

astronomer. The problem of the determination of an orbit from three observations is not exactly an enticing one. It is a tiresome piece of analysis which appears to offer little scope at the present time for the aspiring mathematician. In the case of a parabolic orbit the solution can even be made without successive approximations as M. Poincaré points out in the preface. In the case of an elliptic orbit, almost the only point of mathematical interest is the presence of a transcendental equation.

The treatises on this subject are well known, if not numerous. Gauss, in his *Theoria motus*, laid the foundations of the method at present in practical use, while Laplace a short time before had given a different form of solution. In the preface to the 'Leçons,' M. Poincaré has devoted some space to showing that Gauss's method is really equivalent to that of Laplace in spite of their apparent dissimilarity. The former has, however, been fully worked up with tables and formulæ for practical use in the great treatises of Oppolzer (of which there is a French translation) and Watson. In spite of the fact that a computer who has at his finger ends the notation and formulæ given in either of the last named volumes, will probably not care to change to another, M. Tisserand's work may nevertheless be found of use. The equations are developed quickly and easily, and moreover are all put together in a form which admits of immediate application. The young astronomer, unless he has acquired a firm grasp of his mathematics, may perhaps find it somewhat difficult to see the bearing of all the formulæ owing to the brevity of the explanations.

There are two chapters. The first on the method of Olbers for the determination of the orbit of a comet from three observations; the second on Gauss's method for the similar determination of the orbit of a planet. A numerical example of the latter, fully worked out, is set forth, showing the form in which the calculations would be actually made. Tables VIII and IX of Oppolzer's treatise are reproduced.

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*Vorlesungen über mathematische Physik, Band I. Mechanik.* Von GUSTAV KIRCHHOFF. 4<sup>te</sup> Auflage von W. WIEN. Teubner, Leipzig.

KIRCHHOFF's four volumes on mathematical physics which have appeared at various times since 1876 are so well known that little need be said about them here. The first volume