

PUBLICATIONS OF THE ASTRONOMICAL OBSERVATORY
UNIVERSITY OF MINNESOTA
VOLUME III NUMBER 11

AD 741024

PROPER MOTIONS OF FAINT STARS
IN THE REGION OF THE
HYADES

ON THE PROPER MOTION OF HZ22

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Report on Contract Nonr 1802 (00)

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PROPER MOTIONS OF FAINT STARS IN THE REGION OF THE HYADES

The question of the possible occurrence of stars of very low luminosity in galactic clusters has long been important—and has remained unanswered. Obviously a statistical answer is the best that can be obtained for the average galactic cluster, while determination of membership in a cluster for individual stars is possible only for the nearer clusters with reasonable proper motions. The most promising of these is the Hyades, with a proper motion of the order of $0''.1$ annually, but even here few definite members are known fainter than apparent magnitude 14 and none fainter than $m=16$. A pilot survey with a blink microscope of pairs of plates taken with the Palomar 48-inch Schmidt telescope, having intervals of 8 years, showed that motions down to $0''.05$ could be detected and that those larger than $0''.1$ annually were fairly easy to see. Since the Palomar plates go to a limiting magnitude of 21.2 pg 20.8 red it should thus be possible to detect stars belonging to the Hyades cluster down to absolute magnitude +18 or fainter than the luminosity function is known even in the immediate vicinity of the sun.

Of the nine Palomar National Geographic Survey plates covering the region of the Hyades two were taken in 1949 and 1950 and fortunately these are at centers $3^{\text{h}}54^{\text{m}}+24^{\circ}$ and $4^{\text{h}}00^{\text{m}}+18^{\circ}$ (1855), furthest away from the vertex of the cluster motion; thus the motion of cluster members is largest in these areas. Through the kindness of Dr. Fritz Zwicky repeat plates (in the red) were taken in January 1961. Both pairs of plates were blinked by the present writer and more than 400 moving objects were found. Immediately after the blinking of each pair of red plates was completed, the old red plate was exchanged for the blue plate and approximate colors of all moving objects were determined. This resulted in the identification of some 20 new white dwarfs¹ including the smallest star now known — LP 357-186 — which appears to have a diameter smaller than that of the moon and perhaps only half of it.

The motions of all objects found were measured by Miss Helen Hughes and Mr. Graham Hill and many of them were measured by both. Data for the 366 stars whose motions were judged to be real are given in Table I. A comparison of the present values with those found in other surveys indicates that the mean error in our motions is of the order of $0''.025$ in each coordinate.

Using van Bueren's² values for the convergent, the space velocity and the dispersion in distance for the Hyades, limiting values were calculated for the proper motions to be expected for cluster members in the four corners of each plate. Owing to the considerable accidental errors existing in our motions plus indication of the fact that our motions may be systematically too small plus the fact that the general reflex of the solar motion does not differ too much in direction from the Hyades motion, it is not possible to arrive now at definite conclusions concerning which stars are cluster members. The best we can do is to indicate a number of stars for which this appears probable or possible. Forty five stars have been so identified — these are designated by the letter H in the last column. It should be emphasized, however, that perhaps no more than one third of those so designated will eventually prove to be real Hyades, while it may well be that another ten have either been missed in blinking or have measured motions which differ too much from that of the Hyades to be now recognized as such. At any rate we can say that among the several hundred thousand stars in the area covered by the two plates the 45 stars marked here constitute the majority of the most likely suspects of Hyades members. Repetition of the same plates in another ten or fifteen years should provide motions with an accuracy of perhaps $\pm 0''.010$ in each coordinate and should thus narrow down the list of suspects considerably.

