

HARVARD COLLEGE OBSERVATORY.

CIRCULAR 127.

NEW VARIABLE STARS IN HARVARD MAP, Nos. 3 AND 6.

IN Circular 116, Professor Bailey proposed a Durchmusterung of Variable Stars, or an exhaustive study of these stars in all portions of the sky. While this plan seems at present beyond our reach, it may be approached by a search for variables in all parts of the sky, according to a uniform system. The Harvard Map of the Sky, described in Circular 71, divides the entire sky into 55 portions each approximately 30° square. The study of one of these, No. 50, by Miss Leavitt, described in Circular 122, shows that large numbers of moderately bright variable stars are probably still unknown, and that many of them may readily be discovered by the method of superposing a negative upon a contact print of a second negative covering the same region. The sky has accordingly been divided into three parts, that covered by Nos. 1, 4, 7, 10, etc., being assigned to Miss Cannon, Nos. 2, 5, 8, 11, etc., to Miss Leland, and Nos. 3, 6, 9, 12, etc., to Miss Leavitt. For each region, five plates are selected and a contact print made from one of them. The other four are then superposed on this print in turn, and the stars showing evidence of variability marked. Some of these prove to be known variables, some to be new variables, some are still suspected of variability, and the others are not confirmed and seem to be due to photographic defects or other causes of error. From the number of new variables found by superposing plates of the same region an estimate may be made of the number still undiscovered. Thus, if nine-tenths of them were new, we might expect that many more would be found from other plates, while if only one-tenth were new we should expect that nine-tenths of the whole number were already known. Doubtless, many more could be found by superposing more plates, but in that case a second contact print also should be used. It seems best, first, to cover the whole sky by the method here described, and thus provide for determining the probable distribution. Later, if desired, the work can be extended, but probably this could be done better by means of photographs taken with a large instrument. An examination of Regions 3 and 6 has already

been made by Miss Leavitt, with the results given below. It seems best to make an announcement of the new variables at once, reserving for a later publication in the *Annals*, a detailed study of their variations.

The photographs used in the examination are described in Table I. The number of the region in the Map of the Sky and the position of the centre are given in the first two columns. The third column contains a number for the negative whose designation follows in the fourth column. The negatives, five for each region, are numbered in the order in which they were examined, No. 1 being the plate from which the glass positive was made, and Nos. 2, 3, 4, and 5 having been successively superposed on it. An additional line, for each region, gives the results obtained from all the five plates. The date on which the photograph was taken and the Julian Day and decimal following Greenwich Mean Noon, corresponding to the centre of the exposure, are given in the fifth and sixth columns. The number of new variables discovered, the total number found on the plate, including known variables, and the proportion of new variables, are given in the seventh, eighth, and ninth columns. In the last line of each portion of the table, the total number of variables found, and given in the eighth column, does not equal the numerical sum of the numbers above it, as some variables were independently discovered on more than one plate. The whole number of variables known at the conclusion of the examination of the plate is given in the tenth column. Novae, variables in clusters, variables

TABLE I.
PLATES COMPARED.

No.	Region.	No.	Plate.	Date.			J. D.	New Var.	Total found.	Proport'n new.	All.	Probable No.	Proport'n found.
				y.	m.	d.							
3	h. 3 +60	1	AC 5369	1904	10	15	6769.770	..	..	..	18	..	..
		2	AC 8088	1906	12	6	7551.638	2	4	.50	20	36	.10
		3	AC 6809	1905	10	8	7127.742	1	2	.50	21	40	.05
		4	AC 7940	1906	10	25	7509.767	4	8	.50	25	42	.19
		5	AC 4619	1904	2	8	6519.534	1	6	.17	26	30	.14
		All	...	..	..	..	..	8	14	..	26	42	.33
6	12 +60	1	AC 7427	1906	3	31	7301.663	..	..	..	15	..	..
		2	AC 3351	1903	2	23	6169.826	2	4	.50	17	30	.14
		3	AC 3466	1903	3	31	6205.779	1	6	.17	18	20	.22
		4	AC 6178	1905	3	15	6920.800	3	7	.43	21	32	.25
		5	AC 2534	1902	5	9	5879.626	0	9	.00	21	21	.32
		All	...	..	..	..	..	6	13	..	21	28	.43

fainter at maximum than the tenth magnitude, and suspected variables, are omitted, as it is improbable, though not impossible, that an object belonging to one of these classes should be discovered in this research. The number of known variables contained in the Second Catalogue of Variable Stars, Annals 55, Part I, excluding the classes mentioned, is 18 in region 3 and 15 in region 6. In order to estimate the whole number of variables probably existing in the region, the proportion was used that the number of known variables discovered is to the total number discovered, as the total number already known is to the whole number in the region. This number is given in the eleventh column of Table I. The summary of the results obtained from the five plates, indicates that in region 3 there are probably 42 variables, of which 16, or about two-fifths, remain to be discovered. In region 6, the probable number is 28, of which 7, or one-fourth remain to be discovered. If only the more striking variables are taken into account, these results are greatly modified, for it will be found in Table III that none of the new variables have a range of more than a magnitude, or are brighter than the eighth magnitude. Apparently nearly all the variables, in these regions, which are bright and show conspicuous changes, have been discovered. The last

TABLE II.
KNOWN VARIABLES.

