NOTES ON STELLAR CLASSIFICATION.

IN NATURE, December 23, 1915, and in the third Bulletin of the Hill Observatory, I referred to the shape of the temperature curve which I had published in connection with the meteoritic hypothesis, and I pointed out that if we could deal with a large number of stars, a generalised temperature curve might be placed before us by considering the number of stars in the various groups, for the reason that the longer a star remained at about the same temperature, the larger would be the number of stars in that group, while a rapid rise of temperature would reduce the number. I gave the curves thus produced by discussion of the stars included in the catalogue of the 470 brighter stars published in 1902, and in the later catalogue of the 354 less bright stars catalogued at the Hill Observatory.

In order to carry the inquiry one step further, I now reproduce these two curves, together with a third (Curve 3) based on the catalogue of 287 stars, the result of still more recent work at the Hill Observatory.

One of my chief objects in plotting this third curve was to see whether its shape agreed with the two former ones, because the more the curves based on different catalogues agree, the more they may be accepted as a basis for consideration.

It will be seen that the third curve follows suit with the first and second. Kinks occur in practically the same positions both on the ascending and descending arms of the curve. The main difference is that the apex of the curve occurs later in the case of the hotter stars than it does in either of the others; but the remarkable verticality of the curve near the middle of the ascending side is common to all, and, indeed, is one of the most striking features.

If the similarity of the three curves obtained from different data may be taken as suggesting a probability that the classification on which they are based does really provide us with homogeneous groups of stars on both sides of the curve, several interesting inquiries are suggested.

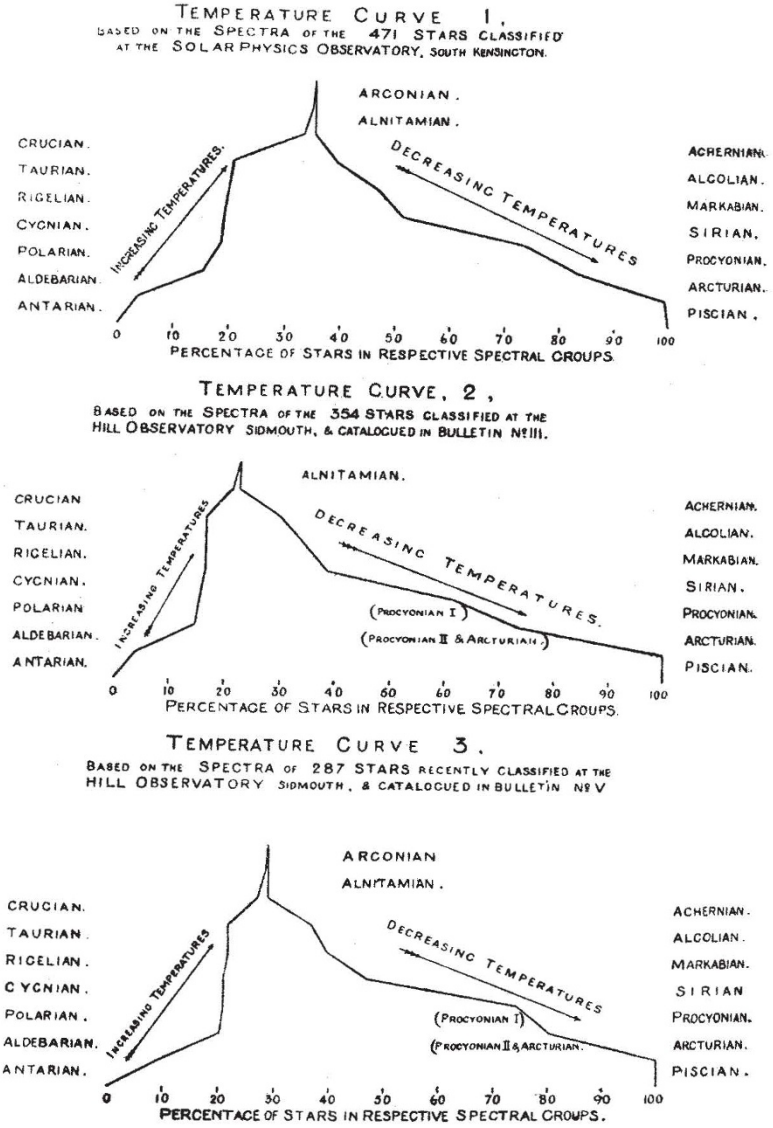

FIG. 1.—Curves based on numbers of stars and temperatures.