LP	RA 1950 Dec	m	Sp	μ	θ
357-1	^{3h} 46 ^m .2 +26° 58'	17.2	m	0.36	125°
357-12	46.4 +27 03	19.7	g	0.07	171
357-3	46.4 +25 30	14.7	m	0.05	113
357-2	46.5 +25 33	15.2	m	0.16	257
357-5	46.5 +23 30	18.9	m	0.05	192
357-6	46.6 +23 16	19.5	m	0.12	84
357-9	46.6 +22 18	18.2	m	0.10	153
357-4	46.7 +24 10	14.2	m	0.22	117
357-8	46.7 +22 33	18.6	m	0.07	114
357-10	46.8 +21 46	16.4	m	0.07	111
357-11*	46.9 +27 17	13.3	k	0.29	125
357-13	47.0 +20 04	14.3	k	0.27	106
357-15	47.6 +23 54	15.8	k	0.15	171
357-16	47.8 +22 18	14.4	g	0.07	142
357-17	48.0 +21 49	16.6	a	0.15	159
357-21	48.2 +26 53	21.:	m	0.08	138
357-18	48.2 +26 18	16.2	m	0.42	129
357-19	48.3 +23 58	19.7	a	0.08	50
357-22	48.6 +25 27	18.3	m	0.11	139
357-20	48.8 +27 04	21.:	m	0.15	114 H
357-25	48.8 +23 08	15.8	m	0.12	147
357-23	48.9 +23 48	16.5	m	0.45	190
357-24	48.9 +23 25	18.0	m	0.06	168
357-26	49.2 +23 16	20.5	m	0.14	214
357-27*	49.2 +24 48	15.8	b	0.08	129
357-29	49.4 +26 57	19.0	k	0.05	180
357-28	49.4 +23 47	16.5	k	0.05	133
357-32	49.6 +25 04	20.2	m	0.14	129
357-33	49.9 +24 05	17.7	m	0.12	198
357-30	50.0 +26 42	16.3	k-m	0.32	149
357-35	50.1 +22 10	16.6	k-m	0.35	93
357-34	50.2 +23 57	15.9	k	0.16	151
357-36	50.2 +22 08	20.8	m	0.10	30
357-38	50.3 +25 35	15.5	k-m	0.27	172
357-42	50.5 +22 58	21.:	m	0.06	174
357-39	50.6 +24 19	15.5	k-m	0.08	82
357-43	50.6 +22 50	20.8	m	0.17	195
357-45	50.9 +27 14	18.8	m	0.14	105 H
357-47	50.8 +26 07	17.4	m	0.06	121
357-40	50.8 +23 36	18.4	m	0.06	126
357-41	50.8 +23 23	16.7	k-m	0.21	136
357-44	50.8 +21 40	14.8	g	0.05	47
357-49	51.0 +24 57	18.2	m	0.11	146
357-48	51.2 +25 11	17.5	m	0.07	114
357-51	51.2 +23 01	20.4	m	0.07	126
357-52	51.3 +21 51	20.8	m	0.10	171

LP	RA 1950 Dec	m	Sp	μ	θ
357-51	3 ^h 51.6 ^m +22° 02'	20.8	m	0.08	129°
357-205	51.6 +21 22	19.2	m	0.07	117
357-204*	51.6 +21 22	20.9	m	0.07	117
357-54	51.7 +25 34	20.8	m	0.15	189
357-57	51.7 +24 00	21.:	k	0.10	152
357-55	51.8 +24 43	17.2	m	0.20	139
357-56	51.8 +24 08	17.7	m	0.39	235
357-58	52.0 +23 19	18.0	m	0.13	137
357-59	52.4 +26 45	16.8	m	0.22	134
357-61	52.4 +22 40	15.0	g	0.09	122 H
357-62	52.6 +21 45	18.3	m	0.20	94
357-206	52.7 +21 10	19.4	m	0.17	93
357-64	52.8 +26 46	15.1	k	0.09	103 H
357-67	52.8 +23 58	16.8	k-m	0.35	93
414-3	52.8 +19 05	17.8	m	0.21	131
357-63	52.9 +25 54	19.6	m	0.12	143
357-66	52.9 +24 14	15.2	k	0.06	116
414-4	52.9 +17 01	14.6	m	0.24	142
357-68	53.0 +22 08	21.:	m	0.10	147
357-69	53.0 +21 44	20.8	m	0.11	105 H
414-176	53.1 +15 22	18.8	m	0.08	31
357-72	53.4 +22 22	17.6	k	0.05	119
414-7	53.5 +16 54	20.6	m	0.08	110
357-70	53.6 +23 56	14.9	k	0.07	95
414-5	53.6 +19 13	15.3	m	0.27	97
357-71	53.7 +23 28	18.3	a	0.04	104
357-74	53.8 +26 56	20.5	g-k	0.13	325
357-73*	53.8 +22 20	6.0	g	0.10	155
414-9	53.8 +19 36	15.8	k	0.09	90
357-76*	53.9 +24 31	13.7	k	0.34	122
357-78	54.0 +22 50	19.8	k	0.03	45
414-10	54.1 +18 31	18.4	k-m	0.13	120 H
357-77	54.2 +23 38	20.6	g-k	0.03	9
414-8	54.2 +19 52	20.7	m	0.21	163
414-11	54.2 +18 00	16.3	k	0.16	212
357-75	54.3 +26 24	19.0	m	0.11	160
357-208	54.3 +21 30	18.7	m	0.07	127
414-13	54.3 +16 02	16.0	m	0.18	110
414-14	54.5 +20 44	18.3	m	0.17	106 H
414-15	54.6 +19 22	20.8	g-k:	0.14	95
357-79	54.7 +22 24	15.2	g	0.07	149
414-16	54.9 +19 18	20.6	m	0.08	121
357-82	55.1 +23 40	20.5	m	0.10	112 H
357-80	55.3 +26 56	12.6	g	0.11	134
357-81	55.3 +26 38	18.1	m	0.11	137
357-84	55.3 +23 16	17.8	m	0.15	90

