THE MOST POWERFUL LOCOMOTIVES EVER BUILT.

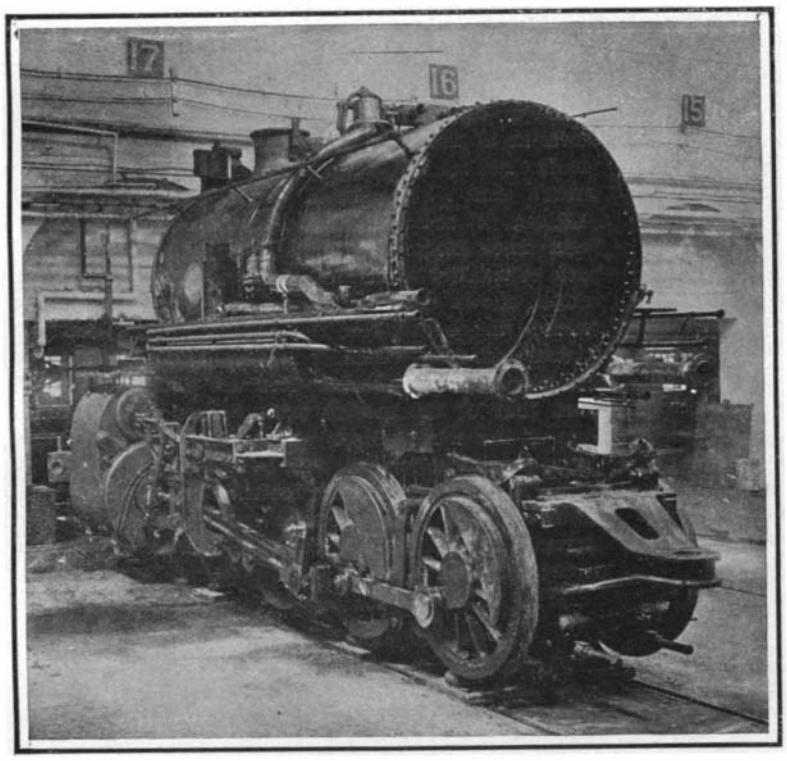
The Baldwin Locomotive Works have recently completed for the Southern Pacific Company two Mallet articulated compound locomotives, which are undoubtedly the heaviest engines thus far built for any railway. These locomotives have eight coupled wheels in each group, and in accordance with the previous practice of the builders, are equipped with two-wheeled leading and trailing trucks. The constructive details embody various features of special interest. The calculated tractive force of this design is 94,640 pounds. The locomotives will be used on the Sacramento Division between Roseville and Truckee, where the maximum grade is 116 feet per mile, and the rating 1,212 tons of cars and lading.

The enormous size of the engine will be readily appreciated from a study of the following dimensions: The high-pressure cylinders are 26 inches diameter by 30 inches stroke; and the low-pressure cylinders, 40 inches diameter by 30 inches stroke. The boiler is placed in the piping system between the high and low-pressure cylinders, is located in the smokebox.

