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LOW DISPERSION SPECTRA OF GALAXIES. II. HERCULES AND ABELL NO. 2197 and 2199

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Abstract

Low dispersion spectra (≃ 10,000 Å/mm) have been obtained of the brighter members of the Hercules Cluster and Abell #2197 and 2199. The survey identifies the reddest and bluest galaxies in each cluster. Color-magnitude diagrams are drawn for each cluster.

Introduction

The preceding paper (Philip and Sanduleak, 1969) describes the crossed-prism survey of clusters of galaxies. This paper surveys galaxies in the Hercules Cluster and two clusters in Abell's catalogue (1958), numbers 2197 and 2199.

Observations

The observational data was obtained from two plates taken with the Warner and Swasey Observatory Schmidt telescope. The plates are listed in Table 1.

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Table 1

Crossed Prism Plates

Warner and Swasey Observatory

Plate #	Object	R A (1962)	Dec	Emulsion	Exposure	Date	Remarks
6592	Hercules Cluster	16 03	17 54	IN	60^{min}	5 29/30 1962	
6595	Abell #2197,2199	16 27	39 48	IN	75^{min}	5 29/30 1962	Red end of spectra slightly out of focus.

The galaxies measured in the Hercules Cluster are listed in Table 2. The NGC number (or I.C. number if the number is followed by an asterisk) is listed in column 1, the right ascension and declination (1950) in columns 2 and 3, the composite color index in column 4 and remarks in column 5. All galaxies, to mag. = 15.5, from Zwicky and Herzog (1963) that fall in the area of the plate taken of the Hercules Cluster are listed in Table 2. Those galaxies without an index are followed by an explanatory remark in the remarks column.

The galaxies measured in Abell 2197, 2199 are listed in Table 3, following the same format as in Table 2. The positions and magnitudes are taken from Zwicky and Herzog (1966).

Discussion

The color-magnitude diagram for the Hercules Cluster is presented in Figure 1. The diagram resembles that of the Coma Cluster, in that the brightest galaxies have the same spectral index, and the fainter galaxies have redder and bluer indices. There is another plot to the right of the Hercules C-M diagram which shows the C-M diagram for galaxies outside the immediate area of the cluster. In appearance this plot is very different, being merely

TABLE 2

GALAXIES IN THE HERCULES CLUSTER

N.G.C. OR I.C. NUMBER	R.A. (1950)	DEC.	MAG.	INDEX	REMARKS
	15 51.8	18 47	15.1	-	DIFFUSE
	15 51.9	19 15	15.0	3.13	
	15 52.1	18 47	14.8	3.25	
	15 52.2	18 40	14.7	-	DIFFUSE
	15 52.3	16 45	14.5	3.03	
	15 52.6	19 03	15.4	3.14	
	15 53.4	18 25	14.7	-	DIFFUSE
	15 53.6	17 18	15.0	3.14	
	15 54.1	16 40	14.7	3.17	
	15 54.3	20 11	14.9	3.28	
	15 54.7	18 47	15.5	-	DIFFUSE
	15 54.8	18 19	15.2	-	DIFFUSE
	15 55.3	18 10	15.3	-	DIFFUSE
	15 55.4	16 21	15.7	3.50	
6022	15 55.5	16 25	15.2	-	TOO FAINT
6023	15 55.5	16 27	14.7	3.34	
	15 55.7	16 29	15.3	-	TOO FAINT
	15 56.0	18 14	15.6	3.20	
	15 56.0	20 06	15.2	3.39	
1151*	15 56.2	17 35	13.4	-	DIFFUSE
	15 57.5	18 56	14.6	3.50	
	15 58.0	16 17	15.6	3.32	
	15 58.2	16 46	15.7	3.25	
	15 58.4	16 51	15.4	-	TOO FAINT
1156*	15 58.4	19 52	14.9	3.47	
	15 58.5	18 13	15.5	-	DIFFUSE
	15 58.6	16 28	15.0	3.23	
	15 58.6	17 41	15.4	3.52	
	15 58.6	19 04	15.6	3.40	
	15 58.7	18 45	15.7	3.32	
	15 58.8	19 35	15.0	3.43	
	15 59.0	16 27	15.2	-	TOO FAINT
1162*	15 59.0	17 49	15.2	-	TOO FAINT
	15 59.1	16 21	[illegible]	2.95	
	15 59.1	16 [illegible]	[illegible]	3.03	
	15 59.2	16 53	15.4	-	AMORPHOUS