LP	RA 1950 Dec	m	Sp	μ	θ
357-86	^h 55.4 +27° 07'	15.2	k	0.18	104°
357-87	55.4 +25 40	18.8	m	0.14	159
357-85	55.4 +21 49	16.7	f	0.30	135
414-17	55.4 +18 07	15.9	m	0.09	171
414-18*	55.5 +18 01	16.4	k	0.50	177
357-88	55.6 +25 22	18.7	m	0.09	114
357-209	55.7 +21 24	21. +	m	0.08	148
414-19	55.7 +19 25	18.7	al	0.10	135
357-90	55.8 +24 14	15.0	k-m	0.26	227
414-20	55.8 +17 26	21. +	m	0.06	51
357-89*	56.0 +25 10	13.5	k	0.26	118
357-91	56.0 +23 14	17.3	g	0.08	167
414-178	56.0 +15 15	14.3	g-k	0.10	94
357-94	56.2 +26 44	14.3	k	0.18	123
357-96	56.2 +25 00	18.5	m	0.05	143
357-97	56.2 +25 00	19.0	m	0.06	84
357-92	56.2 +22 52	20.2	m	0.04	129
357-93	56.2 +21 46	16.7	m	0.16	218
414-21	56.3 +15 36	16.0	m	0.27	194
357-98	56.4 +23 15	17.2	m	0.14	88
414-22	56.4 +20 54	15.6	m	0.26	117
414-23	56.4 +19 28	21. :	m	0.12	153
414-24	56.4 +17 28	21. :	m	0.08	115
414-25	56.4 +16 32	16.2	m	0.15	107
414-26	56.5 +15 55	21. +	m	0.37	178
357-100	56.6 +25 57	18.9	m	0.21	116
357-102	56.7 +26 00	17.6	k-m	0.05	135
414-28	56.7 +18 30	20.5	m	0.05	34
357-101	56.8 +26 05	21. :	m	0.14	123
357-103*	56.8 +25 58	14.0	k-m	0.78	107
357-104	56.8 +25 01	18.4	g-k	0.08	126
357-99	56.8 +21 44	16.8	m	0.28	132
357-105	57.0 +23 32	17.7	m	0.11	124
414-27*	57.0 +19 34	13.7	k	0.24	164
414-29	57.2 +20 16	19.5	m	0.16	152
414-31	57.3 +10 02	21. +	m	0.05	112
414-30	57.4 +19 16	17.0	m	0.11	108
414-32	57.4 +17 35	19.0	m	0.05	120
357-107	57.6 +25 53	20.7	m*	0.21	133
357-108	57.6 +24 32	12.7	g:	0.13	133
357-109	57.6 +22 58	18.6	m	0.07	90
414-197*	57.9 +16 39	15.3	k	0.23	178
414-33	58.0 +16 42	17.2	g	0.18	194
414-179	58.0 +15 07	18.0	m	0.12	135
357-110	58.1 +21 33	15.4	b	0.23	187
414-34	58.2 +16 20	17.7	g	0.15	156

