ROYAL ASTRONOMICAL SOCIETY OF NEW ZEALAND.

VARIABLE STAR SECTION.

CIRCULAR No. 156.

V442 CENTAURI.

Frank M. Bateson & A.F. Jones.

SUMMARY: A total of 2,201 visual observations of the U Gem type variable, V442 Cen, are discussed. These cover the period 1954 March 22 (J.D. 2,434,824) to 1968 June 30 (J.D. 2,440,038).

A total of 163 maxima are listed. These range from 11.8 visual to 12.8visual with a median magnitude of 12.27. At minima the variable is below 14.0 and nothing can be stated about its behaviour then. This limits the discussion of the steepness of the rise and fall. The mean cycle between successive maxima is 25.14 days. On the average the variable takes 0.92 days to increase from magnitude 13.0v to maximum.

INTRODUCTION:

The 1950 position of V442 Cen is:-

11h 22m 24s. S. 35° 37'2

Variability was discovered by Luyten (1), who listed it as 152.1933 Cen with a range of 12.8 to <15. It is HV 8364. Erro (2) discussed High Latitude Field 354 in which V442 Cen is situated. He made magnitude estimates from 83 MF plates supplemented by estimates from 527 plates of the Harvard A, B, AM and RB series. Erro gave the range as 12.1 to <16.5ptg., and assigned V442 Cen to the SS Cygni class. He listed 49 maxima from J.D. 2,412,210 to 2,429,020. These ranged in brightness from 11.7 to 13.0ptg.

Erro stated:- "The rise and fall occupy not more than 20 days. Early maxima are determined largely by one observation only but they are well defined; the MF plates gave three or four observations for several of the maxima."

The G.C.V.S. (3) classes V442 Cen as of U Gem type with range of 11.7 to <16.5ptg., with the mean cycle as 55 days.

CHARTS:

Charts have been published by Brun & Petit (4) and by Bateson, Jones & Stranson (5).

SEQUENCE:

On chart No. 102 (5) comparison stars are identified by letters. No reliable magnitudes have yet been determined for these. For the purpose of this paper the following provisional visual magnitudes have been determined from step estimates by Jones.

"g" = 11.8	"i" = 12.3	"n" = 13.3
"h" = 12.1	"l" = 13.0	"q" = 13.7

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The magnitude of "g" was estimated by comparison with Harvard visual magnitudes for comparison stars in the field of X Cen. Star "g" was adopted as the zero point for the step estimates, which have been converted to provisional visual magnitudes. Since the main objective of this paper is the determination of the mean cycle, between successive maxima, it is considered that these magnitudes are sufficiently accurate.

OBSERVATIONS:

A.F. Jones has consistently observed V442 Cen since 1954 March 22. As almost all the observations have been made by him they form a reliable and consistent set of records. For the period 1954 March 22 (J.D. 2,434,824) to 1968 June 30 (J.D. 2,440,038) there are available observations from:-

JONES,	A.F.	2,020
BATESON,	F.M.	128
HUNTER,	K.	4
JONES,	M.V.	11
MARINO,	B.F.	10
MCMILLAN,	S.C.	1
MATCHETT,	(Dr) V.L.	18
SALISBURY,	J.V.	1
WALKER,	W.S.G.	8
TOTAL		2,201.

These have been plotted and the observed maxima are listed in Table 1, where the first column gives the reference number. The J.D. of maxima are shown in the second column, with the visual magnitude of maxima in the third column. The next column shows the intervals, in days, between successive maxima. When it appears probable that at least one maximum has been missed the interval in column four is given in brackets.

Succeeding columns in Table 1 give respectively the intervals in days of the rise from magnitude 13.0v to maxima; the time, in days, taken to fall from maxima to 13.0v and the total time that the star was brighter than 13.0v for each maximum. These are followed by a column giving the weight assigned to the details in the preceding columns. This weight is on the following scale:-

5 = Well observed on both branches of the curve.
4 = Well observed on both branches but with some scatter between estimates.
3 = Some observations on both branches but estimates limited in number.
2A= Observed either on ascending branch only or on ascending branch and at maximum.
2B= Observed either on descending branch only or on descending branch and at maximum.
1 = One or two estimates only.