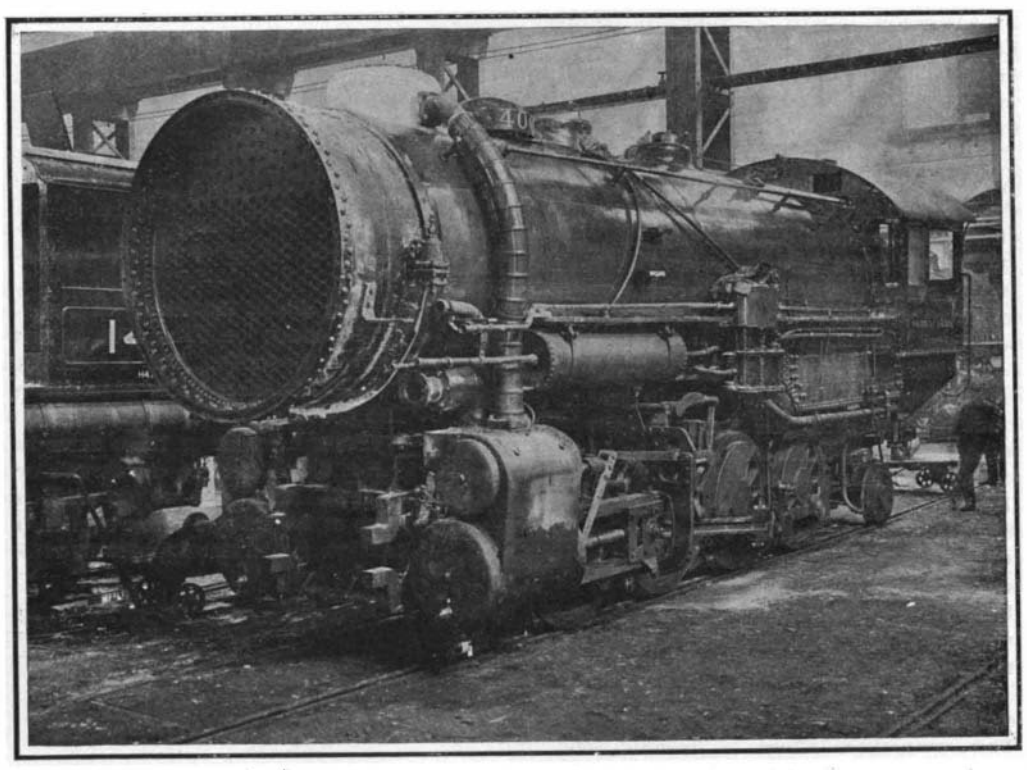
In order to facilitate repairs, the boiler is provided with a separable joint, which is placed at the rear end of the combustion chamber. The joint is effected by riveting a ring to each boiler section, and uniting the rings by 42 bolts, 1¼ inches in diameter. Two of the illustrations show the boiler separated at this point, the forward half resting upon the forward truck, upon which the low-pressure cylinders are carried, the rear half with the high-pressure cylinders being carried upon its own frame and wheels.

The waist-bearer under the combustion chamber is bolted into place, while the front waist-bearer and the high-pressure cylinder saddle are riveted to the shell. The dome, which is of cast steel, is placed immediately above the high-pressure cylinders, and the arrangement of the throttle and live steam pipes is similar to that used on heavy articulated locomotives previously built at these works. The exhaust from the high-pressure reverse shaft is placed on the center line of the engine, and is fitted with a universal joint located immediately above the articulated frame connection. The joint is guided between the inner walls of the high-pressure cylinder saddle. In this way the reversing connections are simplified, and when the engine is on a curve the angular position of the reach rod has practically no effect on the forward valve motion. This arrangement has been made the subject of a patent.