Des.	Name.	Max.	Min.	Class.	Year of Discovery.	Found on Plates.	Des.	Name.	Max.	Min.	Class.	Year of Discovery.	Found on Plates.
011272	S Cassiop.	7.6	14.5	II	1861	.....	044068	— Camelop.	..	..	III	1902	.....
013057	RW Cassiop.	8.9	11.0	IV	1905	2 . . .	100860	U Urs. Maj.	7.0	8.3	III	1898	.....
014958	X Cassiop.	9.0	12.3	II	1895	.....	103769	R Urs. Maj.	7.0	13.5	II	1853	2 3 4 5
015354	U Persei	7.5	11.0	II	1890	. 3 4 5	103867	— Urs. Maj.	..	..	..	1906	.....
020448	RV Androm.	8.5	10.5	II	1904	.....	113972	Z Draconis	9.9	13.6	V	1903	.....
021556	RS Persei	8	10	..	1904	.....	115158	Z Urs. Maj.	..	..	II	1904	. 3 . 5
021558	S Persei	7.8	11.2	II	1874	.....	121561	— Urs. Maj.	..	..	..	1906	.....
022150	RR Persei	9	<13	II	1904	.....	123160	T Urs. Maj.	6.4	13.1	II	1860	... 5
023947	— Persei	..	..	V	1906	. . 4 .	123366	— Draconis	9.7	<12.5	..	1906	. 3 . 5
023969	RZ Cassiop.	6.4	7.8	V	1906	. . . 5	123459	RS Urs. Maj.	9.2	14.5	II	1905	.....
024368	— Cassiop.	..	..	IV	1906	.....	123556	Y Urs. Maj.	8	9	III	1904	. . . 5
024356	W Persei	7.5	11.5	II	1893	.....	123961	S Urs. Maj.	7.3	12.5	II	1853	. 3 4 5
025867	RX Cassiop.	8.6	9.1	V	1904	.....	125266	— Draconis	8.5	10.5	..	1906	.....
031646	RT Persei	9.5	11.5	V	1904	.....	132262	RR Urs. Maj.	9.4	<12	II	1905	.....
042257	— Camelop.	7.8	9.5	..	1906	.....	133273	T Urs. Min.	8.5	<13	II	1903	.....
043065	T Camelop.	7.0	13.5	II	1891	. . . 5	141567	U Urs. Min.	8.5	12	II	1904	2 . 4 5
043274	X Camelop.	8.0	13	II	1903	2 . . .							

column of Table I gives, for each plate, the proportion of the computed total actually found.

A list of known variables in these two regions has been made from the Second Catalogue of Variable Stars, Annals 55, Part I, and is given in Table II. Stars in the classes mentioned in the foregoing paragraph are omitted. The first six columns contain the designation, name, maximum and minimum magnitudes, class of variation, and year of discovery. The last column indicates on which plates, if any, the variable was rediscovered. The numbers correspond to those in the third column of Table I.

The new variables are given in Table III, in which the successive columns give the designation, Harvard Number, constellation, number in the Bonn Durchmusterung, right ascension and declination for 1900, brightest and faintest magnitudes as yet observed, range, and numbers of the plates on which the variable was independently discovered.

TABLE III.
NEW VARIABLES.

Design.	Harvard No.	Constellation.	DM. No.	R. A. 1900.	Dec. 1900.	Br.	Ft.	Range.	Found on Plates.
020057	2891	Perseus	+57° 489	<i>h. m. s.</i> 2 0 48	+57 58.2	9.3	10.0	0.7	2 . . .
021556b	2892	Perseus	+55° 597	2 15 5	+56 8.8	9.2	10.1	0.9	. . 4 .
021959	2893	Cassiopeia	+58° 470	2 19 51	+59 0.6	10.6	11.2	0.6	. . 4 .
023765	2894	Cassiopeia	+65° 289	2 37 38	+65 18.6	8.2	9.0	0.8	. . 4 .
024462	2895	Cassiopeia	+62° 480	2 44 24	+62 22.4	8.8	9.4	0.6	2 . 4 .
034658	2896	Camelopard.	+58° 663	3 46 9	+58 21.6	9.0	10.0	1.0	. . . 5
035658	2897	Camelopard.	+58° 694	3 56 43	+58 22.9	8.6	9.2	0.6	. 3 4 5
042164	2898	Camelopard.	+64° 451	4 21 28	+64 13.5	9.5	10.5	1.0	. . 4 5
112245	2899	Ursa Major	+45° 1924	11 22 22	+45 44.2	8.2	9.0	0.8	2 . . .
113267	2900	Draco	+68° 652	11 32 14	+67 53.2	9.0	9.7	0.7	. 3 4 5
113552	2901	Ursa Major	+52° 1579	11 35 24	+52 33.9	9.5	10.5	1.0	. . 4 .
121270	2902	Draco	. . . .	12 12 48	+70 4.0	8.8	9.6	0.8	. . 4 .
121664	2903	Ursa Major	+64° 890	12 16 12	+64 14.0	8.3	9.0	0.7	2 3 . 5
122169	2904	Draco	+69° 663	12 21 49	+69 14.4	9.4	10.0	0.6	. . 4 .

REMARKS.

023765. Apparently of the Algol Type.
024462. Apparently of the Algol Type.
034658. Period apparently short.

113267. Period evidently very short.
113552. Apparently of the Algol Type.

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