PHYSICAL ASTRONOMY. – *The ballistic theory and stars with continuous variation.* Note by MM. **Charles Nordmann** and **C. Le Morvan**, presented by M. Deslandres.

It is known that Mr. La Rosa proposed to explain the brightness variation of stars with continuous variation by the brightness fluctuations which would occur in the quantity of light that we receive from a star turning around a center, if the ballistic assumption of Ritz is exact.

We recently made the remark ([1]) that, such as it is, this explanation does not account for the observed fact highlighted by one of us (and since universally confirmed) that the amplitude of the brightness variation of variable stars continuously in variation is much greater in the most refrangible† than in the least refrangible part of the spectrum.

Since then, Mr. La Rosa ([2]) pointed out that to give an account of this fact it is enough to suppose that the center around which the variable star turns is

([1]) *Comptes Rendus*, **179**, 1924, p. 1139
([2]) *Comptes Rendus*, **180**, 1924, p. 912

† [Capable of refraction; e.g., violet rays are most refrangible rays.]

itself bright, and with which the spectral distribution of its light differs from that of revolving star. The introduction of this new assumption, however plausible, only confirms the point that we had made.

We propose to go further on this basis, with an analysis of the phenomenon.

Ignoring, with Mr. La Rosa, the brightness fluctuations of the central star whose movement is smaller than that of the companion, and calling I_r, I_b the intensities of the red radiations and blue sent by this star and i_r, i_b the intensities correspondingly given by the companion at the time of the minimum, the changes of the total light of two stars will be given by the relationship

$$\text{(a)} \qquad \frac{I_r + mi_r}{I_r + i_r} \quad \text{and} \quad \frac{I_b + mi_b}{I_b + i_b}$$

where m is the amplitude of the brightness variation due to the movement of the companion.

Let us apply, for example, with the specific case of β Lyrae these formulas indicated by Mr. La Rosa.

One has, by applying Pogson's law, for observations which provided (in stellar magnitudes) $0^{gr}. 66$ and $1^{gr}.34$ for the amplitude of the brightness variation of this star in the red and the green,

$$0.66 = 2.5 \log \frac{I_r + mi_r}{I_r + i_r}$$

and

$$1.34 = 2.5 \log \frac{I_b + mi_b}{I_b + i_b}$$

From this we deduce easily

$$m = 0.8\frac{I_r}{i_r} + 1.8 = 2.4\frac{I_b}{i_b} + 3.4, \quad \text{where} \quad m > 3.4$$

and

$$\frac{I_r}{i_r} = 3\frac{I_b}{i_b} + 2, \quad \text{where} \quad \frac{I_r}{i_r} > 2.$$

It follows that the main star (as for the mass) is (with regard to the red part of its spectrum) at least twice more brilliant than the companion. In addition, one has

$$\frac{I_r}{i_r} > 3\frac{I_b}{i_b}.$$

It follows that this main star must be, proportionally at least, three times more brilliant in the red or three times less brilliant in blue than the companion.

In a more general way, observations have shown than all the continuously variable stars studied so far in this respect, to our knowledge, have a greater variation of amplitude in blue than in the red. Since, by definition, *m* is necessarily larger than 1, we deduce from the formulas (a) above that for all these stars, we have

$$\frac{i_r}{i_b} < \frac{\mathrm{I}_r}{\mathrm{I}_b}.$$

It follows that in all variable stars with continuous variation, it is the companion that is proportionally richer in refrangible rays, that is to say, has a temperature higher than main star.

Such are some of the deductions which rise from the interesting explanation of the variation of stars drawn from the ballistic assumption by Mr. La Rosa. If this hypothesis is correct, it thus enables us to further penetrate these deductions in the physical knowledge of variable stars. But since the ballistic hypothesis is not proven, we can only consider these deductions as additional assumptions with which it is necessary to superimpose to give an account of the characteristics revealed in these stars by observation.