

THE OPPOSITION OF MARS IN 1909.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

The prospect of another favorable opposition of the planet Mars in the near future, while the memory of the observations which have been made recently is still fresh in the mind, will encourage observers of this interesting planet not to spare any effort in the endeavor to learn all that is possible regarding its surface markings. If the opposition of July, 1907, was a favorable one, that of September, 1909, will be still more so; for the planet this year will come nearly two million miles nearer the earth.

In a plot of an orbit which is constructed within the limits of this page, and in which very great distances are represented by very short lines, it is difficult to exhibit to the eye a difference of two million miles. If the plot be made carefully, however, this difference may be measured, and will correspond to scale with that which is found in the Nautical Almanac. The axis of the earth's orbit *AP* (Fig. 1) represents nearly 186,000,000 miles; and the nearest approach of Mars to the earth's orbit, which is near the perihelion *P*, is a distance of about 35,000,000 miles.

On August 21, 1908, the planet was near aphelion *A*, and at its maximum distance from the earth. If the sun were out of the way, it could be represented as in Fig. 2 at the date attached. After this, Mars became morning star and increased in apparent diameter, presenting the gibbous phase. The apparent diameter is inversely proportional to its distance from the earth. Between August 21 and October 21 the planets were moving in opposite directions, and as a consequence on October 21, two months after conjunction, the distance between them was not sufficiently diminished to greatly increase the apparent size. After December 21, as the distances between the earth and Mars diminish, the diameter increases rapidly until opposition is reached. Since this occurs near the close of the day (the 23d) the date of opposition given in the Almanac, the positions of the earth and Mars are shown for the 24th; i. e., at the beginning of the following day. On account of the eccentricity of the planet's orbit, the minimum distance is reached six days before opposition. For the same reason, in July, 1907, the minimum distance was reached a week after opposition. In order to compare the distance between the earth and Mars at the opposition of 1907 with that of 1909, at the former date the positions of the planets are indicated in the plot; and the effect of the diminution of distance in increasing the apparent diameter at the latter date, is shown in Fig. 2.

An opposition unfavorable for observation would evidently occur when Mars is near aphelion *A*, and when the distance between the planets is about 61,000,000 miles. Fig. 3, drawn to the same scale as Fig. 2, shows the apparent diameter of Mars at the most favorable and unfavorable opposition, i. e., when the planet is near perihelion and aphelion. The distance varies between 35,000,000 and 61,000,000 miles. The diameter is diminished in the proportion of 7 : 4; and the area of the planet's disk in the proportion of about 3 : 1. At an aphelion opposition the apparent diameter of the planet is not very much in excess of that which is shown for June 21, three months before opposition occurs this year.

The positions of the earth and Mars are shown for the opposition of 1911, which will occur on November 24. On account of the eccentricity of the orbit, the planets will be separated by their minimum distance a week sooner, when the apparent diameter will be less than that which corresponds with August 21, and greater than that of June 21, 1909.

The illustrations here given are designed to call attention to the rare opportunities which are afforded the inquiring student of astronomy by the oppositions of 1907 and 1909. The present times afford exceptional advantages in the study of our celestial neighbor, being midway as we are between two remarkable oppositions. Thus for the practical observer and the theorist there is opened an extensive field for inquiry and speculation. The positions of the earth and Mars at the dates of oppositions during the past seventy-five years if plotted would show that oppositions occur on the average at

intervals of two years and fifty days; but owing to the eccentricity of the planet's orbit, there is a great variation in the lengths of these intervals.

The Postal Department and the Automatic Stamp-Vending Machine.

To the present Postmaster-General of the United States is due the first comparative investigation of coin-controlled stamp-vending machines for government use. A few months ago a number of promising machines were tested at Washington with a rigor that was bound to expose any inherent defects. To an official whose specialty seems to be the legal rifling of such apparatus was assigned the task of robbing each machine, either by means of counterfeit money or slugs, or by inserting thin instruments through the slots in order to operate ratchets and levers, so that stamps could be extracted without the insertion of any coin whatever. Most of the machines were unable to withstand this mechanical pocket-picking, and were accordingly rejected. Others were too cumbersome or were so complicated that only a graduate engineer could buy a stamp from them.

As a result of this investigation, in which the machines were abused as no thief could ever abuse them, the Postal Department finally selected a simple auto-

The Improvement of the Columbia River.

BY DAY ALLEN WILLEY.