	15 59.2	17 23	15.5	3.28	
6028	15 59.2	19 29	14.8	3.39	
	15 59.3	16 34	15.6	3.49	
6030	15 59.6	18 06	14.5	3.36	
	15 59.7	16 35	15.7	3.17	
	15 59.8	17 13	14.9	3.32	
	15 59.8	18 57	15.2	-	TOO FAINT
	15 59.9	16 31	15.4	3.40.	
	16 00.0	16 17	15.6	3.38	
	16 00.0	16 29	14.6	3.33	
	16 00.0	16 30	15.7	3.39	
	16 00.4	16 15	15.5	3.29	
	16 00.6	19 56	15.7	3.37	
	16 00.6	16 42	15.4	3.48	
	16 01.0	16 32	15.5	3.38	
	16 01.2	19 18	15.5	-	DIFFUSE
6034	16 01.2	17 20	15.2	3.32	
	16 01.2	16 28	14.8	3.35	
	16 01.3	20 25	15.6	3.42	
	16 01.4	16 28	15.5	3.25	
	16 01.5	17 23	15.4	-	OVERLAP
	16 01.6	16 30	15.6	3.35	
	16 01.8	17 25	15.7	3.46	
6040	16 02.1	17 53	14.6	3.27	
	16 02.2	17 36	15.7	3.09	
6041	16 02.3	17 51	14.9	3.37	
	16 02.3	17 01	15.3	3.32	
	16 02.3	16 37	15.5	3.33	
6042	16 02.4	17 50	15.6	3.26	
	16 02.4	16 40	15.6	3.30.	
	16 02.4	16 40	15.6	3.00	
	16 02.5	17 35	15.7	3.27	
	16 02.5	16 43	15.1	3.45	
1172*	16 02.7	18 00	15.3	3.25	
6043	16 02.7	17 55	15.4	3.39	
6045	16 02.8	17 54	14.8	3.32	
6047	16 02.8	17 52	15.4	3.34	
1173*	16 02.9	17 33	15.6	3.11	
6050	16 03.1	17 54	14.9	-	AMORPHOUS
	16 03.1	16 20	15.3	3.38	
6055	16 03.2	18 17	15.4	3.41	
1176*	16 03.2	18 06	15.1	3.36	
1178*	16 03.2	17 44	15.0	3.26	TOO FAINT
1181*	16 03.2	17 44	15.0	3.26	TOO FAINT
	16 03.2	[illegible]	[illegible]	3.50	
	16 03.2	[illegible]	[illegible]	3.33	
1182*	16 03.3	17 56	15.2	3.34	
	16 03.3	16 40	15.6	3.14	

6057	16 03.4	18 18	15.7	3.41	
	16 03.4	18 12	15.7	3.36	
1184*	16 03.4	17 55	15.6	3.30	
1185*	16 03.5	17 51	15.1	3.31	
	16 03.5	17 29	15.4	-	TOO FAINT
	16 03.5	16 20	15.5	3.29	
	16 03.6	20 04	15.2	3.39	
	16 03.6	18 40	15.7	3.42	
	16 03.6	18 21	15.7	3.43	
	16 03.8	18 49	15.7	3.39	
	16 03.9	18 45	15.6	3.46	
	16 04.0	18 33	15.7	3.29	
6061	16 04.0	18 23	15.0	3.44	
1189*	16 04.0	18 19	15.5	3.42	
	16 04.0	16 34	15.6	3.32	
6062	16 04.1	19 55	14.4	-	OVERLAP
1194*	16 04.4	17 54	15.5	3.38	
1195*	16 04.4	17 19	15.4	3.26	
	16 04.4	16 27	14.3	3.29	
	16 06.5	16 54	15.4	3.01	
6073	16 07.9	16 50	14.5	-	ORIENTATION
	16 08.2	20 05	15.4	-	DIFFUSE
	16 08.6	18 06	15.4	-	DIFFUSE
	16 08.6	17 11	15.0	3.14	
	16 08.8	18 38	15.5	3.11.	

