"	0.20W	"	fair	
334	"	19 40.5	-15°	60"	"	3	"	2.01E	"	good	
335	M 31	0 38.7	+18° 50'	40"	"	3	"	0.20E	"	fair	
336	M 6822	19 40.5	-15°	60"	57530	2	"	0.18E	"	fair	
337	"	"	"	120"	"	3-2	"	1.48W	"	fair (image only)	
338	M 6822	19 40.5	-15°	60"	"	2-1	"	0.18W	"	fair to poor (image only)	
339	M 31	0 38.7	+18° 50'	40"	"	3	Nov 13	0.20E	"	poor to good	
340	M 6822	19 40.5	-15°	60"	"	"	"	0.18E	"	weak image only	

Plate Number	Object	RA	Dec	Equinox	Plate	Size	Date	Mag.	HA	Quality	Remarks
341	M 6822	19 40.5	-15°	60"	57530	5-4	July 17	17.7W	0.18E	fair to good	Shapley reported near diffuse variable nebulae has Nothing? it is not a Shapley object is probably an accident.
342	"	"	"	30"	"	4-2	"	0.25W	"	"	
343	"	"	"	100"	"	3-2	"	0.22W	"	good	
344	"	"	"	60"	"	3	Aug 15	0.18E	"	fair image large	
345	"	"	"	100"	"	"	"	"	"	good	
346	"	"	"	"	"	"	"	"	"	fair	
347	"	"	"	"	"	"	"	"	"	good	
348	"	"	"	"	"	"	"	"	"	fair + weak	
349	"	"	"	"	"	"	"	"	"	"	
350	"	"	"	"	"	"	"	"	"	"	
351	"	"	"	"	"	"	"	"	"	"	
352	"	"	"	"	"	"	"	"	"	"	
353	"	"	"	"	"	"	"	"	"	"	
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355	"	"	"	"	"	"	"	"	"	"	
356	"	"	"	"	"	"	"	"	"	"	
357	"	"	"	"	"	"	"	"	"	"	
358	"	"	"	"	"	"	"	"	"	"	
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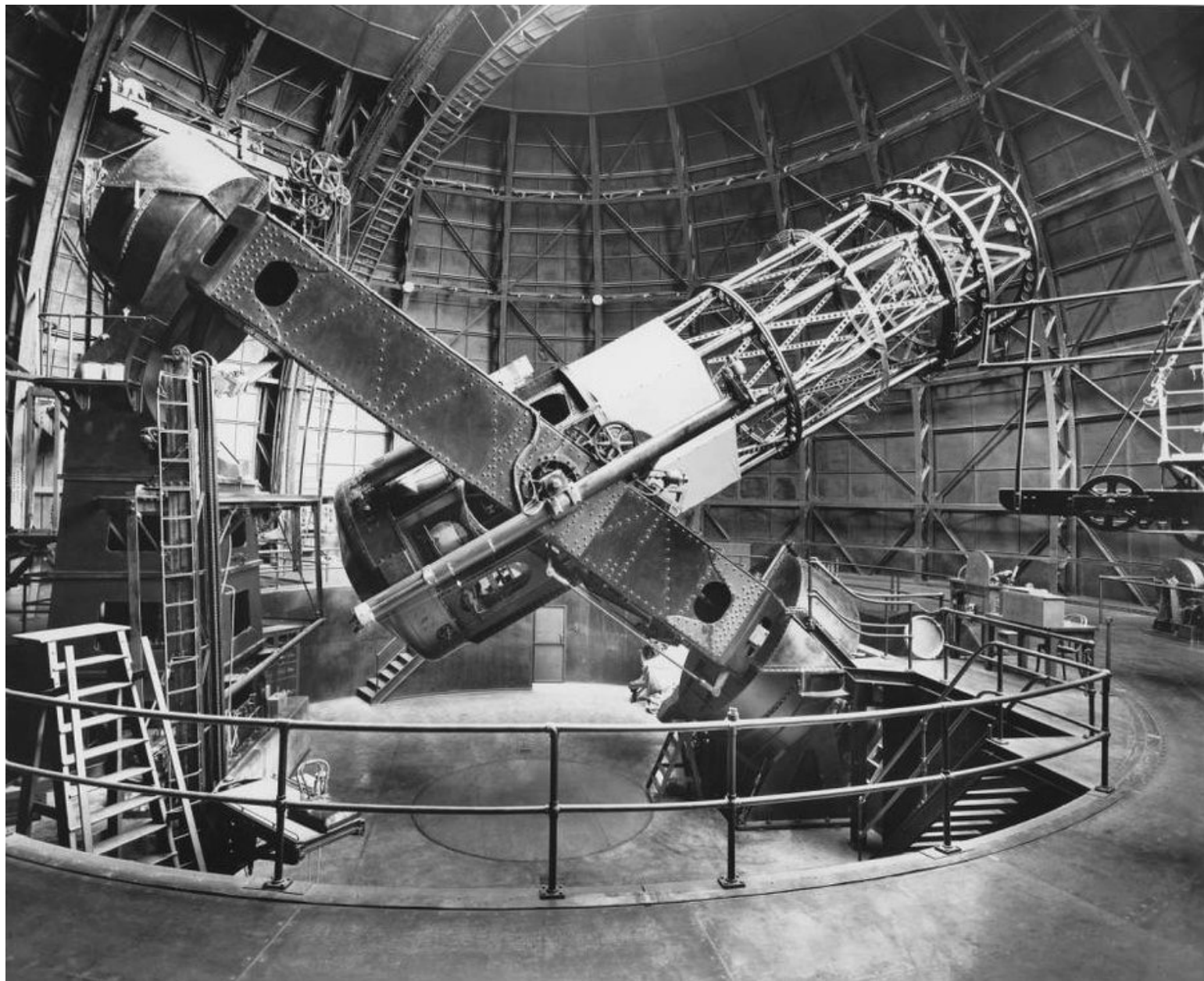
Log book del 5-6 ottobre 1923 quando
Hubble scopre una cefeide in M31. (destra)
la lastra della scoperta