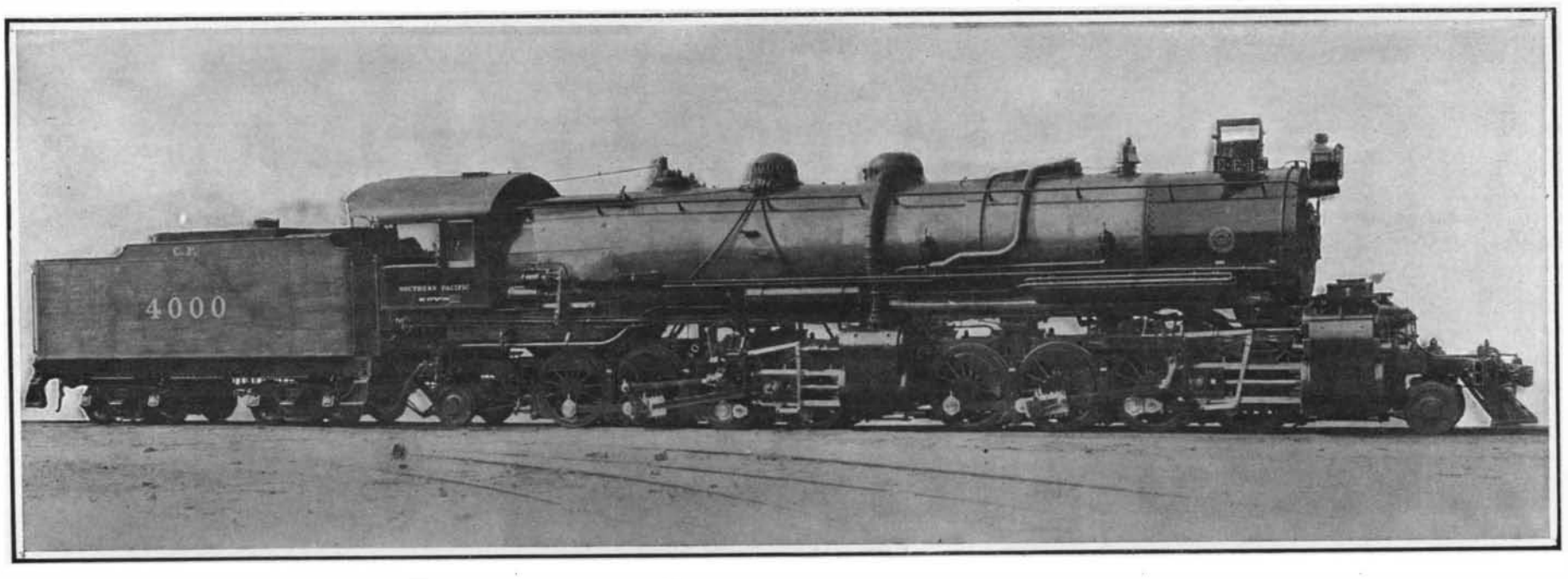
One of the locomotives is equipped with vanadium-steel frames, and the other with frames of carbon steel. The connection between the frames is single, and is effected by a cast-steel radius bar, which also constitutes a most substantial tie for the rear end of the front frames. The fulcrum pin is 7 inches in diameter; it is inserted from below, and held in place by a plate supported on a cast-steel crosstie, which spans the bottom rails of the rear frames between the high-pressure cylinders. The weights on the two



Low-pressure engine and truck with combustion chamber, superheater, and smokebox of boiler.



The boiler, separated at forward tube plate from combustion chamber. Mounted on the same frames are the high-pressure cylinders.



Total weight engine and tender, 300 tons. **Drawbar pull,** 94,640 pounds. **Cylinders:** Two high-pressure, 26 inches by 30 inches; two low-pressure, 40 inches by 30 inches. **Diameter of boiler,** 7 feet; heating surface, 6,393 square feet.

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84 inches diameter; the firebox is 10 feet 6 inches long; the fire tubes, 21 feet long; and the feed-water heater tubes, 5 feet 3 inches long. The total heating surface is 6,393 square feet. The steam pressure is 200 pounds to the square inch. The total weight on drivers is 394,150 pounds; the total weight of engine is 425,900 pounds; and the engine and tender together weigh just under 300 tons. The maximum pull on the drawbar is 47 tons.

The boiler is straight-topped, 84 inches in diameter, and is equipped for oil burning. The fire tubes are 21 feet long; they terminate in a combustion chamber, 54 inches long, in front of which is a feed-water heater 63 inches in length. Two non-lifting injectors are provided, and they discharge, right and left, into the feed-water heater chamber, which is kept constantly filled with water. The feed passes out through the top of the chamber, and is then delivered into the main barrel through two checks, placed right and left immediately back of the front tube sheet. A superheater, sure cylinders passes into two pipes which lead to the superheater. The steam enters the superheater at the front end of the device and passes successively through six groups of tubes. It then enters a T connection, from which it is conveyed to the low-pressure cylinders through a single pipe having a ball joint at each end and a slip joint in the middle. The steam distribution is controlled by 15-inch piston valves, which are duplicates of those used on the high-pressure cylinders. The final exhaust passes out through the front of each casting, into a T connection, which communicates with a flexible pipe leading to the smokebox. The slip joint in this pipe is made tight by means of snap rings and leakage grooves. At the smokebox end the ball joint is fitted with a coiled spring, which holds the pipe against its seat.

Reversing is effected by the Raggonet power gear, which is operated by compressed air and is self-locking. The gear is directly connected to the high-pressure reverse shaft. The reach rod connection to the groups of wheels are equalized by contact between the front and rear frames, no equalizing bolts being used in this design. The front frames are stopped immediately ahead of the leading driving pedestals, where they are securely bolted to a large steel box casting, previously mentioned, which supports the low-pressure cylinders.