TABLE 3

GALAXIES IN THE ABELL 2197 AND 2199 CLUSTERS

N.G.C. OR I.C. NUMBER	R.A. (1950)	DEC.	MAG.	INDEX	REMARKS
	16 2.0	38 29	14.9	3.30.	
6119	16 17.9	37 56	15.4	-	TOO FAINT
	16 18.0	38 21	15.4	3.53	
6120	16 18.0	37 54	14.3	3.29	
	16 19.2	40 14	15.2	3.38	
6129	16 20.0	38 06	14.7	3.59	
6131	16 20.2	39 03	14.2	-	DIFFUSE
	16 20.3	40 34	15.1	3.14.	
	16 21.0	39 42	15.7	3.43	
	16 21.0	37 40	15.0	3.32	
	16 21.2	39 55	15.4	3.46	
	16 21.2	38 04	15.5	3.43	
6137	16 21.3	38 02	14.0	3.45	
	16 21.6	40 02	14.6	3.60.	
6142	16 21.6	37 22	14.8	3.50	
	16 21.8	41 46	15.3	3.43	
	16 21.8	39 15	14.9	3.44	
	16 21.9	41 50	15.0	3.30	
	16 22.1	41 12	15.4	-	TOO FAINT
	16 22.5	38 43	15.6	3.38	
	16 22.6	39 20	15.6	3.47	
6145	16 23.4	41 04	15.1	3.47	
6146	16 23.5	41 01	13.8	3.37	
	16 23.8	39 59	14.0	3.48	
	16 24.0	39 43	15.4	3.38	
	16 24.2	40 28	15.3	3.11	
	16 24.6	40 05	15.2	3.18	
	16 24.7	41 01	15.7	-	DIFFUSE
	16 25.0	40 35	15.0	-	OVERLAP
	16 25.3	41 22	15.2	-	TOO FAINT
	16 25.4	39 38	15.3	3.47	
	16 25.6	39 13	14.8	3.50.	
	16 25.8	38 53	15.5	-	OVERLAP
6150	16 25.9	41 07	14.0	3.47	
6153	16 26.0	39 30	15.7	3.50	
	16 26.0	38 31	15.4	3.43	

	16 26.2	39 22	15.4	3.40	
	16 26.5	40 25	15.5	3.43	
	16 26.5	39 56	15.5	3.37	
	16 26.6	38 55	15.1	3.41	
	16 26.7	41 17	15.3	3.43	
	16 26.8	41 20	14.3	3.11	
6166	16 26.9	39 40	13.9	3.48	
	16 27.0	41 15	15.5	3.50	
	16 27.0	41 14	15.6	3.37	
	16 27.0	40 14	14.9	3.43	
	16 27.0	39 35	15.4	3.47	
	16 27.0	39 35	15.4	3.35	
	16 27.1	39 57	15.5	3.25	
	16 27.4	41 24	14.8	3.33	
	16 27.7	40 59	15.5	3.38	
6173	16 28.1	40 55	14.0	3.41	
	16 28.1	39 53	15.6	3.44	
6175	16 28.3	40 45	15.0	3.43	
	16 28.7	40 47	15.7	3.50	
	16 28.7	41 13	15.4	-	DIFFUSE
	16 28.8	40 50	15.7	3.39	
	16 28.8	39 44	15.6	3.44	
	16 28.9	41 36	15.4	3.20	
6180	16 28.9	40 40	15.2	3.34	
	16 28.9	39 57	15.3	3.42	
	16 29.2	39 58	15.5	3.50	
	16 29.3	41 02	15.6	3.36	VERY COMPACT
	16 29.4	41 16	14.8	-	AMORPHOUS
	16 29.4	39 57	15.6	3.47	
	16 29.4	39 54	14.8	3.35	
	16 29.6	39 16	15.5	3.43	
	16 29.8	40 00	15.6	3.41	
6184	16 29.9	40 41	15.1	3.42	
	16 30.0	41 37	15.6	3.40	
	16 30.5	37 20	15.7	3.41	
	16 31.0	37 27	15.2	-	DIFFUSE
4612	16 32.1	39 22	14.6	3.38	
	16 32.4	41 27	15.7	3.29	
6195	16 34.8	39 08	14.7	3.50	
	16 35.8	37 22	15.4	-	DIFFUSE
	16 36.5	40 01	15.4	3.55	
	16 36.6	40 01	15.5	3.55	
	16 36.7	42 02	15.5	3.45	
	16 37.3	39 23	15.5	3.35	
	16 38.1	37 19	15.2	3.39	
	16 38.3	37 17	[illegible]	3.39	
	16 38.3	39 25	15.1	3.35	
	16 39.5	39 52	15.4	3.38	