331 Nova suspected
 332 SBb
 333 R Co. obs. faint
 334 7:30-8:30 P.M.T.
 335 Confirms nova suspected on H 3314
 336 R seen minimum seen rather brighter than last minimum
 37

on this plate (H 335-4), three stars were found, 2 of which were new, and 1 proved to be a variable, later identified as a Cepheid - the 1st to be recognized in H₃

✓



Il telescopio Hooker da 100" @ Mt Wilson diventò operativo nel 1917



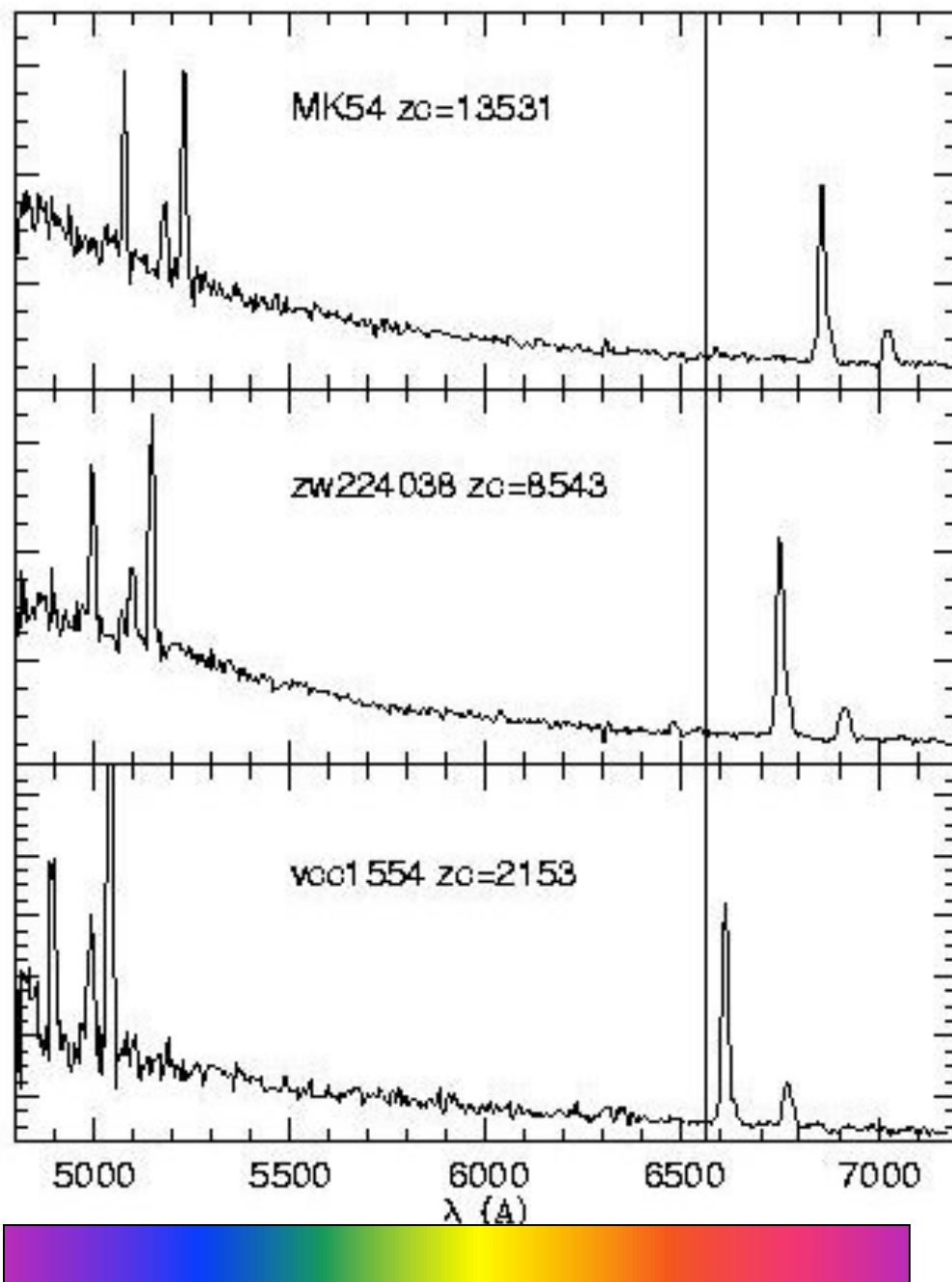
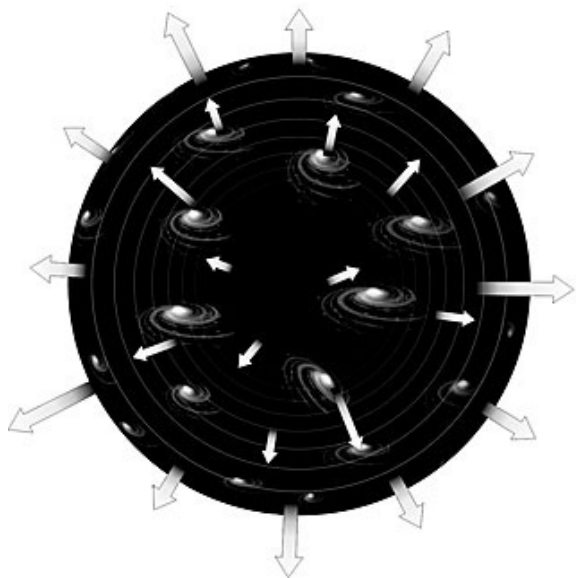
Albert Einstein (sinistra), Edwin Hubble (centro), e Walter Adams (destra)
(1931, oculare del 100" @ Mt. Wilson)

Redshift

nell'universo in espansione le galassie recedono le une dalle altre.