The boiler is supported on the front frames by two bearings, both of which have their sliding surfaces normally in contact. The front bearing carries the centering springs, and the wear is taken, in each case, by a cast-iron shoe 2 inches thick. Both bearings are fitted with clamps to keep the frames from falling away when the boiler is lifted.

The locomotive is readily separable, as the joint in the boiler is but a short distance ahead of the articulated frame connection, and all pipes which pass the joint are provided with unions. The separable feature was tested by the builders, and proved entirely feasible. The tender is designed in accordance with Asso-

ciated Lines standards, and is fitted with a 9,000-gallon water-bottom tank. The capacity for oil is 2,850 gallons. The trucks under both the locomotive and tender are equipped with "Standard" solid forged and rolled steel wheels. The detail parts of this locomotive have, where possible, been designed in accordance with existing standards of the Associated Lines. The engine is practically equivalent, in weight and capacity, to two large Consolidated type locomotives, and in spite of its great size, presents a pleasing and symmetrical appearance.

$200 in Prizes for the Best Garden.

If you have a small garden and you are proud of it, the readers of American Homes and Gardens want to know all about it. For the encouragement of those who have converted an unsightly lot into a lovely, blossoming piece of ground, however small, the Editor of American Homes and Gardens offers cash prizes aggregating $200.

The prizes are offered for the best-planted, developed and successful village or suburban gardens. The Editor and the readers of American Homes and Gardens want to know how you planted your garden and what success you had with it. You need not be a skilled writer to compete.

The unusual opportunity offered in the Garden Competition should call forth immediate and practical results. It is a project that should appeal alike to the owners and creators of gardens, and to those who want helpful hints and suggestions on the making of a small garden. For it is the home garden, the inexpensive home-grown garden, for which these prizes are offered. In other words, the gardens of the people, as distinguished from the gardens of the gardeners. Everyone may have a small garden, even if it be but a front yard, and it is precisely these home gardens which are made and tended by the family that are sought in this competition.

The Garden Competition raises the plain question, Who has the best garden? And the readers of the Scientific American are invited, with the utmost cordiality, to answer this question.

If your garden is a small one, so much the better. No garden is too unimportant for consideration in this competition, for the award of the prizes will be based on the merits of the gardens as gardens, and not on their size and cost.

This competition affords a splendid opportunity to give many persons pleasure by making known the beauties of your own garden to them; but it should help and stimulate others in new and other garden work, by giving them some detailed information as to the successful gardens others have created. And if one garden is good, two are better and three more so, until a whole community may be alive with this richest of rural treasures. The practical questions are, How is it done, and what can be done? These two questions, it is hoped, will be abundantly answered in the material sent in for this competition. We invite our subscribers and readers, and their friends, and the friends of their friends, who have gardens that they think of real interest and beauty, or who may possess choice bits of garden loveliness, to enter this competition

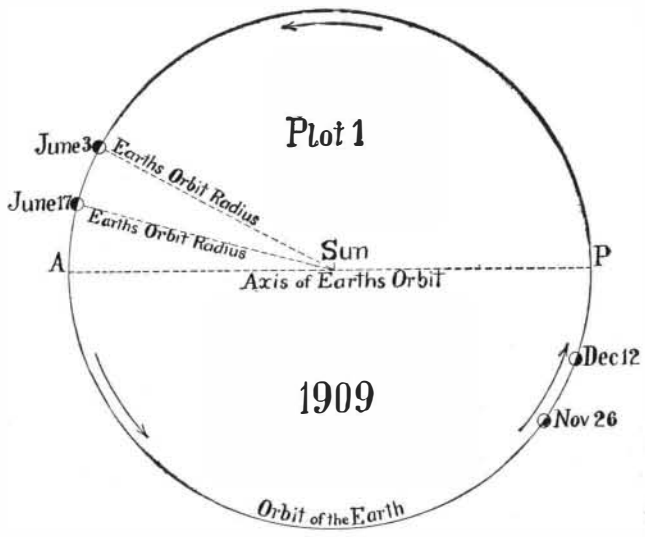
The full conditions of the contest will be found in the May number of American Homes and Gardens.