	16 39.9	40 16	15.1	3.37	
	16 40.0	39 45	15.2	3.38	
	16 40.1	40 05	14.8	3.37	
	16 40.4	40 22	15.5	-	DIFFUSE
62\2	16 41.7	39 54	15.0	3.31	
	16 42.5	39 53	15.1	3.34	

a scatter diagram, and is probably the result of the majority of these galaxies being field galaxies. In Figure 2 is shown a plot of the positions of the cluster galaxies. Solid triangles indicate the 8 reddest galaxies, hollow circles indicate the 6 bluest galaxies; and solid circles indicate the position of the remaining galaxies. As was noted in the Coma Cluster, the blue galaxies seem to be somewhat more centrally condensed in the cluster than do the reddest galaxies which are spread over a larger area of the celestial sphere.

The galaxies measured in Abell 2197 and 2199 are plotted in a color-magnitude diagram in Figure 3. In Zwicky and Herzog (1966) these two clusters are marked as cluster #12 on page 188. Figure 3 is divided into three sections. The first, on the left, plots all the measured galaxies that fell within the boundary marked in Zwicky and Herzog (1966) for cluster 12. The next two sections plot the color-magnitude diagram for the clusters Abell 2197 and 2199. The contours of these clusters were transferred from a chart in Clark (1968) showing isopleths for each cluster. The isopleths representing 990 galaxies per square degree close on themselves and ~~this isopleth was~~ these isopleths were transferred to the chart in Zwicky and Herzog to decide which galaxies would be chosen as belonging to each cluster. Only the brightest 1 1/2 magnitudes of the cluster members are being sampled in the color-magnitude diagrams. The diagrams for 2197 and 2199 are quite similar, in spite of the low statistical sample of galaxies in each diagram. The diagrams resemble that for the Coma Cluster more than that for the Virgo Cluster, therefore Abell 2197 and 2199 can be classified as regular clusters. A plot of the positions of the bluest and reddest galaxies in each cluster does not reveal any information due to the small number of galaxies in each sample. The galaxy

at $\alpha = 16^h\ 26^m.8$, $\delta = 41°\ 20'$ is the bluest galaxy in either cluster. The image is diffuse, but it can definitely be classified as a blue object.

It should be noted that the indices from plate #6595 are much redder than those from the other plates. This occurs because the red ends of the spectra on this plate were slightly out of focus, thus making the red end to appear more heavily exposed. The ordering of the galaxies by color is not disturbed by this effect.

It is hoped that further plates can be obtained of clusters within 100 mpc of the sun, such as the Perseus and Ursa Major Clusters. I wish to acknowledge the support of the Office of Naval Research.