Supposing that the stellar systems with which we are dealing were of very recent origin, it is clear, if the meteoritic hypothesis is true, that the stars will all be found in the ascending arm. If, on the contrary, the systems are very old, and there are no recent formations, it is the descending arm into which they will be crowded.

If my classification embracing high and low temperatures really does provide us with homogeneous groups of stars, some hotting, some cooling, and if such a result proceeds from either a simultaneous or a continually acting formation of star groups, a break in the series can only be due to the cause I have already considered in Bulletin IV., a more rapid change of temperature giving an accelerated stellar change at one point of the curve.

But on the supposition that neither a simultaneous nor a continually acting formation took place, then we should expect breaks or a break in the curve. Supposing one break, we should be dealing with two groups of stars representing the old and the newer formations, or let us say old and new star systems. If this be conceded, the classification lands us in a new region of thought which it is important to study, and the vertical part of the curve may be taken as indicating the locus of the cessation of the old system and the advanced guard of the new.

PLATE I.—COMPARISON OF THE TWO CLASSIFICATIONS.

BULLETIN III.—CATALOGUE OF 354 STARS.

	Argonian	
	Alnitamian	B 2, Oe5 1
Crucian	B3 7, B2 6, B1 1, B5 1	
Taurian		
Rigelian	B9 1	
Cygnian	A 1, A2 1, A2p 1	
Polarian	F8p 2, G 1	
Aldebarian	II. K 10, G 2, K5p 1, Kp 1, F 1	
	I. K 12, K5 5, K2 1, Kp 1, Ma 4	
Antarian	Ma 10, Mb 3, K5 1	
Achernian	B3 11, B2 4, B5 4, Bp 3, B3p 1, B5p 1, B8 1, K 1	
Algolian	B8 7, B5 6, A 2	
Markabian	A 12, Ap 1, B8p 1, B9 2	
Sirian	I. A 24, A2 20, A3 8, Ap 3, A2p 1, A4 1	
	II. A5 12, A 2, A2 3, A3 2, A8 1, F 3, F5 1	
Procyonian	I. F 15, F5 14, Fp 1, F8 2, G 1, A 1, A5 5, A8 1	
	II. G 13, Gp 2, G5 6, F 2, F5 1, F8 2, K5p 1, K 6, A8p 1	
Arcturian	K 42, Kp 1, K5 2, G2 2, G5 11, B5 1	
Piscian		

BULLETIN V.—CATALOGUE OF 287 STARS.

	Argonian	Od 1
	Alnitamian	B2 2, B 1, Oe5 1
Crucian	B 1, B1 2, B2 2, B3 9, B5 1	
Taurian		
Rigelian	B9 2	
Cygnian		
Polarian	F 2	
Aldebarian	II. K 11, Kp 1, K5 2, G2 1, G5 1, Mb 1	
	I. K 7, K5 7, K5p 1	
Antarian	Ma 17, Mb 5, K5 3	
Achernian	A 2, B2 2, B2p 1, B3 14, B5 4	
Algolian	B5 2, B8 5, B9 1	
Markabian	A 9, Ap 2, A2 1, B5 1, B8 5, B9 2	
Sirian	I. A 25, Ap 1, A2 12, A3 3, A5 9, B8 2, B9 1	
	II. A 7, A2 2, A3 1, A3p 1, A5 8, F 6, Gp 1	
Procyonian	I. F 7, F5 5, F8 3, F8p 1, A 1, A5 1	
	II. F 2, F8 1, G 4, G5 5, K 4	
Arcturian	K 29, G2 2, G5 9, F 1	
Piscian		

On my classification we shall be able to study the peculiarities and differences of the two systems; and a valuable test is in this way provided.

These considerations are certainly fundamental enough, and there are others.

