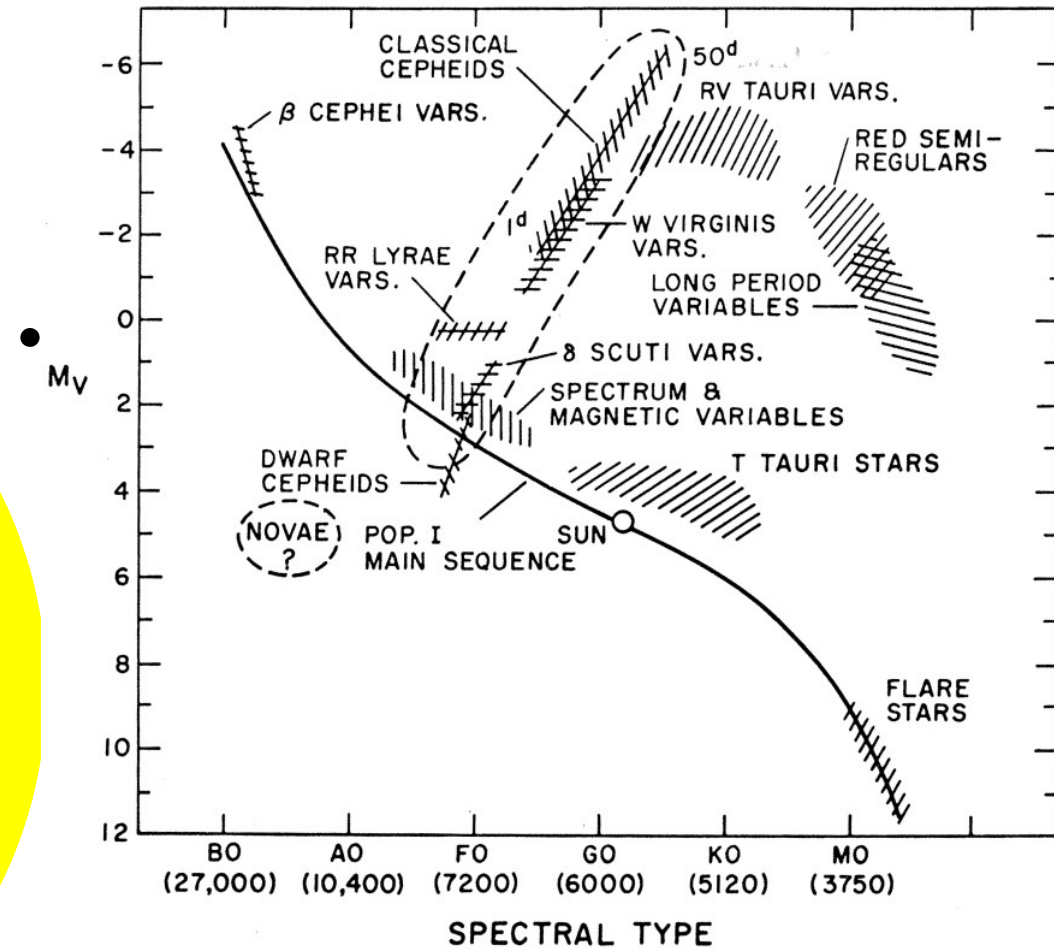


WHAT EXACTLY IS A CEPHEID?