LP	RA 1950 Dec	m	Sp	μ	θ
357-113	3 ^h 58.5 ^m +24° 40'	20.3	m	0.08	126°
357-111	58.5 +27 21	16.4	m	0.11	121
414-36	58.6 +18 13	15.2	m	0.24	111
414-37	58.6 +17 50	21.:	m	0.60	90
414-35*	58.7 +18 36	16.8	m	1.15	165
357-112	58.8 +26 42	16.4	f-g	0.07	142
414-40	59.0 +17 11	21.+	m	0.13	87
357-116	59.2 +27 12	16.6	k-m	0.22	172
357-117	59.2 +26 04	21.+	m:	0.06	121
357-118	59.2 +25 38	14.9	k	0.22	189
357-120	59.2 +24 11	18.7	f	0.09	94
414-38	59.2 +19 18	19.8	k	0.06	130
357-121	59.3 +25 50	19.3	m	0.15	198
357-119	59.3 +24 34	14.3	m	0.17	145
414-41	59.8 +20 17	16.0	m	0.16	114 H
414-43*	4 00.0 +20 06	13.6	g	0.18	155
414-44	00.0 +18 18	18.1	m	0.11	123 H
414-42	00.0 +16 23	16.6	m	0.17	104 H
357-124	00.1 +25 32	15.8	k	0.17	115 H
357-125	00.1 +25 32	16.4	g	0.10	153
414-46	00.2 +16 20	19.9	m	0.10	160
414-47	00.2 +15 48	21.+	m	0.05	99
414-180	00.2 +15 24	16.7	m	0.33	142
357-129	00.3 +22 40	16.9	k	0.10	107 H
357-126	00.4 +25 44	18.5	m	0.08	90
357-131	00.4 +21 44	20.8	m	0.03	186
414-198*	00.4 +17 47	15.6	k	0.23	105
414-45	00.4 +17 16	16.2	k	0.17	124 H
357-130	00.6 +22 17	19.5	g	0.06	96
357-127	00.8 +25 39	15.3	m	0.48	179
414-49	00.8 +16 55	17.8	m	0.16	102 H
357-132	00.9 +21 42	17.8	m	0.11	135
414-48	01.0 +18 30	15.0	m	0.20	116
357-133	01.2 +25 27	13.5	k	0.27	116
357-135*	01.2 +23 17	10.:	g-k	0.18	152
357-136	01.2 +22 07	18.5	k-m	0.05	119
414-51	01.3 +18 52	17.6	m	0.07	112
414-50	01.5 +20 16	16.4	m	0.05	113
357-140	01.6 +25 59	16.2	k-m	0.27	157
357-134*	01.6 +25 01	14.6	b	0.25	149
357-146	01.6 +23 10	20.7	m	0.10	101 H
414-181	01.7 +15 13	17.8	m	0.05	51
357-142	01.8 +23 54	18.6	m	0.06	49
357-143	01.8 +23 32	21.:	m	0.66	130
357-144	01.9 +23 23	21.:	k-m	0.04	117
357-139	02.0 +26 15	20.3	m	0.15	91