The Columbia River, which is the most important waterway in the western part of the United States, extends a distance of 1,400 miles from its mouth to British Columbia, where it has its source. Including its tributaries, it forms a system of waterways available for steamboats and barges aggregating 2,132 miles. This is not continuous, however, for the channel is obstructed at two different points. One of these obstructions is formed by what is called the Cascades, a series of rapids located 60 miles from the city of Portland. Here the government built, about twelve years ago, a lock canal. The canal has a depth of 8 feet and is 3,000 feet long, and it contains two locks, each of which is 462 feet in length, and capacious enough for much larger craft than pass through it to the upper river.

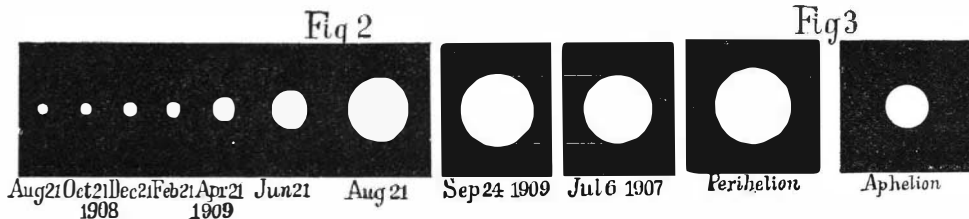
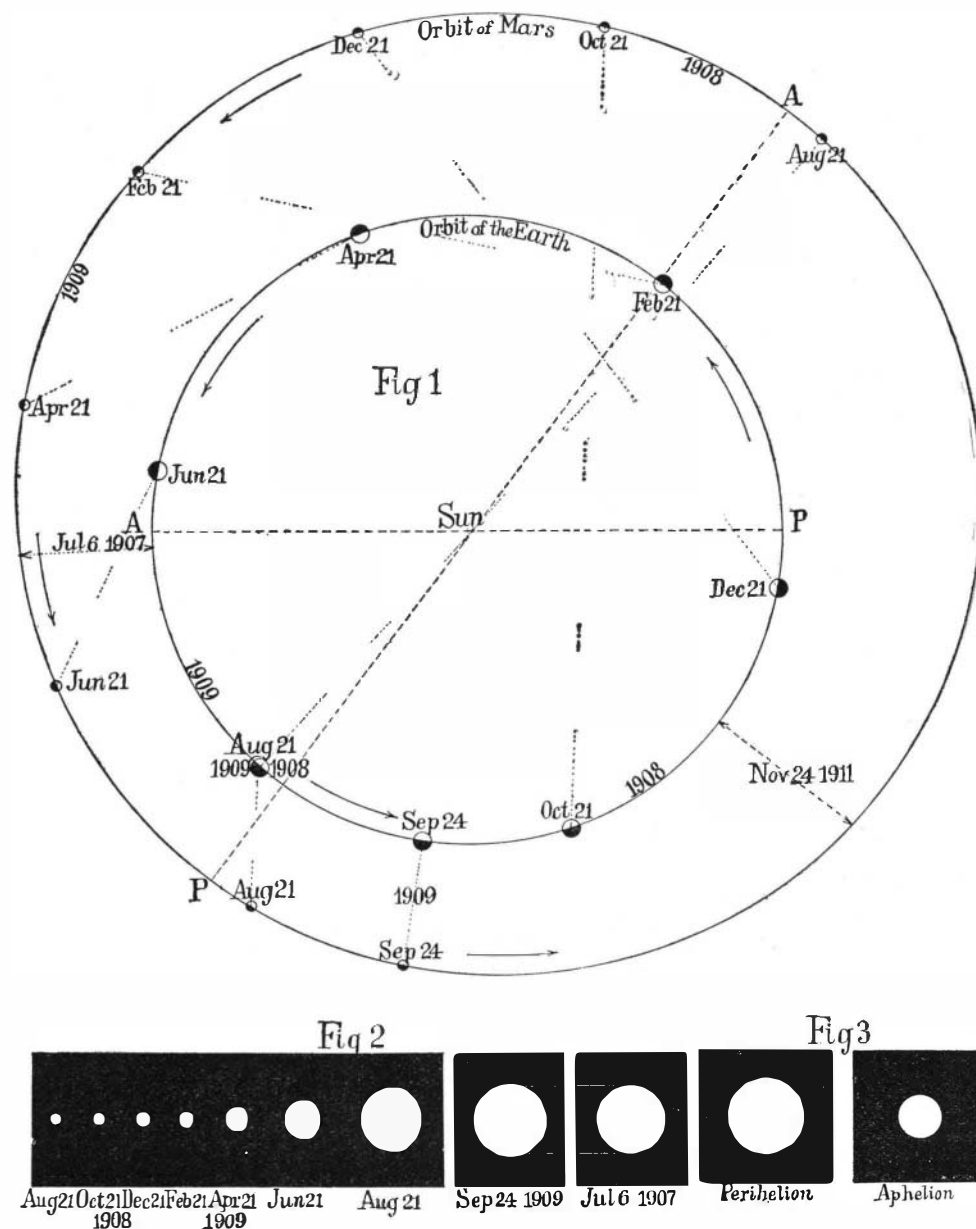
With the aid of the canal, steamers can travel from Portland to what are called the Dalles, a distance of about 200 miles. Here, however, the natural obstacles are very great, and to overcome them an elaborate engineering scheme is now being carried out. The river, for a distance of several miles, flows swiftly through a series of gorges which it has cut out of the rock formation in this part of Oregon. For the purpose of overcoming this obstruction, the United States engineers decided to build the Celilo canal, plans for which were approved by the Secretary of War about four years ago, along the Oregon shore, from Celilo Falls to Big Eddy on the Columbia River, the latter a formidable rapids located about four miles east of the Dalles. The proposed canal has a length of 44,880 feet, a width of 65 feet on the bottom, with locks 300 feet long. The channel of the river for the entire length of the canal is obstructed by reefs, submerged rocks, and falls, which make navigation impossible.