THE LUNAR AND SOLAR ECLIPSES IN JUNE, 1909.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

The gradual advance of the dates of eclipses was clearly illustrated in the year 1908, which included narily, the line of nodes comes into line with the radius of the earth's orbit twice each year, and an eclipse is possible only when the moon is at or near one of the nodes. In nine years the plane of the moon's orbit makes one-half a rotation; and as a consequence, one more eclipse season is included in the number which belongs to this period.

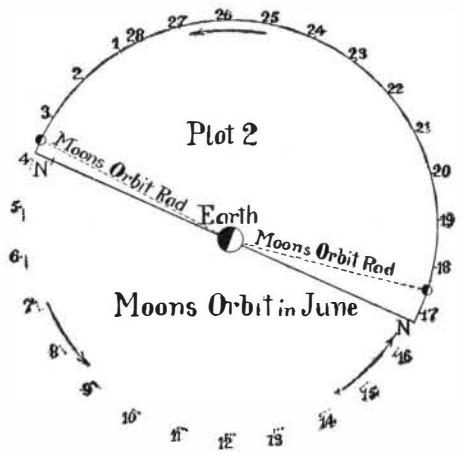
In the year 1909 there will be two eclipses of the



Position of the earth at the time of the ecl.

sun and two of the moon—on June 3rd, a total eclipse of the moon; on June 17th, a central eclipse of the sun; on November 26th, a total eclipse of the moon; and on December 12th, a partial eclipse of the sun. The position of the earth at the time of the eclipse is shown for each of these dates in Plot 1.

Plot 2 is a plot of the moon's orbit for the month of June. That part of the orbit which is above the plane of the ecliptic is represented by a full line. The position of the moon is shown at Greenwich noon for



The moon's orbit for the month of June.

each day from the 1st to the 28th and also for the 3rd and 17th at the time of the eclipse. In each case the projection of the moon's orbit radius on the plane of the ecliptic would coincide with that of the earth if the two plots were combined in one drawing. Since they are shown separately, they are respectively parallel; and the line of nodes *N N'* is shown in its position relatively to the orbit radii of the earth and moon.

Figs. 1 and 2 are projections of the earth on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic at the dates of the eclipses. In these projections more than one-half of the visible hemisphere is illuminated between the dates of the vernal equinox and the summer solstice. This area gradually diminishes as illustrated in the figures, which may be compared with the positions of the earth shown at the corresponding dates in Plot 1.

On June 3rd, 13.5 h., when the moon will be near the descending node *N'*, she will come wholly within the earth's shadow. The eclipse, seen in the direction of the arrows, will be partly visible at Washington, the moon rising eclipsed. The beginning of the eclipse will be visible in South America, Africa, Europe, and southwestern Asia. The end will be visible in Africa, central and western Europe, South America, and nearly the whole of North America.