LP	RA 1950 Dec	m	Sp	μ	θ	
357-147	4 ^h 02.0 ^m +21° 27'	21.:	m	0.20	140"	
414-52	02.1 +19 58	21.+	m	0.18	107	
414-55	02.1 +16 18	18.9	m	0.10	135	
357-141	02.2 +25 14	17.6	m	0.27	97	
357-148	02.4 +25 22	20.7	m ⁺	0.10	101	H
357-150	02.4 +22 22	22.:	m ⁺	0.51	133	
414-53	02.4 +17 26	18.6	m	0.10	135	
414-54	02.4 +17 13	18.2	k-m	0.18	132	
414-57	02.7 +20 48	20.2	k	0.09	69	
414-59	02.7 +17 31	16.1	m	0.42	123	
357-151	02.8 +27 04	16.9	m	0.14	122	
357-153	02.8 +25 33	17.9	m	0.27	153	
414-60	02.8 +17 03	19.1	m	0.11	158	
357-155	02.9 +22 54	18.4	m	0.12	90	
357-152	03.0 +26 14	17.0	m	0.46	168	
414-58	03.0 +18 20	18.8	m	0.26	165	
414-61	03.2 +19 45	21.:	m	0.10	106	H
414-62	03.2 +18 48	16.6	g	0.05	120	
357-220	03.4 +26 39	21.:	m	0.11	146	
357-160	03.4 +23 18	15.9	m	0.12	104	H
357-158	03.5 +23 51	16.7	k	0.14	158	
357-159*	03.5 +23 51	20.5	m	0.14	158	
357-210	03.5 +21 10	17.6	g-k	0.05	76	
357-157	03.6 +27 08	16.8	k	0.15	140	
414-64	03.6 +18 04	16.2	k-m	0.20	126	
414-66	03.8 +16 20	19.0	m	0.12	207	
414-63	03.9 +20 14	18.8	g	0.16	110	H
357-161	04.0 +27 22	16.8	m	0.12	213	
357-163	04.0 +22 27	20.2	m	0.07	159	
414-65*	04.0 +17 40	12.8	k	0.17	101	
414-67	04.0 +16 08	17.3	m	0.21	160	
357-164	04.1 +21 48	21.:	m ⁺	0.09	157	
357-162	04.2 +22 47	16.6	k-m	0.16	129	
414-68*	04.2 +15 51	13.8	m	0.33	197	
414-69	04.3 +20 12	16.5	k	0.23	103	
414-70	04.5 +19 04	16.0	m	0.08	149	
414-71	04.5 +18 04	21.+	m	0.08	73	
357-166	04.6 +25 16	20.0	m	0.10	130	
357-165	04.7 +26 14	17.4	m	0.09	114	H
357-167	04.8 +24 28	16.8	k	0.17	67	
414-78	04.9 +16 04	20.2	m	0.12	124	H
357-170	05.0 +21 30	20.4	m	0.10	125	
414-73	05.0 +21 17	16.6	m	0.17	120	
414-74n	05.0 +19 36	20.3	g	0.10	180	
414-74s	05.0 +19 38	21.+	m	0.09	102	
414-75	05.0 +18 52	18.3	k	0.09	98	

LP	RA 1950 Dec	m	Sp	μ	α	
414-76	^h 05.0 +16° 40'	19.2	m	0.14	152°	
414-77	05.0 +16 14	20.9	k	0.11	118	H
357-211	05.1 +21 10	20.4	m	0.07	99	
357-169	05.2 +21 50	21.0	m	0.10	94	
414-183	05.3 +15 22	20.5	k	0.15	133	
414-81	05.4 +20 00	16.0	m	0.07	175	
414-86	05.4 +16 30	17.2	m	0.11	155	
414-82	05.5 +19 32	18.9	m	0.11	133	
414-79	05.6 +21 14	14.2	g-k	0.08	123	
414-80	05.6 +21 12	17.0	m	0.12	126	
414-85	05.6 +16 50	21.4	m	0.15	32	
414-83	05.7 +18 54	18.9	m	0.08	128	
414-84	05.8 +18 40	14.7	k-m	0.06	127	
357-171	06.0 +26 02	19.2	k-m	0.13	140	
414-87	06.0 +20 20	17.6	k-m	0.12	195	
414-96	06.0 +15 50	16.6	m	0.13	149	
414-91	06.1 +17 12	20.8	m	0.10	110	H
414-92	06.1 +16 50	17.2	k	0.09	36	
414-93	06.1 +16 49	16.2	m	0.11	158	
414-88	06.2 +20 06	18.0	g-k	0.08	149	
357-173	06.4 +23 04	18.6	g	0.18	149	
357-175	06.4 +22 15	18.5	f	0.05	28	
414-90	06.4 +18 27	17.9	m	0.30	112	
414-89*	06.4 +18 27	18.0	m ⁺	0.30	112	
414-94	06.4 +16 27	15.6	m	0.20	145	
414-97	06.4 +15 42	15.4	k-m	0.12	126	H
357-172	06.6 +26 16	14.8	g	0.08	171	
414-101	06.6 +17 00	15.5	a	0.13	81	
357-174	06.7 +22 24	13.3	g	0.16	100	
414-102	06.7 +16 45	20.5	m	0.15	71	
414-98	06.8 +21 00	20.6	m	0.06	201	
414-99	06.8 +18 52	18.4	m	0.24	106	
414-100	06.9 +17 14	20.2	g	0.10	15	
357-176	07.0 +25 58	13.8	g	0.18	128	
414-184	07.1 +15 07	20.7	m	0.07	153	
357-212	07.3 +21 08	16.7	g	0.06	145	
414-106	07.3 +19 47	15.7	a	0.55	121	
414-107*	07.3 +17 55	14.5	a	0.10	160	
414-105	07.4 +20 01	18.8	m	0.40	121	
414-185	07.6 +15 18	16.2	m	0.10	101	H
357-178	07.8 +26 20	17.3	k	0.20	172	
357-179	07.8 +23 41	16.0	g	0.08	167	
414-109	08.2 +18 29	21.1	m	0.08	99	
414-111	08.4 +17 51	18.8	m	0.06	168	
414-112	08.4 +17 28	15.7	m	0.12	144	
357-180	08.5 +25 14	18.0	m	0.09	127	

