ART. LX.—*Note on the Companion of Sirius*;
by ASAPH HALL.

IN 1844, Bessel showed by a careful discussion of the observations of Sirius, that the right ascensions of this star could not be represented within the limits of their probable errors by means of a uniform proper motion. The residuals were distributed in a periodical form; and Bessel, after a simple and ingenious transformation of the equations of motion, and the assumption of a value for the annual parallax of Sirius, was led to infer the existence of a dark body near this star that disturbed its proper motion. This, indeed, seemed to be the only reasonable hypothesis left. It is evident, if we imagine such a system, that while the center of gravity of the two bodies would move in a right line, or apparently on the arc of a great circle, the stars themselves would be subject to periodical variations in their motions. Bessel's conclusion was criticised by W. Struve, in his studies on stellar astronomy, page 53 of the notes, who decided that Bessel was mistaken; but Struve's criticism does not seem to be well founded, and in 1851, Dr. C. A. F. Peters showed, in a very complete investigation of this question, that the observations of right ascension fully confirm Bessel's opinion. Peters also computed an orbit of the disturbing body, and found the time of its revolution to be fifty years. In 1861, Professor T. H. Safford found that the observations of declination indicate a similar disturbing force. In January, 1862, Mr. Alvan G. Clark discovered a companion of Sirius very nearly in the position pointed out by theory, thus confirming in a remarkable manner Bessel's hypothesis.

A very complete discussion of the observations of Sirius, both in right ascension and declination, and also of the micro-metrical measurements of the Clark companion during the first five years after its discovery, was published by Professor Auwers in 1868. The identity of this companion with Bessel's disturbing body, is, in the opinion of Auwers, put beyond doubt by his investigation. The elements of the disturbing body found by him are nearly the same as those found before by Peters, and the accuracy with which the observations are represented by the elements is so great that confidence in the identity of the two bodies is fully justified. The weight to which this result is entitled is very great, especially since the variable proper motion of Sirius has been investigated by four able astronomers. Yet there are some things which seem to me to throw a slight degree of doubt on the identity of the Clark companion with Bessel's disturbing body: First, the relatively great mass of the companion, which, according to

Auwers, is one-half the mass of Sirius, or if we assume Gylden's parallax of Sirius, $0''.193$, seven times the mass of our sun. Unless, therefore, we assume a special constitution for this companion, it ought to shine with the brilliancy of a star of the first magnitude, while in fact it is only of about the ninth magnitude. But the assumption of a peculiar constitution of the companion is purely arbitrary, and is not in itself plausible. Some observers, indeed, claim to have seen a disk to the Clark companion, but a real disk visible at the distance of Sirius would correspond to an enormous body, nearly filling the orbit of Venus; and, moreover, most observers have failed to see a disk.

Again, the micrometrical observations now extend over eighteen years, or more than one-third of the period of the disturbing body as determined by Peters and Auwers from the periodical variations in the right ascensions and declinations of Sirius, and these observations furnish some knowledge of the probable period of the Clark companion. The difference between the positions predicted by Auwers and the observed positions is not indeed very great, but the micrometrical observations indicate, I think, that the periodic time of the Clark companion will prove to be decidedly greater than what the disturbed motion of Sirius calls for. On this point we can not yet speak with confidence, but the doubt raised by the micrometrical measurements is sufficient, I think, to justify a suspension of judgment, and to incite astronomers to make careful observations of this interesting object. These measurements were begun in 1862 by Professor Geo. P. Bond, who found for that epoch

$$1862.19 \qquad 84^{\circ} \overset{p.}{61} \qquad 10^{\circ} \overset{s.}{07}$$

My own observations for the last seven years, together with the residual found by comparing with Auwers' predicted places, are given in the following table:

Date.	<i>p.</i>	<i>s.</i>	C — O.	
			$\Delta p.$	$\Delta s.$
1874.23	58°·05	11°·11	+ 7°·08	— 0°·19
1875.28	56°·38	11°·08	+ 6°·99	— 0°·34
1876.22	55°·22	11°·19	+ 6°·47	— 0°·65
1877.26	53°·38	10°·95	+ 6°·46	— 0°·68
1878.24	51°·68	10°·76	+ 6°·24	— 0°·79
1879.20	50°·13	10°·57	+ 5°·84	— 0°·91
1880.25	47°·83	10°·30	+ 5°·81	— 1°·08

It is not worth while to speculate on these residuals, since we are now approaching a critical time, and a few more years of careful observation will go far towards deciding the question of identity.

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