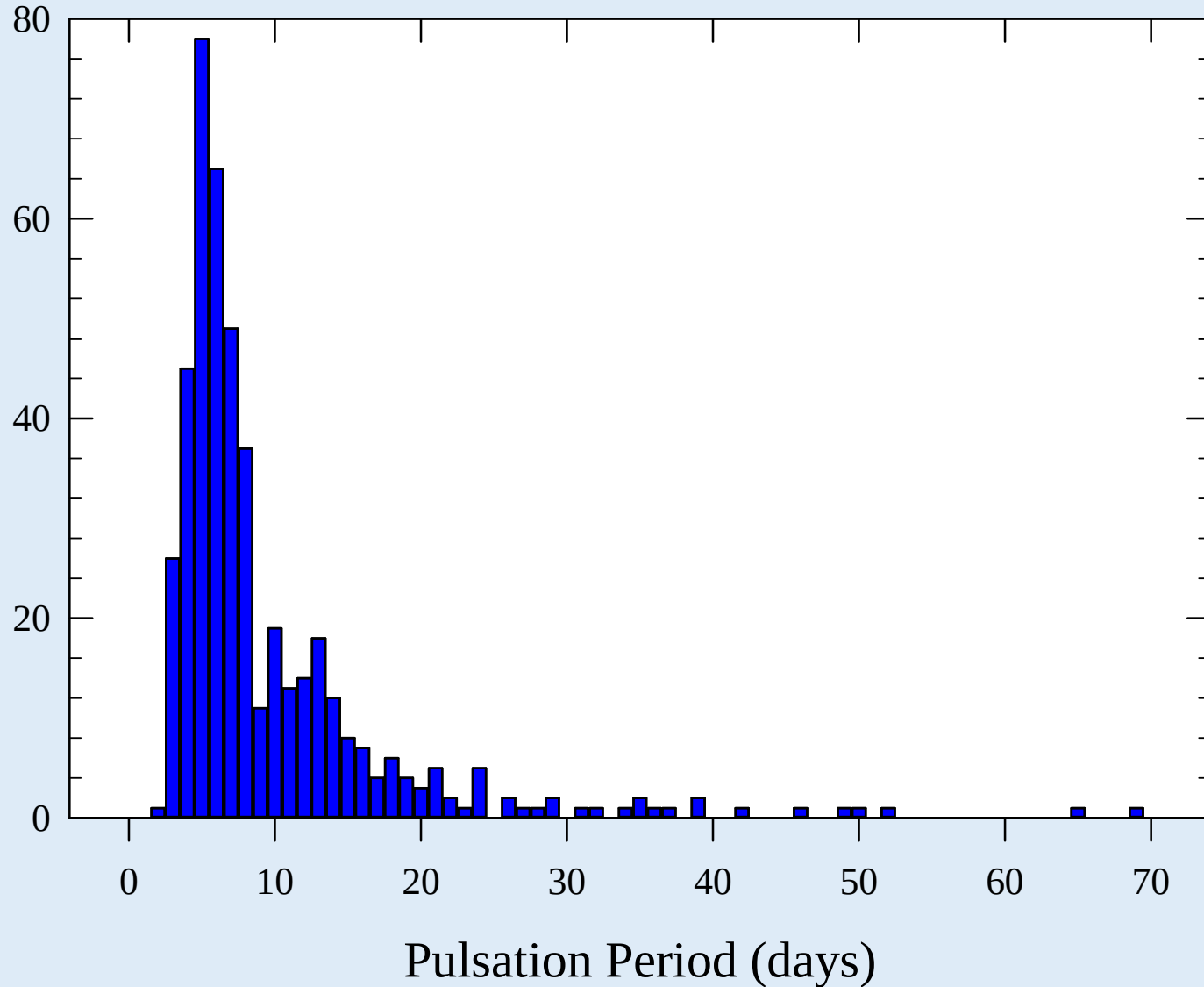
- F-G-K Supergiants
- Mass $\approx 4.0 M_{\odot}$
- Radius $\approx 35 M_{\odot}$
- Lum. $\approx 10^3 - 10^4 L_{\odot}$
- Age $\approx 10 - 250$ Myr
- Periods $\approx 2 - 50$ days
- δ Cep – prototype
- Intrinsic Variable Stars:
Radial Pulsations



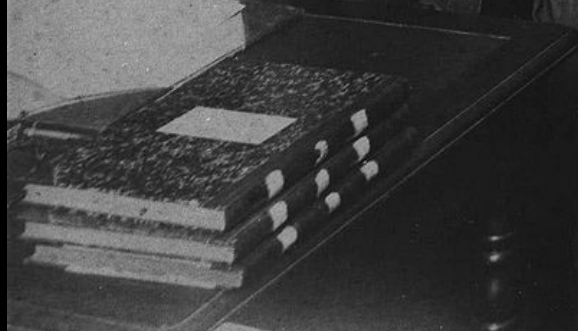
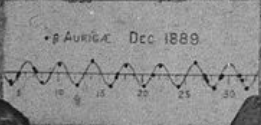
(Cox 1974)

JUST A MATTER OF TIME...

Galactic Cepheid Period Distribution







1215

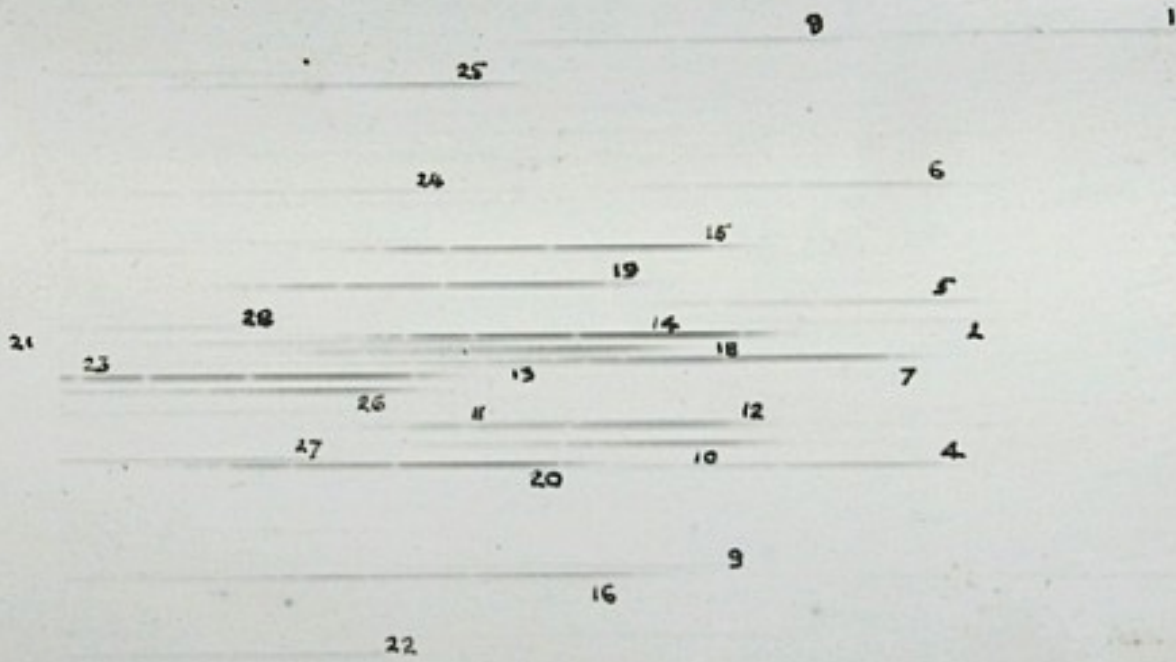
Proaupa Cluster.