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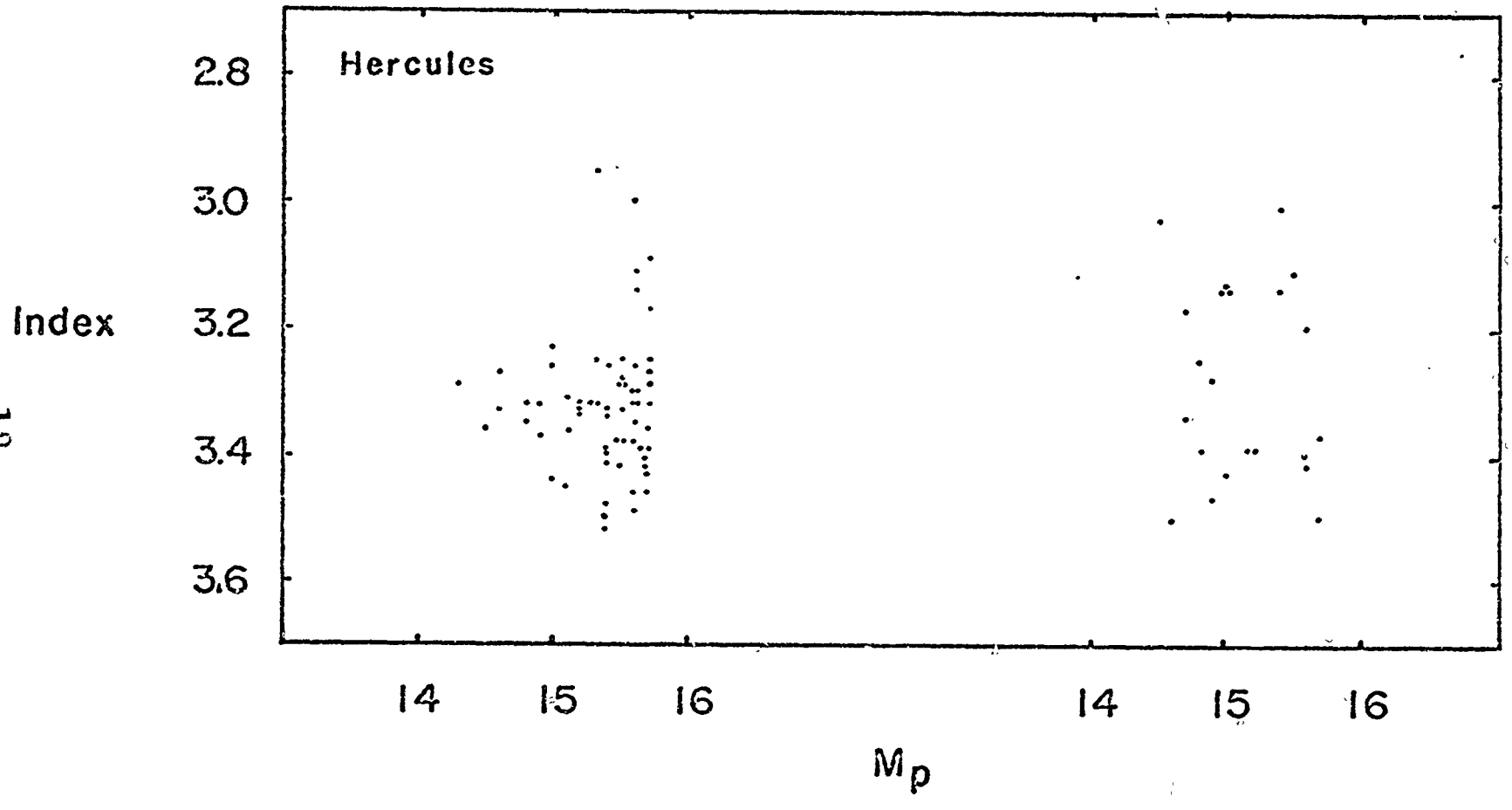
_____ (1966) Catalogue of Galaxies and Clusters of Galaxies (California Institute of Technology), Vol. III.

Titles for Figures

Fig. 1 Color-magnitude diagram for galaxies in the Hercules Cluster. The plot to the left is for galaxies in the cluster, the plot to the right shows galaxies surrounding the cluster.

Fig. 2 Positions of the reddest and bluest galaxies in the Hercules Cluster. The solid triangles mark the eight reddest galaxies, the hollow circles mark the six bluest galaxies, and the solid circles mark the remainder.

Fig. 3 Color-magnitude diagram for galaxies in Zwicky and Herzog's (1966) cluster #12, Abell 2197 and Abell 2199.


