This, remembering (8), is the equation of the orbit. It is a conic whose focus is the sun, and axis is $(m, m_1, m_2) = \mu$. The eccentricity is $e = \frac{f}{M}$, the semi-parameter, $p = \frac{c^2}{M}$. Hence, the semi-major axis is $c^2 M / (M^2 - f^2)$, or a by (11). The center is $-a e (m, m_1, m_2) = -a e \mu$. We may put the orbit, therefore, in the form:

$$\rho = -a e \mu + \mu a \cos E + \nu b \sin E. \qquad e < 1.$$

$$\rho = -a e \mu + \mu a \cosh E + \nu b \sinh E. \qquad e > 1.$$

This substituted in (7) and integrated gives Kepler's equation

$$(13) \quad \begin{aligned} E - e \sin E &= \frac{c}{a b}(t - t_0) \qquad e < 1. \\ E - e \sinh E &= \frac{c}{a b}(t - t_0) \qquad e > 1. \end{aligned}$$

For analytical treatment see Dr. Dzisbek's Theories of Planetary Motion, pp. 1–13.

Notes concerning tests of the Purdue experimental locomotive. By Wm. F. M. Goss.

The Purdue experimental Locomotive Plant was installed early in the present year. It has been fully described in a paper read before the American Society of Mechanical Engineers at its San Francisco meeting, and a brief reference to the plan of mounting must serve the present purpose.

The driving wheels of the locomotive rest upon other wheels which are carried by shafts running in fixed bearings. When, as in the process of running, the drivers turn, their supporting wheels are driven by rolling contact. The locomotive as a whole instead of moving forward, remains at rest while the track, that is, the periphery of the supporting wheels, moves rearward. The locomotive draw-bar is connected with a series of scale-beams which constitute a traction dynamometer. Friction brakes on the shafts of the supporting wheels, interpose a resistance to the turning of the latter and, by so doing, supply a load for the locomotive. The whole arrangement is such that while the locomotive is fired in the usual way, it may be run under any load and at any speed, the conditions being similar to those of the track.

In the spring and early summer of the present year nearly a dozen runs were made. All were of a preliminary nature, the whole apparatus being entirely new, and the attendents unskilled in the management of the complicated mounting machinery.

At the beginning of the present school year the work was taken up anew. The object of the present work is, in general, to determine the performance of the engine under conditions varying, first, as to cut-off and, secondly, as to speed. To this end, five series of six tests each have been arranged, all to be run under a constant pulling load of 2500 pounds. This constancy of load makes the mean effective pressure practically constant for all tests, and the power developed dependent upon the speed. The load lacks but little of being equivalent to 10 horse-power for each mile per hour of speed.

All of the tests of the same series are run at the same speed, but each test varies from the others of the series by a change in cut-off. The second series differs from the first, and the third from the second, and so on, only in a change of speed. The first series at 15 miles per hour, and the second at 25 miles per hour, have already been run, and, in carrying them on, all conditions were as perfectly maintained as could be desired. The remaining series will be at 35, 45, and 55 miles per hour respectively. Every test is complete in itself. The observed data include speed, drawbar stress, coal and water consumption, calorimeter determination, draft and temperature in smoke-box, and cylinder performance as obtained by the use of four indicators. All tests are of three hours duration and are run without intermediate stops or change of speed. A comparison of results, first of the tests of each series, and secondly, of tests of the same cut-off in the different series, cannot fail to furnish an analysis of the performance of the locomotive which will be far more complete than anything hitherto attempted.

The electrostatic theory of cohesion and Van der Waal's equation. By Reginald A. Fessenden.

Quartz suspensions. By Benj. W. Snow.

A thermo-regulator for rooms heated by steam. By J. C. Arthur.