14 March 1921.

12" P.C.

Exp. 9^h 30^m - 10^h 30^m E.M.T.

2521



See Key Chart for identification of Stars.

Manson's "Record" Plate
Rytil

3

W.J.S.L.

The Magellanic Clouds





LMC



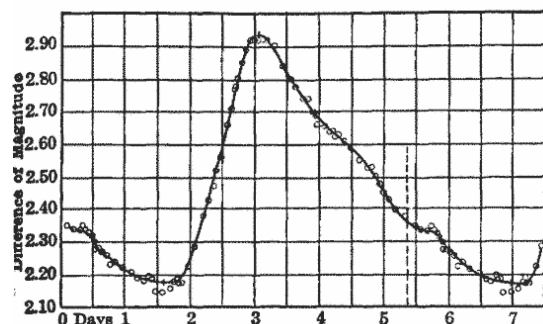
SMC



1777 VARIABLES IN THE MAGELLANIC CLOUDS.

BY HENRIETTA S. LEAVITT.

The variables appear to fall into three or four distinct groups. The majority of the light curves have a striking resemblance, in form, to those of cluster variables. As a rule, they are faint during the greater part of the time, the maxima being very brief, while the increase of light usually does not occupy more than from one-sixth to one-tenth of the entire period. It is worthy of notice that in Table VI the brighter variables have the longer periods.



cluster variables = cepheids

“it is worthy of notice that in Table VI the brighter stars have the longer periods”

TABLE VI.

PERIODS OF VARIABLES IN THE SMALL MAGELLANIC CLOUD.

Harvard No.	Max.	Min.	Range.	Epoch.	Period.	Min. to Max.	Average Dev.	Earliest Observation.	No. Periods.	No. Plats.
818	13.6	14.7	1.1	4.0	<i>d.</i> 10.336	<i>d.</i> 1.7	.12	1890	566	44
821	11.2	12.1	0.9	97.	127.	49.	.06	1890	45	89
823	12.2	14.1	1.9	2.9	31.94	3.	.13	1890	184	56
824	11.4	12.8	1.4	4.	65.8	7.	.12	1889	94	83
827	13.4	14.3	0.9	11.6	13.47	6.	.11	1890	448	60
842	14.6	16.1	1.5	2.61	4.2897	0.6	.06	1896	843	26
1374	13.9	15.2	1.3	6.0	8.397	2.	.10	1893	574	42
1400	14.1	14.8	0.7	4.0	6.650	1.	.11	1893	724	42
1425	14.3	15.3	1.0	2.8	4.547	0.8	.09	1893	1042	33
1436	14.8	16.4	1.6	0.02	1.6637	0.3	.10	1893	2859	22
1446	14.8	16.4	1.6	1.38	1.7620	0.3	.09	1896	2052	21
1505	14.8	16.1	1.3	0.02	1.25336	0.2	.10	1896	2335	25
1506	15.1	16.3	1.2	1.08	1.87502	0.3	.09	1896	1560	23
1646	14.4	15.4	1.0	4.30	5.311	0.7	.06	1896	681	24
1649	14.3	15.2	0.9	5.05	5.323	0.7	.10	1893	894	32
1742	14.3	15.5	1.2	0.95	4.9866	0.7	.07	1893	954	28

1912: paper published under name of Edward Pickering, reported work on 25 variable stars in the SMC 'prepared by Miss Leavitt'

HARVARD COLLEGE OBSERVATORY.

CIRCULAR 173.

PERIODS OF 25 VARIABLE STARS IN THE SMALL MAGELLANIC
CLOUD.

The following statement regarding the periods of 25 variable stars in the Small Magellanic Cloud has been prepared by Miss Leavitt.

EDWARD C. PICKERING.

MARCH 3, 1912.

A remarkable relation between the brightness of these variables and the length of their periods will be noticed.

PERIODS OF VARIABLE STARS IN THE SMALL MAGELLANIC CLOUD.