The final column of Table 1 lists the J.D.'s (with first four figures omitted) during which there were either no observations or else only one or two scattered negative estimates. These dates thus show the main gaps in the observations during which maxima could have taken place and gone unobserved.

A question mark in any column of Table 1 indicates that the particular value is considered doubtful.

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DISCUSSION:

Erro's (2) tabulated maxima are obviously based on plates well scattered in time. As a result the intervals between successive maxima in his list range from 20 to 1,864 days. If the 19 maxima with cycles of less than 100 days are taken the mean cycle is 49.4 days--a figure, which from the nature of the material, is likely to be in excess of the true value.

In Table 1 of the 163 maxima listed 111 appear to represent intervals in which it is unlikely that any maxima have been missed. The remaining maxima, for which the intervals are shown in brackets in the fourth column of Table 1, represent those during which at least one additional maximum could have gone unobserved.

The frequencies of the intervals between successive maxima for the 111 mentioned above are shown in Table 2. The mean interval for these is 25.14 days. If the remaining maxima are included, ignoring the fact that their intervals probably represent false periods, the mean cycle is 32.09 days.

One of the difficulties in discussing the records on which Table 1 is based is that, for most of the time, the variable was invisible. Observations at such times simply noted that the variable was invisible and fainter than the faintest comparison star seen, usually "l", "n" or "q". As a result nothing is known about the behaviour of V442 Cen at minimum. Such observations have, however, greatly helped in fixing the times when the variable rose to visibility and thereafter in showing the rate of the rise. However, because magnitude at maximum is not much above the normal point of invisibility, when compared to the total range of the variable, it is only possible to indicate the degree of steepness of the rise and fall for a small portion of the light curve.

The best that can be done is to take the time from magnitude 13.0 to maximum as some indication of the steepness of the rise. The total time the variable was above 13.0, from rise to fall, provides some indication of the widths of the maxima. There are 98 maxima for which both these figures are reasonably certain.

Table 3 lists the frequencies for various intervals of the rise from 13.0 to maximum brightness. The average time for this increase is 0.92 days.

Table 4 gives the frequencies for the widths of maxima as defined above. The average time the variable was above 13.0, on the rise, to 13.0, on the fall, is 4.1 days. This illustrates how easy it is for even the most assiduous observer to miss maxima through poor weather, moonlight or when the star is not well placed for observing.

For all maxima the range in magnitude is 11.6 to 12.8v. The magnitudes listed for 39 maxima in Table 1 are uncertain. The frequencies of each maximum magnitude for the remaining 124 maxima are given in Table 5. For these the average magnitude at maximum is 12.27v

There are 96 maxima for which both the magnitude and the time the variable was above 13.0 are reasonably certain. Table 6 gives the maxima magnitudes in the first column, followed in the second column by the number of maxima observed for each of these magnitudes. Successive columns then list the average time to rise from 13.0 to maximum; average total time variable was brighter than magnitude 13.0 from rise to fall; and in the last two columns the time taken to rise or fall 0.1 magnitude, assuming the rate is constant. This assumption is not always correct, especially for the decline where the longest

enduring maxima tend to fall slowly at first, accelerating about half way through the decline.

As one would expect, the brighter the maximum the longer the variable takes to increase. The bright maxima are also the broadest. The steepest rise occurs for maxima that attain magnitude 12.0 to 12.2. It appears that the fainter maxima have rises that are less steep, probably because the variable is then nearing its peak and the rate of increase has already slowed. However, as remarked earlier, the segement of the light curve observed above 13.0 is too limited in range to draw any firm conclusions regarding the various shapes of the curves beyond stating that there are indications of both broad and sharp maxima.

CONCLUSIONS:

It is concluded that V442 Cen is a U Gem type variable with a visual range of 11.8 to 12.8 at maxima and minima that are fainter than 14.0. The mean cycle is 25.14 days. Mean maximum magnitude is 12.27v. The increase to maximum is very steep with a decline that is from twice to four times less steep than the rise.

V442 Cen is one of the most interesting of southern U Gem type variables because of the frequency of its maxima. Visually it can only be followed if observers make estimates, preferably at least twice on every possible night. With the same co-operation between observers as exists for VW Hydri it should be possible to make certain that very few maxima are missed. This star is also one that will repay careful study from those with larger instruments, capable of observing the variable at minima. It is commended to observers with photoelectric photometers for close study preferably in three colours.