LP	RA 1950 Dec		m	Sp	μ	θ	
414-113*	4 ^h 08.5	+17° 28'	21.0	m ⁺	0.12	144°	
414-110*	08.6	+19 32	15.8	k-m	0.48	126	
414-114	08.6	+15 52	15.9	m	0.11	100	H
414-186	08.6	+15 10	17.8	m	0.32	154	
357-183	08.8	+24 20	16.8	k	0.25	140	
357-184	08.9	+21 30	21.1	m	0.43	152	
357-182	09.0	+24 43	17.3	m	0.11	308	
414-115	09.2	+17 55	18.9	m	0.17	113	
414-187	09.2	+15 06	18.7	m	0.15	137	
357-188	09.4	+23 47	18.3	a	0.42	144	
414-117	09.5	+16 07	14.8	m	0.14	103	H
414-118	09.5	+16 04	19.0	m	0.09	129	
414-116	09.7	+17 15	19.2	g	0.07	123	
357-197	09.8	+22 34	16.7	k	0.09	83	
357-189	10.1	+24 34	19.4	m	0.09	141	
357-190	10.2	+23 58	21.1	m ⁺	0.11	156	
357-131	10.3	+23 44	18.6	m	0.08	122	
414-120	10.3	+18 53	16.5	b	0.07	107	
357-188	10.4	+26 06	18.8	m	0.23	124	
357-193	10.5	+23 10	20.9	m	0.11	188	
414-124	10.6	+13 35	18.7	m	0.09	167	
414-125	10.7	+16 14	18.5	m	0.12	205	
414-122	10.8	+19 54	19.7	f	0.09	59	
414-123	10.8	+19 54	20.1	m	0.11	73	
414-121	10.9	+20 48	17.9	m	0.11	175	
357-214	11.2	+22 22	15.9	k	0.11	127	
357-213*	11.2	+22 10	16.9	k	0.24	142	
414-129*	11.2	+17 00	15.6	k-m	0.19	118	
357-195	11.4	+26 20	17.9	k	0.06	45	
357-219	11.4	+21 20	16.0	g	0.13	97	
357-194	11.6	+27 08	19.3	f	0.05	52	
357-215*	11.6	+22 14	10.8	g	0.49	123	
414-127	11.6	+20 32	19.0	m	0.23	135	
414-188	11.6	+15 58	21.1	m	0.19	117	
357-196	11.7	+25 41	20.6	m	0.16	119	H
357-201	11.8	+24 16	19.2	m	0.12	107	H
414-134	11.8	+16 23	18.5	b	0.05	202	
414-135	11.8	+16 10	16.6	k-m	0.08	135	
414-189	11.8	+15 18	17.6	k	0.18	167	
357-217	11.8	+21 52	18.2	k	0.53	315	
357-199	12.0	+26 15	19.5	f	0.06	180	
414-131*	12.0	+19 40	14.8	m	0.33	162	
414-132	12.0	+19 28	19.5	m	0.39	98	
414-133	12.0	+17 04	17.7	m	0.13	59	
414-136	12.0	+15 54	15.8	m	0.19	186	
357-197	12.2	+26 52	19.2	m	0.09	130	