H.	Max.	Min.	Epoch.	Period.	Res. <i>M</i> .	Res. <i>m</i> .	H.	Max.	Min.	Epoch.	Period.	Res. <i>M</i> .	Res. <i>m</i> .
			<i>d.</i>	<i>d.</i>						<i>d.</i>	<i>d.</i>		
1505	14.8	16.1	0.02	1.25336	-0.6	-0.5	1400	14.1	14.8	4.0	6.650	+0.2	-0.3
1436	14.8	16.4	0.02	1.6637	-0.3	+0.1	1355	14.0	14.8	4.8	7.483	+0.2	-0.2
1446	14.8	16.4	1.38	1.7620	-0.3	+0.1	1374	13.9	15.2	6.0	8.397	+0.2	-0.3
1506	15.1	16.3	1.08	1.87502	+0.1	+0.1	818	13.6	14.7	4.0	10.336	0.0	0.0
1413	14.7	15.6	0.35	2.17352	-0.2	-0.5	1610	13.4	14.6	11.0	11.645	0.0	0.0
1460	14.4	15.7	0.00	2.913	-0.3	-0.1	1365	13.8	14.8	9.6	12.417	+0.4	+0.2
1422	14.7	15.9	0.6	3.501	+0.2	+0.2	1351	13.4	14.4	4.0	13.08	+0.1	-0.1
842	14.6	16.1	2.61	4.2897	+0.3	+0.6	827	13.4	14.3	11.6	13.47	+0.1	-0.2
1425	14.3	15.3	2.8	4.547	0.0	-0.1	822	13.0	14.6	13.0	16.75	-0.1	+0.3
1742	14.3	15.5	0.95	4.9866	+0.1	+0.2	823	12.2	14.1	2.9	31.94	-0.3	+0.4
1646	14.4	15.4	4.30	5.311	+0.3	+0.1	824	11.4	12.8	4.	65.8	-0.4	-0.2
1649	14.3	15.2	5.05	5.323	+0.2	-0.1	821	11.2	12.1	97.	127.0	-0.1	-0.4
1492	13.8	14.8	0.6	6.2926	-0.2	-0.4							

The first period-luminosity diagram

magnitude

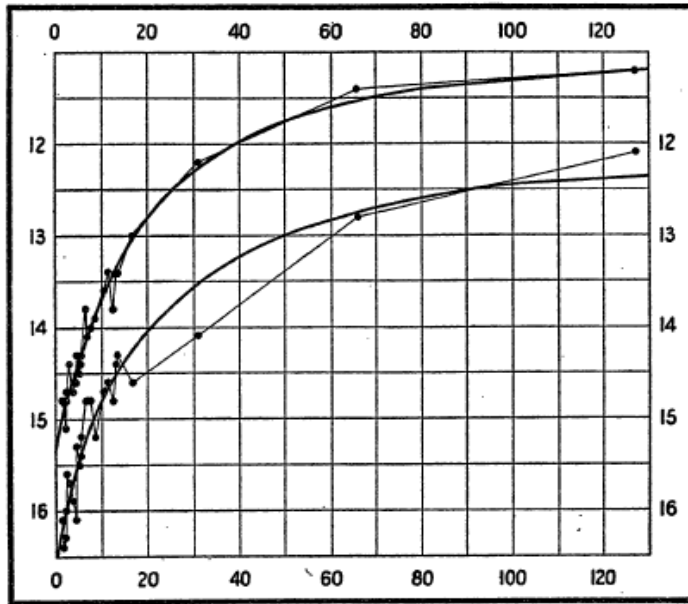


FIG. 1.

days

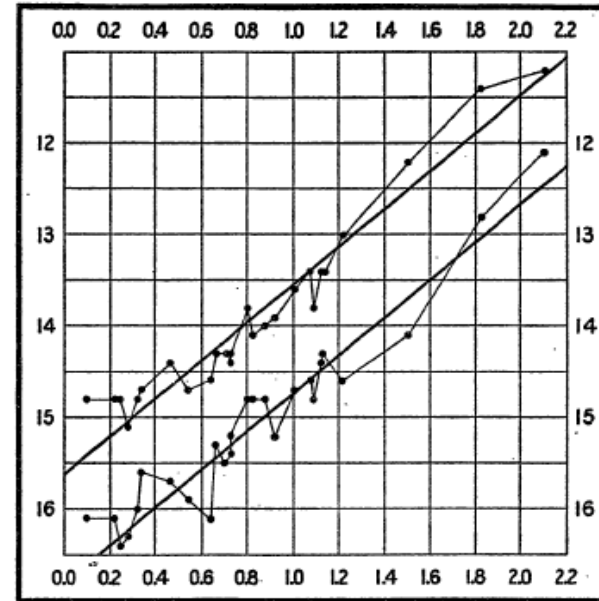


FIG. 2.

log (days)

lower curve: minimum brightnesses
upper curve: maximum brightnesses

note: plot on right is logarithmic, shows near straight line relationship

P (days)