ACKNOWLEDGEMENTS:

The senior author would like to pay a tribute to A.F. Jones for his very consistent and careful observations, without which this paper could not have been written. Observers are thanked for their records. We are indebted to the Director, Carter Observatory, for the loan of a publication.

1970 June 21.

18 POOLES ROAD,
GREERTON.
TAURANGA.
NEW ZEALAND.

REFERENCES:

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(2) Erro, L.E. H.B. 913 (1940).
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(4) Brun, A. & Petit, M. Variable Stars, 12, 1 (97), p.18. (1959).
(5) Bateson, F.M., Jones, A.F. & Stranson, I. "Charts for Southern Variables" Series 4. (1968).

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TABLE 1.

OBSERVED MAXIMA OF V442 Cen.

No.	J.D.	VISUAL MAG.	INT. d.	PRE MAX. d.	POST MAX d.	TOTAL TIME ABOVE 13.0v d.	WEIGHT.	GAPS.
1	2,434,829	12.4	...	...	2.0	?	2B	
2	844	12.4	15	0.2	3.9	4.1	2B	
3	863	12.3	19	1.0	2.9	3.9	2B	
4	891.5	12.3	28.5	1.0	3.0	4.0	3	
5	913	12.4	21.5	1.0	2.6	3.6	3	
6	933	12.8	20	0.2	1.0	1.2	2A	
7	958	11.9	25	0.5	6.3	6.8	3	
8	2,435,017	12.7	(59)	0.5	1.0	1.5	2B	987-010
9	034	12.3?	17	1.0?	3.5	4.5?	1	040-067
10	115.9	12.0	(81.9)	0.5	2.1	2.6	3	077-104
11	138	12.3	22.1	1.0	1.5	2.5	5	
12	172	11.8	34	2.0	6.5	8.5	5	
13	204?	12.5?	32	0.5?	1.5	2.0?	1	
14	229?	12.3	25	0.5	1.5	2.0	1	
15	252.5	12.3	23.5	1.5	1.5	3.0	3	
16	271	12.4	18.5	1.0	1.5	2.5	3	256-265
17	288.3	12.4	17.3	0.8	1.4	2.2	2A	
18	306	12.0	17.7	1.1	2.3	3.4	5	
19	323?	12.8	17	0.5?	1.0	1.5?	2B	
20	369	12.3	(46)	1.2	1.0	2.2	3	331-362
21	413.5?	12.3?	(44.5)	0.5	2.2	2.7	2B	(370-386;395-(401
22	438.5	12.3	25	0.7	5.0	5.7	3	
23	467?	12.3?	28.5	0.7	2.0	2.7	3	
24	489	12.3	22	1.2	1.5	2.7	3	
25	503?	12.5	14	0.7	1.2	1.9	2B	
26	523	12.4	20	0.7	2.0	2.7	2B	
27	551.8	12.3	28.8	0.8	2.2	3.0	3	
28	564	12.4	12.2	0.2	1.5	1.7	2B	
29	586.5	11.8	22.5	1.5	5.3	6.8	5	568-580
30	633.8	12.5	(47.3)	0.3	1.7	2.0	4	610-618
31	656.0	12.1	22.2	0;5	2.0	2.5	5	
32	671?	12.8?	15	0.5?	1.5	2.0?	1	
33	685.8	12.5	14.8	0.8	2.0	2.8	2B	
34	700	12.4	14.2	0.5	2.0	2.5	3	
35	717.5	12.3	17.5	1.5	3.0	4.5	3	703-713
36	732.2	12.5	14.7	0.9	1.2	2.1	3	
37	764.3	12.5	(32.1)	2.0	3.2?	5.2?	2A	733-753
38	780?	12.3?	15.7	0.5?	7.7	8.2?	2B	769-779
39	806.5	12.5	26.5	0.5	2.5	3.0	3	794-801
40	845.5	12.3	39.0	1.0?	3.5	4.5?	3	816-822
41	871?	12.2?	25.5	1.0	6.5?	7.5?	3	
42	901.5	12.5	30.5	0.5	1.5	2.0	2A	
43	928?	12.7?	26.5	0.5?	1.0	1.5?	2B	906-913
44	958?	12.5?	30	0.5?	1.0	1.5?	2B	939-953
45	992	12.0?	34	3.0	8.0	11.0	5	966-979
46	2,436,021.8	12.5	29.8	1.3	1.2	2.5	5	
47	073.9	12.5	(52.1)	0.4	5.1	5.5	3	(034-043;053-(072.
48	113	12.0	(39.1)	1.0	6.0?	7.0?	3	082-111
49	145?	12.2	32	?	?	?	1	123-130
50	171	12.2	26	0.7?	2.0	2.7?	2B	146-170
51	198.8	11.9	27.8	1.9	4.7	6.6	3	174-185
52	224.2	12.3	25.4	0.3	2.2?	2.5?	2A	