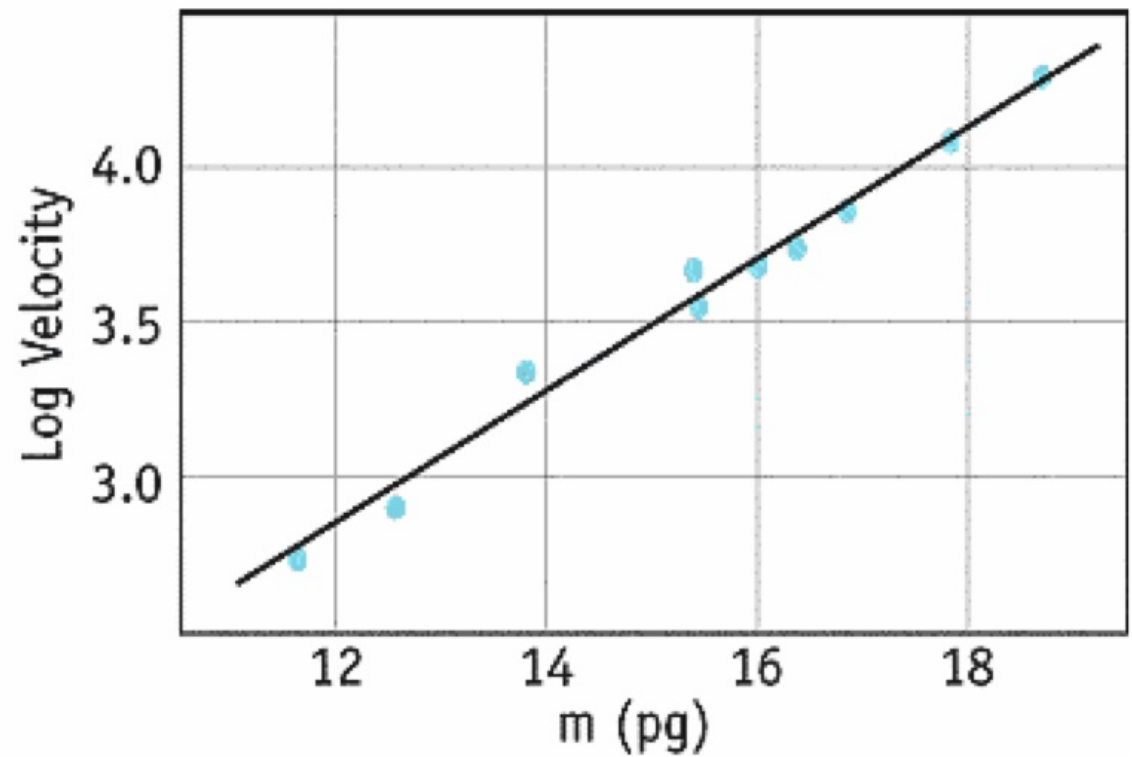
L'effetto Doppler produce uno spostamento delle righe spettrali verso le lunghezze d'onda maggiori (redshift).