The similarity of the third curve to the first and second justifies the return to some considerations which I referred to in the fourth Bulletin regarding the kinks in the curves. The descending arm of the curve is much more continuous than the ascending one; the greatest change from the more vertical to the flatter shape of the ascending arm occurs at the Aldebarian and Crucian stages—that is to say, the greatest number of stars at nearly the same temperature occurs in those two regions. It is suggested that this is due to the fact that the stars involved reach their highest temperature in these regions, so that we may assume that not all stars first visible as Antarian reach the highest temperature, but one set may reach it near the Aldebarian stage, and another at the Crucian stage, or rather *between* the Crucian and Alnitamian stages, only a very small number of stars reaching the Argonian stage. It is very remarkable what a small percentage of stars reach the Argonian stage. It is fair to assume that the power of reaching these various stages of temperature must depend on the initial equipment of the swarm, and from this point of view a close inquiry into the mass and density conditions may be expected to help matters.

In all that has gone before I have dealt with a rise followed by a fall of temperature. I am bound to say that for years after I put this view forward as the only one acceptable on the meteoritic hypothesis it was generally scouted. This would not have mattered so much had the Harvard classification, with its thousands upon thousands of stars, not taken the other view of a continued fall of temperature, as demanded by the views formulated by Kant and Laplace.

There have been many signs lately that the opposition to my views is weakening; but the more they are accepted, the more is it necessary that a large number of stars should be added to those I have classified. We want tens of thousands of stars in homogeneous groups in order that inquiries may be prosecuted with advantage.

I showed in Fig. 1 of the fourth Bulletin that the letters A, B, F, K of the Harvard classification occurred in the spectra of stars located on both sides of my temperature curve, and although differences were indicated by sub-numbers, it is a common practice to use the descriptive letters alone, and it is difficult, therefore, to ensure homogeneity.

One of the great desiderata of the moment, therefore, is to inquire whether something cannot be done to render the stupendous and long-continued work of classification carried out at Harvard available under conditions which would ensure the complete homogeneity of the stars classed together. In order to study this question I have prepared tables which show the Harvard classification of the stars included in the Hill Observatory catalogues of 354 and 287 stars (PLATE 1). I chose these catalogues because the classification was carried on by the same three observers and with the same instrument, and the classification by each observer was carefully checked by the others. The dispersion employed between K and H_δ, 927 Ångström units, is equal to 28 mm.

My hope was that the same sub-numbers of the Harvard classification would not be found on both sides of the temperature curve.

In the comparisons I have previously made of the Harvard classification and my own I have indicated the Harvard classification of the stars chosen as the type star in each of my groups, but it will be seen from the present comparison that the Harvard classification, in consequence of the much greater detail which it attempts to secure, does not justify us, as I hoped it would, in giving a distinction between the letters and their accompanying numerals used on both sides of the curve.

But this difficulty is not common to all parts of the curve. Near the top, at the Crucian and Achernian stages, the greatest number of stars in which, on both sides, are classified B3, it is not of the highest importance to draw the distinction. In the case of the Sirian and Cygnian stars, where it is imperative that a complete separation should be chosen, the majority of stars in both are classified in A, with the exception of two classified as F, which probably may be due to misprints. But when we come to the difference between the Polarian and Procyonian and the Aldebarian and Arcturian, it will be seen that the attempt is hopeless. Twenty-two Aldebarian stars are classified as K, and forty-two Arcturian stars also classified as K.

NORMAN LOCKYER.

Hill Observatory,
August 21, 1919.

THE SUPPLY OF DRUGS DURING THE WAR.

WHEN war broke out, the National Health Insurance Commission was charged by the Government with the duty of safeguarding the position of this country with regard to the supply of drugs, and the Commissioners have just issued a memorandum [1] describing the work done in this connection. The work fell mainly into two categories, viz. (1) conservation of existing supplies by such means as restriction of exports and the most economical use of the materials available, and (2) encouragement of home production of fine chemicals used in medicine. The second is, of course, much the more interesting, and some of the results of this work were illustrated in the exhibits shown by various fine chemical manufactureres at the recent British Scientific Products Exhibition. Certain manufacturers took up on their own initiative the pro-

[1] Memorandum on the Special Measures Taken by the National Health Insurance Commission (England) in Relation to the Supply of Drugs and her Medical Stores during the War. Cd. 183. (1919.)