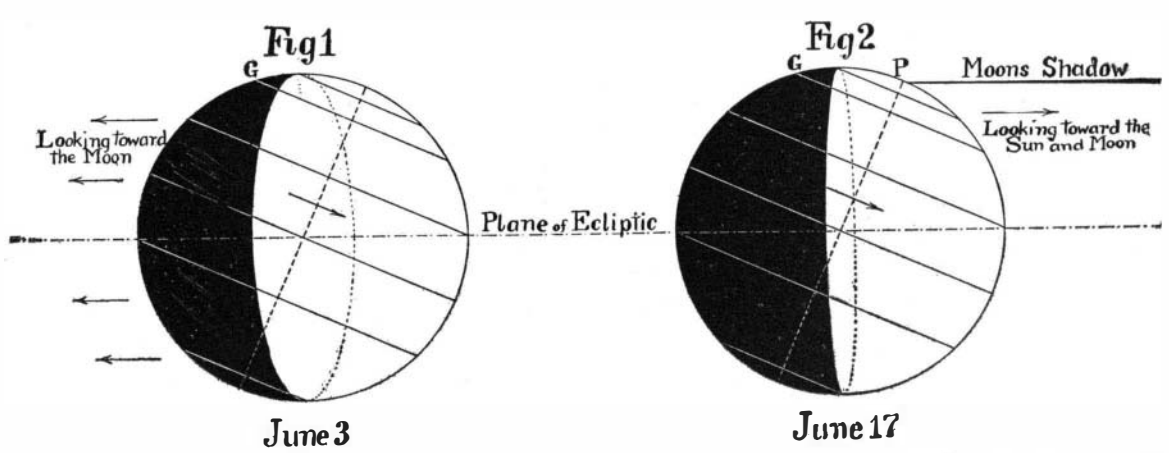
During the interval between the two eclipses the moon's orbit will be below the plane of the ecliptic, as shown by the dotted line. The eclipse of the sun on the 17th (17 d. 11.5 h.) will occur some time after the moon has passed the ascending node *N*. The distance from the ecliptic will be so great that the vertex of the moon's shadow will pass very near the north pole. (Fig. 2.) The path of the moon's shadow is shown in Fig. 3, which is an enlarged projection of a portion of the earth's surface near the pole on a plane which is perpendicular to its axis. In this projection the position of the meridian of Greenwich, and of one from which a central eclipse will be visible at noon, are shown. The latter, in Fig. 2, is indistinguishable from the great circle which represents the earth, which is approaching the summer solstice, when the meridian at noon will coincide with *a b*, the plane perpendicular to the ecliptic which will contain the earth's axis. The central eclipse between latitudes 51.5 deg. N. and 64.25 deg. N. will be total; and beyond these limits it will be annular. In Fig. 3 the path of totality is limited by arrowheads. A central eclipse shows that the vertex of the moon's shadow reaches the earth where the eclipse is total; and that it does not quite reach it beyond these limits; i. e., the length of the shadow does not differ very much from that of the moon's orbit radius, which at the date of the solar eclipse will be about 236,000 miles. As a partial eclipse it will be visible in nearly all North America, Greenland, Iceland, Japan, north Philippines, China, Siberia, and a small part of northern Europe. It will be visible at Washington, the sun setting eclipsed.

A $10,000 Aviation Prize for America.

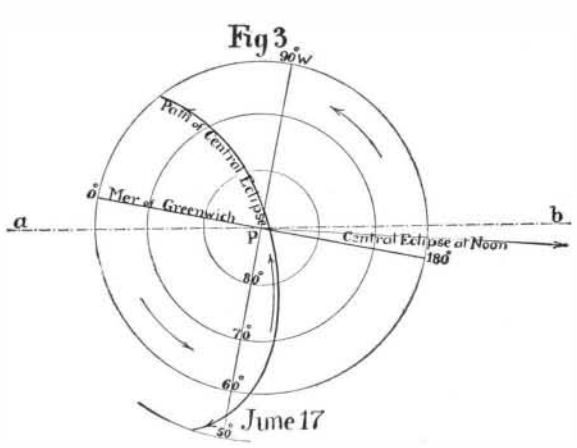
With a view to encouraging inventors to complete their machines and make flights this summer at New York, the Aeronautic Society has decided to offer a prize of $10,000 for a flight of 100 miles. This prize will be divided into five sections, the first of which—$2,000—will be awarded to the aviator who makes the fastest circuit of the Morris Park race track—1¾ miles—at the first 1909 exhibition and meet of the Society on the 29th instant; or, if no machine makes the flight on that date, to the first one that accomplishes it upon any subsequent exhibition-flight day, which will probably be Saturdays throughout the summer. Proportionate amounts will be given for a flight less than a complete circuit on May 29th. As soon as the first section has been won, announcement will be made of the flight required to win the second section, etc.

The offering of so liberal a prize *for flying machines only* at this time should make it worth the while of wealthy sportsmen to aid inventors to a considerable extent financially, with the object in view of winning it. Besides flying for the cash prize, each aviator can at the same time set up a record for the Scientific American Trophy—a record which, if unsurpassed during the year, will entitle the holder to be declared the winner for 1909 and to have his name and record inscribed upon the trophy. Any aviator winning it three times in three different years will become the permanent winner.

To encourage its members, over a score of whom are building aeroplanes, the Aeronautic Society has offered three $250 prizes for the first three machines making a flight of 500 feet at Morris Park.



Projections of the earth on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic at the dates of the eclipses.



The path of totality.