V.S.S. CIRCULAR No. 156 (cont).

TABLE 1 (CONT).

No.	J.D.	VISUAL. MAG.	INT d.	PRE MAX d.	POST MAX d.	TOTAL TIME ABOVE 13.0v d.	WEIGHT	GAPS.
53	2,436,268.9	12.5	(44.7)	0.6?	0.8	1.4?	2B	231-241;247-257
54	279	11.9?	10.1	2.0	3.7	5.7	3	
55	312.2	12.3	33.2	0.7	1.6	2.3	5	
56	338	12.3	25.8	0.7?	0.5	1.2?	2B	324-329
57	351.9	12.2	13.9	0.4	2.1	2.5	3	
58	374.1	12.0	22.2	0.3	5.6	5.9	5	
59	404?	12.4	29.9	?	?	?	1	
60	418	12.2	14	0.4	3.9	4.3	3	
61	437	12.4	19	1.5	2.3?	3.8?	2A	
62	498.7	12.3	(61.7)	0.7	1.3	2.0	3	(449-457;463-470; (473-497.
63	560	12.3	(61.3)	1.0	4.0	5.0	3	(501-512;518-526; (529-547.
64	593.7	12.5	33.7	0.7	2.3?	3.0?	2A	
65	625.9	12.3	32.2	0.4	4.6	5.0	3	
66	655	12.1?	29.1	0.7	3.2	3.9	3	
67	690.5	12.1	35.5	0.8	2.5	3.3	3	665-670
68	718.9	12.2	28.4	0.9	1.8	2.7	5	704-711
69	738.3	12.1	19.4	1.3	2.1	3.4	3	
70	757.0	12.0	18.7	3.3	6.0	9.3	5	
71	823	12.0	(66)	1.0	3.5	4.5	2B	(771-778;782-788; (791-800;811-817; (818-822.
72	849.0	11.9	26	1.3	7.5	8.8	5	831.-841.
73	882?	12.7?	33	?	?	?	1	858-866;874-880.
74	914	12.2?	(32)	?	?	?	1	884-900;902-913.
75	936.5	12.0	22.5	1.0	7.0	8.0	3	915-934
76	962.5	12.4	26.0	0.5	2.0	2.5	2B	945-951
77	986.2	12.2	23.7	0.9	1.4	2.3	2B	973-980
78	2,437,003.2	12.4	17.0	1.2	2.1	3.3	2B	
79	020.0	12.3	16.8	1.0	2.0	3.0	5	
80	040.3	11.8	20.3	1.3	6.2	7.5	3	
81	087	12.2	47.3	1.0	1.5	2.5	2B	
82	122	12.5?	(35)	?	?	?	1	090-097;102-110.
83	136.3	12.9?	14.3	0.3?	0.7	1.0?	2B	
84	159.8	12.0	23.5	1.3	4.2	5.5	3	146-157
85	197	12.4	(37.2)	0.7?	1.2	1.9?	2B	176-194
86	263	12.0?	(66)	1.3?	7.0?	8.3?	3	202-229;235-260.
87	303.5	12.5	(40.5)	1.0	5.5	6.5	3	270-281
88	328.1	12.7	24.6	0.6	0.9	1.5	2B	
89	366.0	12.3	(37.9)	1.0?	4.3	5.3?	2B	339-347;356-365.
90	401.9	12.4	35.9	1.6?	1.6	3.2?	2B	
91	436.5	11.9	(34.6)	1.0?	3.5	4.5?	3	420-434
92	469.4	12.0	32.9	1.0	2.1	3.1	5	
93	535?	12.7?	(65.6)	1.0?	6.0?	7.0?	3	492-512;514-520.
94	593?	12.3?	(58)	?	?	?	1	550-573
95	620.1	12.4	(27.1)	0.8	4.9?	5.7?	2A	594-613
96	661	12.5?	(40.9)	1.0?	1.5	2.5?	2B	625-641;644-650.
97	686.9	12.1	25.9	1.1	2.9	4.0	3	
98	729	12.0	(42.1)	1.5	6.5	8.0	3	709-719
99	765.8	12.3	36.8	1.3	2.2	3.5	3	
100	795.7	12.1	29.9	1.4	4.3	5.7	3	
101	837	12.2	(41.3)	1.0?	1.0	2.0?	2B	801-807;811-821.
102	863	12.1	26	1.3?	2.0	3.3?	2B	
103	887.5	11.7?	24.5	1.2	6.0	7.2	3	
104	917.2	12.2	29.7	1.2?	4.8?	6.0?	2B	902-915
105	943.2	12.8	26.0	0.7	1.0	1.7	3	922-941