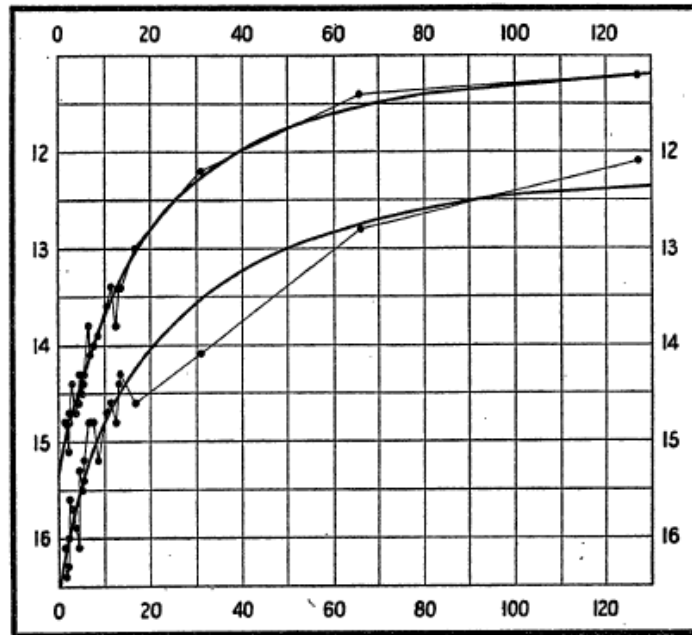


FIG. 1.

log P (days)

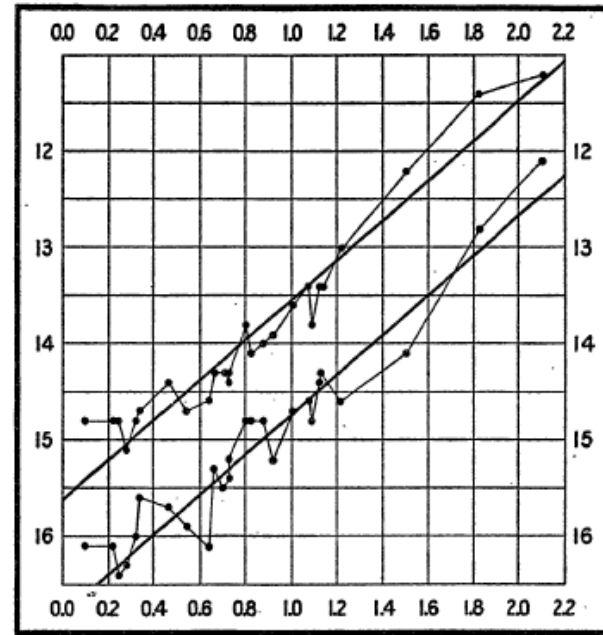
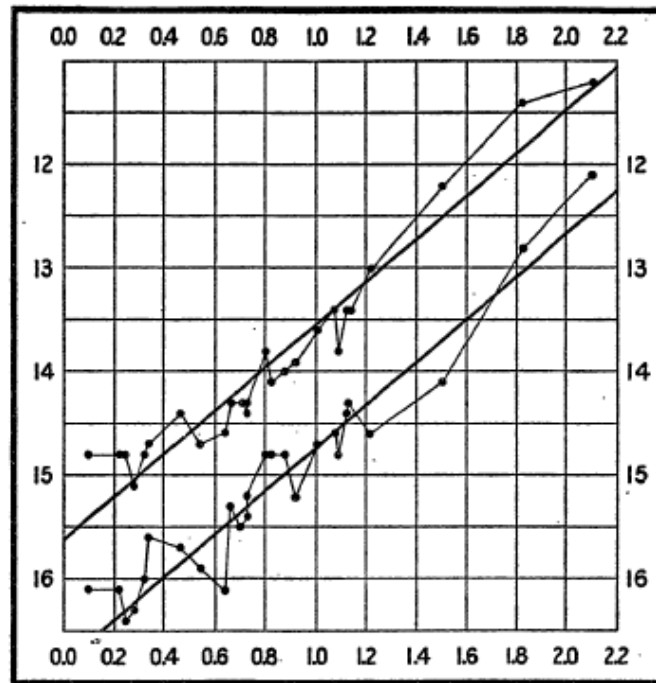


FIG. 2.