The building of the canal involves some heavy concrete construction. One retaining wall alone, built through the lowlands, west of the intake, will be 1,400 feet in length. The concrete side walls of the canal will in some places be 56 feet from bottom of foundation to coping, and the floor will be covered with concrete 18 inches in thickness. Practically eight miles of excavation, most of which will be in solid rock, in addition to the lock building and concrete work, remain to be done.

With the work now under way completed, continuous navigation of the Columbia will be extended from the sea to the Priest Rapids in the State of Washington on the main river. This will make a total navigable mileage in the river proper of about 400 miles; but, as already noted, the Columbia has several large tributaries, especially above the rapids referred to, and a very large area of Washington and Oregon may be reached by river craft. This area comprises not only an extensive wheat-growing country, but cattle and sheep ranches and fruit farms, as well as an extensive mining

district. There are some counties in this region which are entirely destitute of railroads, and their commercial products are hauled from 50 to 75 miles to the nearest stations by freighting outfits. As the improvement referred to will allow craft carrying nearly a thousand tons to ply upon the upper Columbia, it must be regarded as one of the most important engineering projects which has yet been undertaken by the government. Engineer Mr. William G. Carroll of the United States War Department is in charge of the undertaking.

It has been decided to construct a new section of the Rhodesian Railway between Gwelo and Blinkwater, on the borders of the Victoria district. This section, which has a total distance of fifty-two miles, will tap a very rich agricultural country, and also traverse a mining district. Work on the section has already commenced, and it is expected the whole line will be finished within a year. The capital necessary for the line has been promised by the Beit trustees out of an amount left by Mr. Beit in his will for African railway construction. The new line will connect with the Cape to Cairo Railway at Bulawayo. With regard to the extension northward toward the Congo border, on the main Cape to Cairo line, negotiations are still in progress for providing the necessary capital.



THE OPPOSITION OF MARS IN 1909.

matic apparatus, which resists the most ingenious attempts to rob it of its contents, which rejects foreign or defective coins or slugs, and which does not depend for its operation on any power or winding device. The mere insertion of a coin is the only function which the purchaser of a stamp is called upon to perform.

The apparatus selected in reality consists of three machines compactly inclosed in a single casing and designed to sell one, two, and five cent stamps. The lower part of the casing is a letter-box, in which the stamped letter may be deposited. The first machines which the Postal Department has ordered will be installed in large hotels. In all probability similar machines will soon be found in almost every drug store and public institution.

An Important English Patent Decision.

A case has recently been decided in England under the compulsory working clause of the new British patent law, in which it is held that in order to comply with the act the whole machine must be manufactured in the United Kingdom, and not merely certain parts. The applicant for revocation need not necessarily be an Englishman. He may be a citizen of any country. In this particular case the applicant was a German firm selling German-made machines.