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TABLE 1 (CONT).

No.	J.D.	VISUAL MAG.	INT d.	PRE MAX. d.	POST MAX. d.	TOTAL TIME ABOVE 13.0v d	WEIGHT	GAPS.
106	2,437,976	12.3?	(32.8)	0.5	?	?	2A	946-972
107	2,438,031	12.5	(55)	0.4	1.8	2.2	3	980-020
108	048.5	12.7	17.5	0.5	1.5	2.0	3	056-070
109	071.5	12.3	23.0	0.8?	1.8	2.6?	2B	
110	100.0	12.3	28.5	1.7?	1.3	3.0?	2B	
111	122.8	12.4	22.8	0.8?	1.5	2.3?	2B	
112	150?	12.3	27.2	?	?	?	1	
113	177.8	12.7	27.8	0.8	1.0	1.8	3	
114	202.0	12.4	24.2	1.0?	1.0	2.0	2B	183-191
115	230	12.2	28	1.0?	2.3	3.3?	2B	
116	271?	12.5?	(41)	?	?	?	1	246-252
117	297?	12.7?	(28)	?	?	?	1	272-296
118	328?	12.2?	(31)	?	?	?	1	298-313;318-32?
119	362	12.4?	(34)	?	?	?	1	331-353
120	386.1	12.2	24.1	1.8?	2.9	4.7?	3	364-380
121	411.5	12.2	25.4	1.0	4.2	5.2	2B	390-402
122	482	11.9?	(71.5)	2.0	5.3	7.3	3	420-429;443-46(
123	508?	12.4?	26	2.0?	2.5?	4.5?	1	
124	522.9	12.1	14.9	0.6	3.4	4.0	5	
125	542	12.5?	19.1	?	?	?	1	
126	559.5	11.6?	17.5	3.5	6.5	10.0	3	
127	594	12.1	(34.5)	0.5	?	?	1	576-587
128	630?	12.0?	(36)	1.0?	5.5?	6.5?	3	600-629
129	678.2	12.5	(48.2)	1.0	1.0	2.0	3	640-670
130	706.5	12.0	23.3	1.0	5.5	6.5	3	683-699
131	734.2	12.5	27.7	1.2	1.8?	3.0?	2A	716-729
132	756	12.3	21.8	0.8?	2.0	2.8?	2B	740-754
133	807.9	12.1	(51.9)	0.9	7.4	8.3	3	761-766;773-784
134	846	12.5	38.1	0.5	1.3	1.8	3	831-840
135	880.0	12.3	34.0	0.5	3.0	3.5	3	
136	915.7	11.8?	35.7	?	?	?	1	
137	975?	12.5?	(59.3)	?	?	?	1	945-952
138	993?	12.7?	18	?	?	?	1	
139	2,439,027	12.0	(34)	?	3.5	?	2B	002-025
140	065	11.9	(38)	1.0	7.3?	8.3?	1	031-063
141	120.3	12.1	(55.3)	0.6	6.7?	7.3?	3	075-094;100-112
142	152.5	12.1	32.2	0.5	0.8	1.3	5	128-143
143	199	12.3	46.5	2.0	3.0	5.0	4	
144	231.2	12.5	(32.2)	0.7	1.3	2.0	3	209-227
145	252.0	12.4	21.2	0.3	2.5	2.8	3	
146	274.0	12.4	22.0	0.5	2.5	3.0	3	
147	293.9	12.4	19.9	1.2	1.7	2.9	5	
148	325	12.0	(31.1)	0.8?	8.0?	8.8?	2B	302-316
149	358?	12.1?	33	?	?	?	1	
150	416.5	12.1	(58.5)	0.7	5.5	6.2	3	360-413
151	504.0	12.7	(87.5)	1.0	1.0	2.0	3	(423-448;462-467; (470-498
152	546.9	12.0	42.9	1.1	6.1	7.2	2B	
153	603.8	12.3	(56.9)	1.0	2.2	3.2	3	568-581
154	631.8	12.3	28.0	0.8	5.7	6.5	3	
155	663?	12.5?	31.2	?	?	?	1	
156	723?	12.0?	(60)	?	?	?	1	(672-678;687-694; (696-709
157	820?	12.3?	(97)	?	?	?	1	725-819
158	861?	12.3?	(41)	?	?	?	1	834-850
159	903.8	12.2	(42.8)	1.5	5.5	7.0	3	869-875;878-883
160	938.5	12.4	(34.7)	0.8	2.5	3.3	3	925-934
161	971.0	12.1	(32.5)	1.0	2.7	3.7	3	946-958
162	2,440,003.8	11.9	32.8	2.3	4.2	6.5	5	976-981
163	034	12.2	30.2	?	?	?	1	