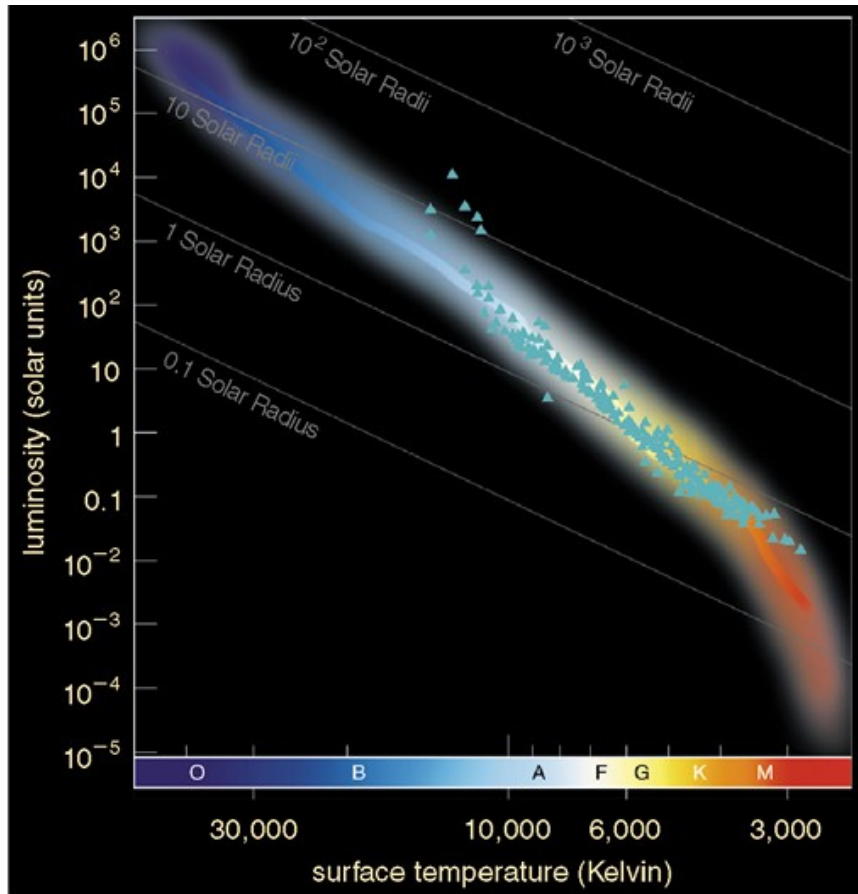
magnitude

A straight line can readily be drawn among each of the two series of points corresponding to maxima and minima, thus showing that there is a simple relation between the brightness of the variables and their periods. The logarithm of the period increases by about 0.48 for each increase of one magnitude in brightness.

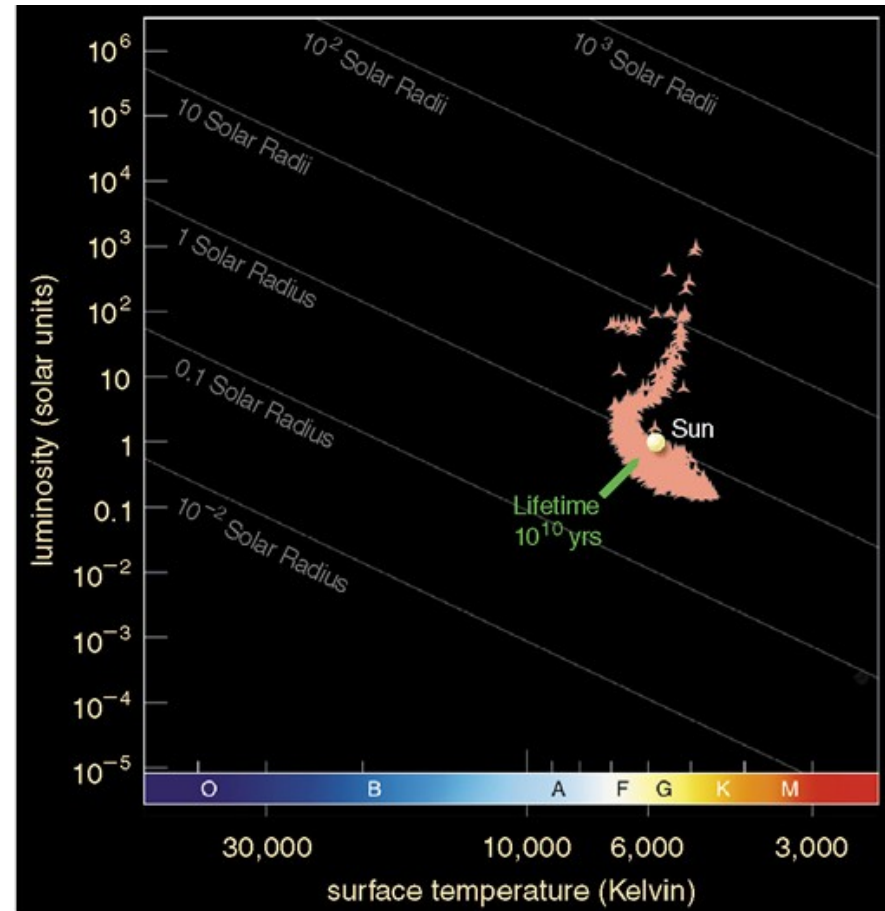
Since the variables are probably at nearly the same distance from the Earth, their periods are apparently associated with their actual emission of light,