LB	RA 1950 Dec		m	Sp	μ	θ	
414-190	4 ^h 12.2 ^m	+15° 14'	21. :	m	0.10	192°	
357-198	12.3	+26 42	21. :	m	0.06	180	
414-142	12.3	+16 44	20.8	m	0.10	102	H
357-203	12.4	+23 44	20.8	m	0.05	154	
414-137	12.5	+21 04	21. :	m+	0.08	100	
414-141	12.5	+17 23	16.7	m	0.10	157	
414-138	12.6	+20 42	16.0	m	0.12	90	
414-139	12.6	+19 29	16.5	m	0.18	88	
414-140	12.7	+18 45	18.8	m	0.10	101	H
414-144	13.1	+17 46	16.0	m	0.10	191	
414-143	13.5	+18 01	20.8	m	0.11	112	H
357-216	13.6	+23 27	17.3	m	0.46	126	
414-145	13.7	+19 28	20.6	m	0.23	111	
414-149	13.7	+16 22	20.8	m	0.16	90	
414-148	13.9	+16 39	17.8	k	0.13	116	H
414-146	14.0	+18 57	19.8	m	0.10	106	H
414-147	14.0	+17 39	19.0	a	0.10	104	H
414-181	14.0	+15 01	18.6	m	0.33	200	
414-150	14.2	+20 44	16.6	m	0.15	172	
414-154	15.1	+18 54	17.9	m	0.15	119	H
414-159	15.3	+15 59	17.3	m	0.12	71	
414-156	15.4	+20 42	21.0	m	0.08	142	
414-153	15.4	+20 34	17.0	m	0.11	101	H
414-157	15.4	+19 13	21.0	m	0.20	115	
414-158	15.6	+18 15	17.5	m	0.12	110	H
414-192	15.8	+15 58	13.6	m	0.06	200	
414-163*	16.0	+16 40	16.5	m	0.32	163	
414-161	16.1	+19 26	16.4	m	0.16	105	H
414-160	16.4	+20 41	15.9	k	0.07	191	
414-193	16.5	+16 10	17.3	m	0.12	171	
414-165	16.6	+17 50	21. :	m	0.68	162	
414-166	16.7	+16 44	19.8	k-1	0.30	138	
414-164	16.8	+20 32	17.6	m	0.14	145	
414-170	17.2	+19 47	17.5	a	0.17	129	
414-169*	17.2	+19 46	17.7	m	0.17	129	
414-194	17.2	+15 42	18.7	m	0.08	110	
414-168	17.3	+20 46	20.8	m	0.28	149	
414-171	17.3	+17 18	15.6	k	0.08	210	
414-167	17.5	+21 15	16.3	k-m	0.11	112	H
414-195	17.6	+16 10	17.1	m	0.18	170	
414-175	17.8	+16 40	15.2	k	0.09	126	
414-172	18.0	+18 48	19.1	m	0.08	135	
414-173	18.0	+18 40	17.2	m	0.19	190	
414-155	18.1	+16 37	17.1	f	0.06	90	

357-11	3 ^h 46 ^m .9	LTT 11272, 0°28 150°
357-27	49.2	LB 1497
357-204	51.6	Comp to 357-205, 241° 11'4
357-73	53.8	32 Tauri, 0°128 147° GC
357-76	53.9	LTT 11299, 0°26 119°
414-18	55.5	G 7-12, 0°55 175°
357-89	56.0	LTT 11310, 0°25 137°
357-103	56.8	W 1322, 0°80 100°
414-27	57.0	G 8-3, 0°28 155°
414-197	57.9	G 8-4, 0°28 180°
414-35	58.7	G 7-17, 1°24 167°
414-43	4 00.0	G 8-6, 0°29 183°
414-198	00.4	G 7-18, 0°28 111°
357-135	01.2	+22° 636
357-134	01.6	LB 1240, G 8-8, 0°28 146°
357-159	03.5	Comp to 357-153, 213° 5'6
414-65	04.0	L 1238-5, 0°19 102°
414-68	04.2	LTT 11348, 0°29 199°
414-89	06.4	Comp to 414-90, 218° 2'8
414-107	07.3	Z 10
414-113	08.5	Comp to 414-112, 107° 54"
414-110	08.6	G 7-25, 0°50 117°
357-213	11.2	G 8-15, 0°32 143°
414-129	11.2	G 7-28, 0°27 113°
357-215	11.6	+21 607, 0°54 122° GC
414-131	12.0	G 7-29, 0°35 176°
414-163	16.0	G 7-36, 0°38 172°
414-169	17.2	Comp to 414-170, 138° 30'6

As expected, the majority of suspected members of the Hyades are red dwarfs, some as faint as $m = +21$ which, if they are Hyads means $M = +18.2$. Three objects may perhaps be singled out — viz. LP 414-147, LP 357-61, and LP 414-63 of estimated colors a, g, and g. If these should ultimately prove to be members of the cluster the first one will be an extremely faint white dwarf — of the same color as, but 4-5 magnitudes fainter than α_2 Eridani B — while the other two would seem to be yellow degenerate stars similar perhaps to VMa 2 or L 379-14.