V.S.S. CIRCULAR No. 156 (cont).

TABLE 2.

FREQUENCIES OF INTERVALS BETWEEN SUCCESSIVE MAXIMA.

INTERVAL	FREQUENCY.	INTERVAL.	FREQUENCY.
9.9 days or less	0	30.0 to 34.9 days	17
10.0 to 14.9 days	10	35.0 to 39.9 "	6
15.0 to 19.9 "	20	40.0 to 44.9 "	1
20.0 to 24.9 "	23	45.0 days or more	2
25.0 to 29.9 "	32	TOTAL	111

TABLE 3.

FREQUENCIES OF TIME TO RISE FROM 13.0 TO MAXIMUM.

INTERVAL	FREQUENCY.	
0.0 to 0.49 days	12	
0.5 " 0.99 "	39	
1.0 " 1.49 "	35	
1.5 " 1.99 "	7	
2.0 days or more	5	Total 98.

TABLE 4.

FREQUENCIES FOR WIDTH OF MAXIMA ABOVE 13.0.

WIDTH	FREQUENCY.	WIDTH.	FREQUENCY.
0.0 to 1.4 days	2	5.5 to 6.4 days	7
1.5 " 2.4 "	21	6.5 " 7.4 "	12
2.5 " 3.4 "	30	7.5 " 8.4 "	4
3.5 " 4.4 "	11	8.5 days or more	5
4.5 " 5.4 "	6	TOTAL	98

TABLE 5.

FREQUENCIES OF MAGNITUDES AT MAXIMA.

MAG. $_v$	FREQUENCY.	MAGv	FREQUENCY.
11.8	3	12.4	21
11.9	6	12.5	17
12.0	14	12.6	0
12.1	13	12.7	5
12.2	14	12.8	3
12.3	28	TOTAL	124

TABLE 6.

COMPARISON OF MAXIMA MAGNITUDES WITH RISE AND FALL.

MAX. MAG.	No.	AVG. RISE 13.0 TO MAX $_d$	AVG. TOTAL DAYS ABOVE 13.0 $_d$	RATE PER 0.1 mag. RISE. $\frac{d}{d}$	FALL $\frac{d}{d}$
11.8	3	1.6	7.6	0.133	0.50
11.9	5	1.4	7.4	0.127	0.54
12.0	12	1.1	5.9	0.110	0.48
12.1	10	0.8	4.2	0.089	0.38
12.2	9	0.8	4.1	0.100	0.41
12.3	22	0.9	3.5	0.129	0.37
12.4	14	0.7	2.8	0.117	0.35
12.5	13	0.8	2.8	0.160	0.40
12.6	-	-	-	-	-
12.7	5	0.7	1.7	0.233	0.33
12.8	3	0.45	1.5	0.225	0.52
	96				