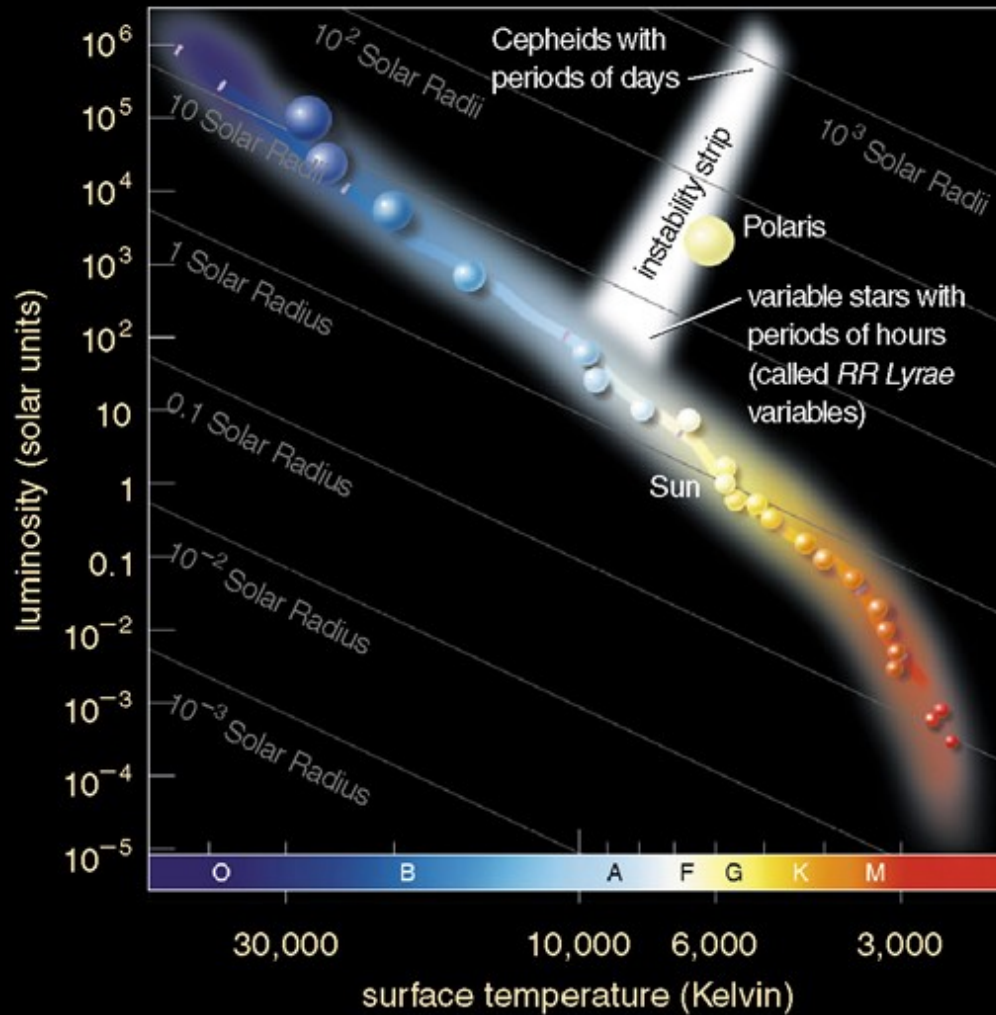


Open Cluster (Pleiades) H-R Diagram

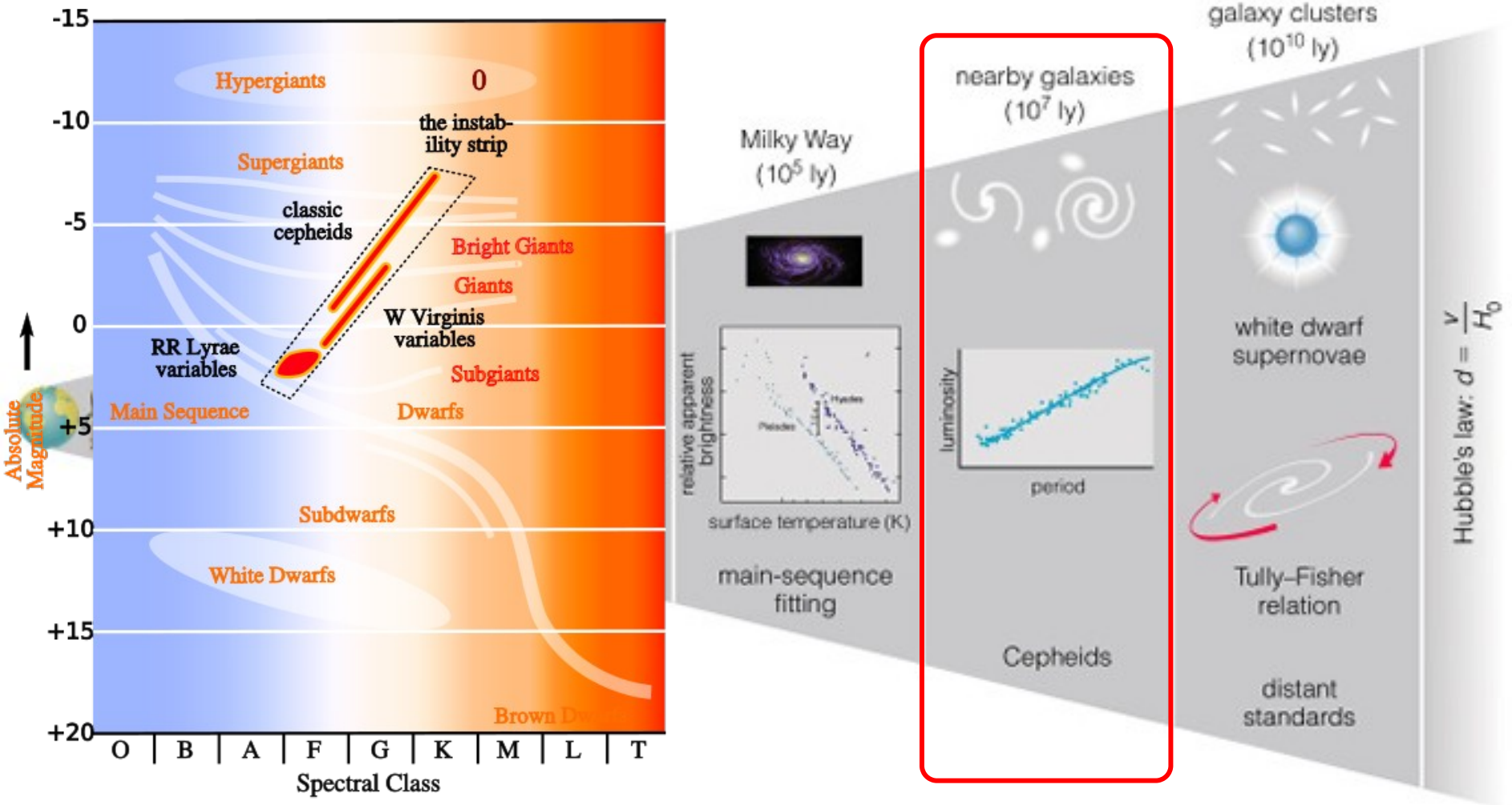


Globular Cluster (Palomar 3) H-R Diagram