Dal redshift si ricava la velocità di recessione





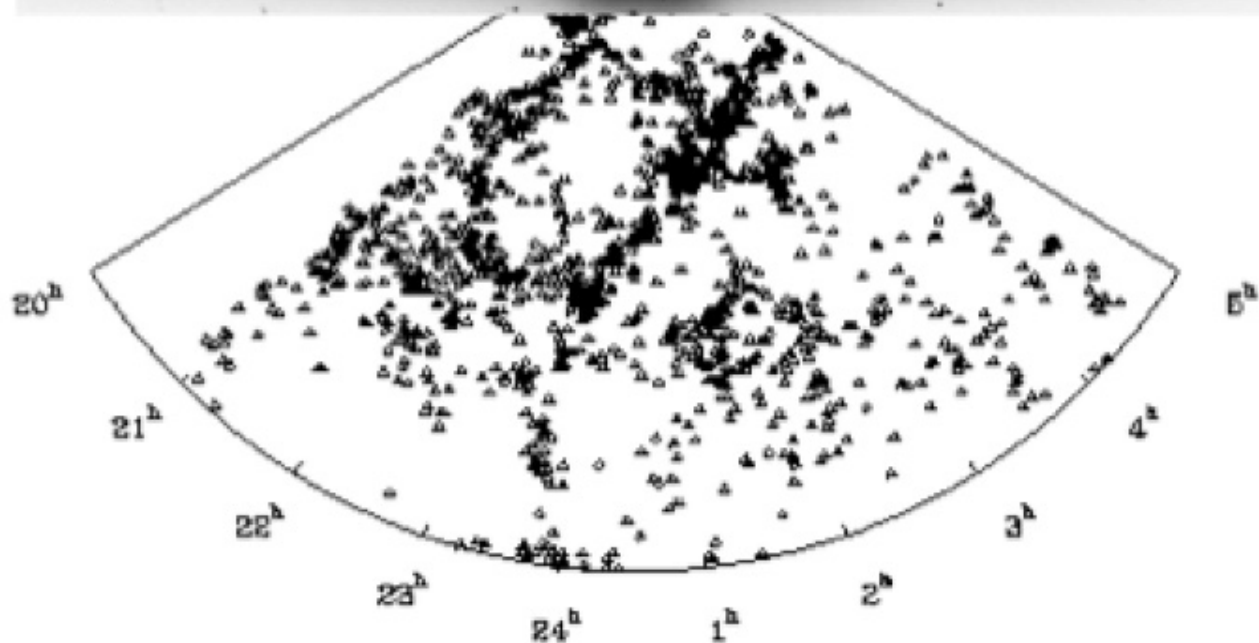
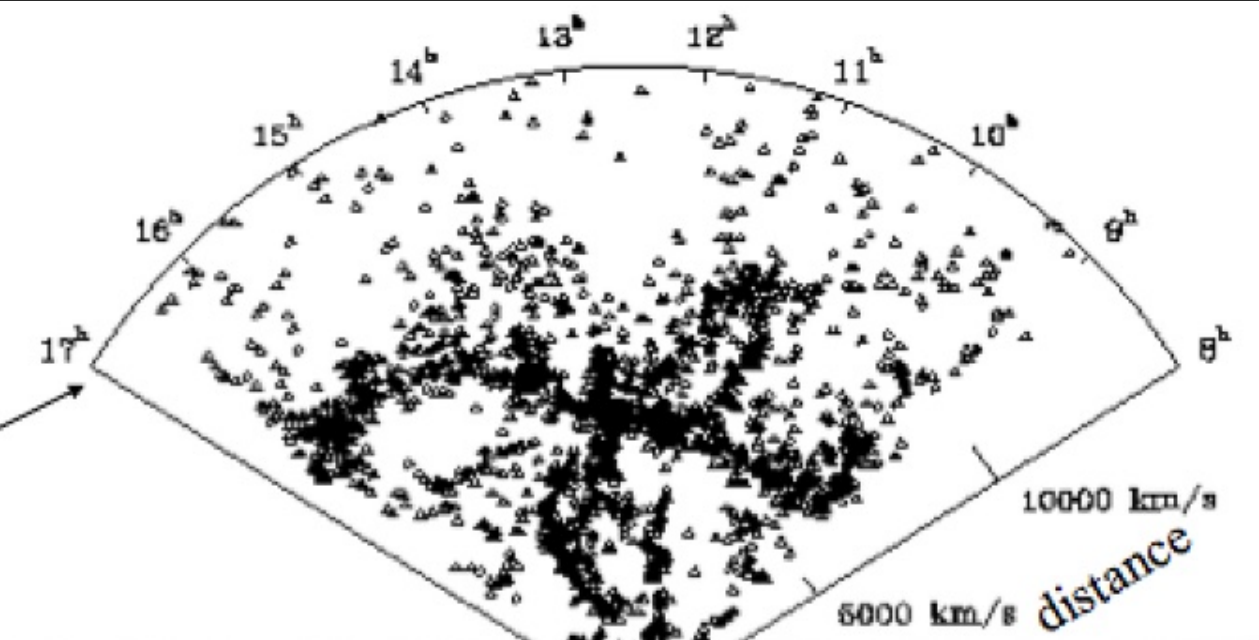
$\text{Dist} = \text{Vel}/H_0$
 $H_0 = 70 \text{ km/sec Mpc}$
Legge di Hubble



3-D Distribution of Galaxies in the Universe

600 M Ly

You are here



CFA survey
Approx 1980