In conclusion it is a pleasure to record here my indebtedness to the Office of Naval Research for a contract which made this research possible.

1. HAC 1565, 1962.
2. Van Bueren, BAN 11:385, 1952.

Minneapolis, Minnesota
15 May 1962

ON THE PROPER MOTION OF HZ 22, $12^h 12^m 3^s +36^\circ 56'$ (1950)

This star was among the first group of faint blue stars near the North Galactic Pole found by Humason and Zwicky¹ who assigned to it a spectral class B3. Using a single old Harvard and a new Mount Wilson 60-inch plate Miller and I² measured a proper motion of $+0.030 -0.021$ relative to comparison stars of $m=12.8$ pg while Pels and Blaauw³ determined $+0.011 -0.016$ (absolute). Greenstein⁴ found the radial velocity variable and classified the star as a normal B2 of population I. It was found to be variable on Harvard plates by Mathews and the orbit as an eclipsing binary was determined by Gaposchkin,⁵ who, correlating the spectroscopic and photometric data derived a distance modulus of 16^m corresponding to 16000 parsecs.

If the star is at this distance it could hardly be expected to have an observable proper motion while both Miller and I as well as Pels and Blaauw found a measurable value. For this reason it was thought worth while to investigate the proper motion anew. The plate stacks at Harvard were searched and six good quality old plates were found (two taken with the 8-inch Draper, three Bruce plates and one taken with the 16-inch Metcalf); in addition to these the star occurs on two plates in the Hyderabad Astrographic Catalogue, on one Mt. Wilson 60-inch plate and on two plates of the Palomar National Geographic Survey.

All plates were measured at Minnesota and reduced to the astrographic plates as standard. The measured coordinates of the star, referred to an arbitrary zero point, are given in full in Table I in order that anyone may satisfy himself as to the reliability of the resulting proper motion. Ten comparison stars were used with a mean magnitude of 12.2 pg.

Table I

Plate	t	1 mm=60"	
		x mm	y mm
I 6183-6281	92.38	9.312	23.398
A 310	94.07	323	399
A 5864	02.37	326	398
A 7152	05.03	331	399
MC 17093	21.05	331	397
Hyd 3359-78	33.24	333	396
60-inch	49.39	337	395
Pal (B+R)	56.35	345	392

It is difficult to escape the conclusion that the (relative) proper motion is (at least) $\mu_\alpha = +0.014 \pm 0.004$, $\mu_\delta = -0.004 \pm 0.002$. The usual corrections from relative to absolute motion based on $m=12.2$ pg for the comparison stars would be about $-0.015 -0.007$, thus resulting in an absolute motion of $-0.001 -0.011$. A small change in the magnitude of the comparison stars or in the solar motion might well change the final motion in right ascension but it is difficult to see how the absolute motion in declination could be made appreciably smaller. If the distance is indeed 16000 parsecs the tangential velocity would be at least 800 km/sec, far in excess of the parabolic velocity relative to the galaxy — unless the mass of the galaxy is assumed to be considerably more than 10^{12} times that of the sun. Moreover, even with this velocity the star would have taken of the order of at least 25 million years to get out there.

The inference of the motion therefore is that perhaps the star is not an ordinary Population I star 1500 times more luminous than the sun, but similar perhaps to the average blue coronal star with $M_{\alpha}+2$ to $+3$. With a radial velocity of -20 km/sec a tangential velocity of not more than 50 to 100 km/sec would be expected; this would suggest a distance of not more than 1000-2000 parsecs, again indicating a luminosity with M around $+1.4$ to $+2.9$.

It might be mentioned that several faint galaxies are visible on the Palomar plates in the immediate vicinity of the star, hence if these plates are repeated around 1985 a new accurate and quite independent value of the absolute proper motion could be determined.

1. Ap. J. 105:85, 1947
2. Ap. J. 114:488, 1950
3. B.A.N. 12: 7, 1953

4. Stars and Stellar Systems VI: 685, 1960
5. A. J. 66: 284, 1961

Minneapolis, Minnesota
15 May 1962