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NEW METHODS IN THE STUDY OF STELLAR SPECTRA¹

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THIS year marks the one hundredth anniversary of one of the greatest contributions to astronomy: In 1844 Bessel published a paper on the *Astronomische Nachrichten* in which he showed that the slow angular proper motions of Procyon and Sirius are slightly irregular and that in the case of Sirius the departures of the observations from uniform, rectilinear motion are suggestive of a period of fifty years. Eighteen years later Alvan G. Clark discovered a faint companion to Sirius in the place predicted by Bessel's successors. The period of this companion, according to a recent orbit by Volet, is 49.94 years—almost precisely the value deduced by Bessel. The extraordinary physical character of the companion of Sirius—the first white dwarf known to astronomers—has been the subject of many recent investigations on the structure of the stars and on the properties of matter in the

degenerate state. These remarkable advances in physical science were possible because Sirius is not a single star, but is a binary pair in which the brilliant primary serves as an indicator of the distance, size and mass of the system. The fundamental contribution by Bessel consisted in the use of a new method: The proper motions were used to reveal the existence of an invisible (until then) companion.

It is appropriate that in view of this anniversary I should devote my address to a description of several new methods which have been of help in our investigations of double stars. We are no longer dependent solely upon visual observations of wide pairs which can be resolved in our telescopes or upon accurate proper motions to infer the existence of invisible companions. Photometric measurements of the brightnesses of certain stars show periodic oscillations which can only be explained if we assume that in a close unresolved pair the plane of the orbit lies in the line of sight and that each component eclipses the other once

¹ Address of the retiring vice-president and chairman of Section D of the American Association for the Advancement of Science (1943).

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