THE COSMIC DISTANCE LADDER



STEPPING OUT INTO THE UNIVERSE

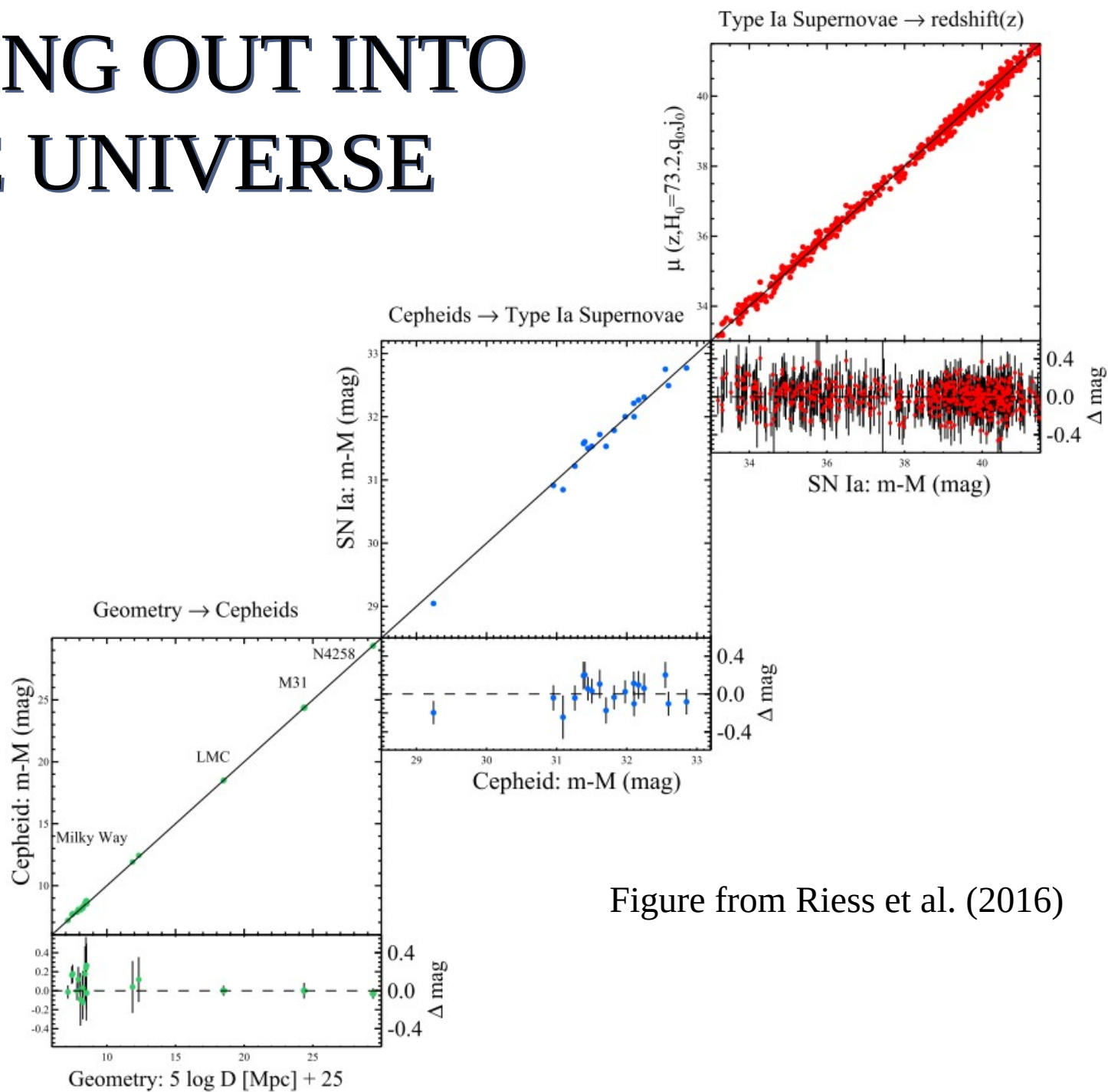


Figure from Riess et al. (2016)