Hercules
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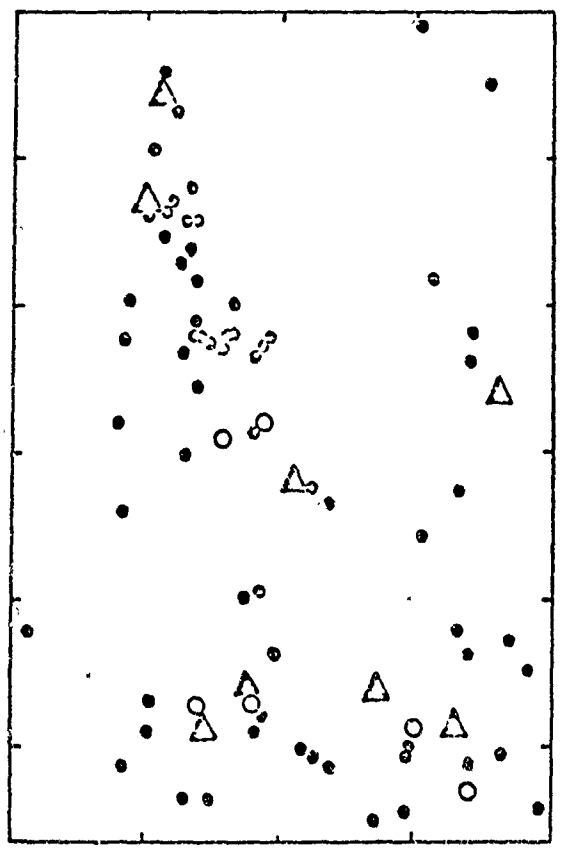

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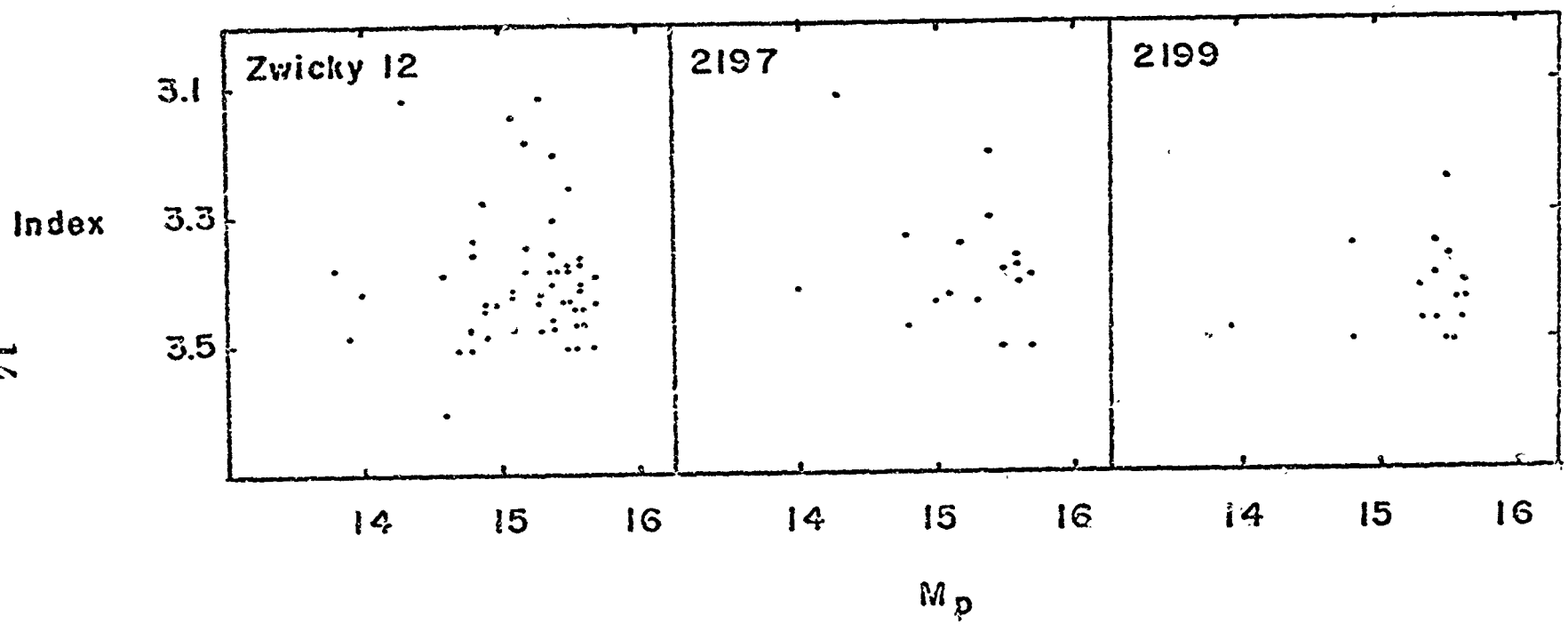
Zwicky 12
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