The movable canal lock as designed by Signor Bartolomei consists primarily of a paddle wheel placed across the section of the canal, with the axis of the wheel resting on iron rails set into the retaining walls at the sides. It is presupposed that the canal is an inclined one, as otherwise there would be no use for locks. The canal may have an inclination of from 3 to 6 or even 7 per cent, and the grade need not necessarily be constant, but different stretches have different grades.

A clear idea of the system can best be obtained from the accompanying drawings and photographs, which were made from the model of the system which Signor Bartolomei has built near Rome. The writer made a thorough study of the model while on a visit to Rome recently. The model canal is about 80 feet long, the width between the rails 14 inches, while the distance from the base of the canal to the running base of the rails is 6 inches. The sides of the canal are perpendicular, and the bottom in cross section is horizontal. The iron T-rails are placed on offsets in the walls, at a distance of about 2 inches from the top of the walls, the base of the rails being placed flat on the offsets. The small boat used is barge shaped, is 3 feet 6 inches long, and draws 4 inches of water. The canal has 25 feet each of 3, 4, and 5 per cent inclines, the remaining 5 feet being open. As may be readily seen from the drawings, the paddle wheel just about closes the canal, the opening below the wheel being about ⅜ inch, or just enough to allow a slightly less quantity of water to pass under the wheel than comes down the canal. The wheel is then locked by a simple device, and the water backs up for a distance of 15 to 20 feet, thus giving a head of about 6 inches. The wheel is then unlocked and immediately begins to revolve, rolling upstream by the aid of the power generated with this head. The greater the head, the faster the wheel moves, thus allowing the water to pass under the wheel faster. When the water has reached its normal head of 6 inches, the wheel assumes its normal speed, which in the case of the model was about one-half mile per hour. It will be seen that the movement of the lock, if it may be so called, is automatic. It should be mentioned that the amount of traffic would make no difference, so long as the boats keep a few hundred feet apart. To stop or hold the boat at a certain point, it is necessary only to lock the wheel and raise it enough to allow the correct quantity of water to pass under to keep the boat afloat.

So far we have been concerned only with the movement of the lock up the canal. A separate canal should be used for the traffic in the other direction, but exactly the same principle of the water wheel is employed. The main axis of the wheel for the descent is carried upon a truck supported by four wheels running directly upon the rails. With the action of a hand wheel, the wheels on either side of this truck may be brought closer together, so that they will raise the axis of the main wheel, taking it off the rails for a fraction of an inch; in other words, just enough to keep it from exerting its tractive force on the rails, and still not measurably increase the flow of water under it. Although the rotation, as well as the action, of the wheel will be exactly as in the upstream movement, the power will be transmitted through the two wheels direct to the rails. The rails of the truck will turn in the opposite direction from that of the water wheel; and as they, and not the water-wheel axis, rest on the rails, the boat and the wheel are propelled downstream, and with the same velocity as in the opposite direction.

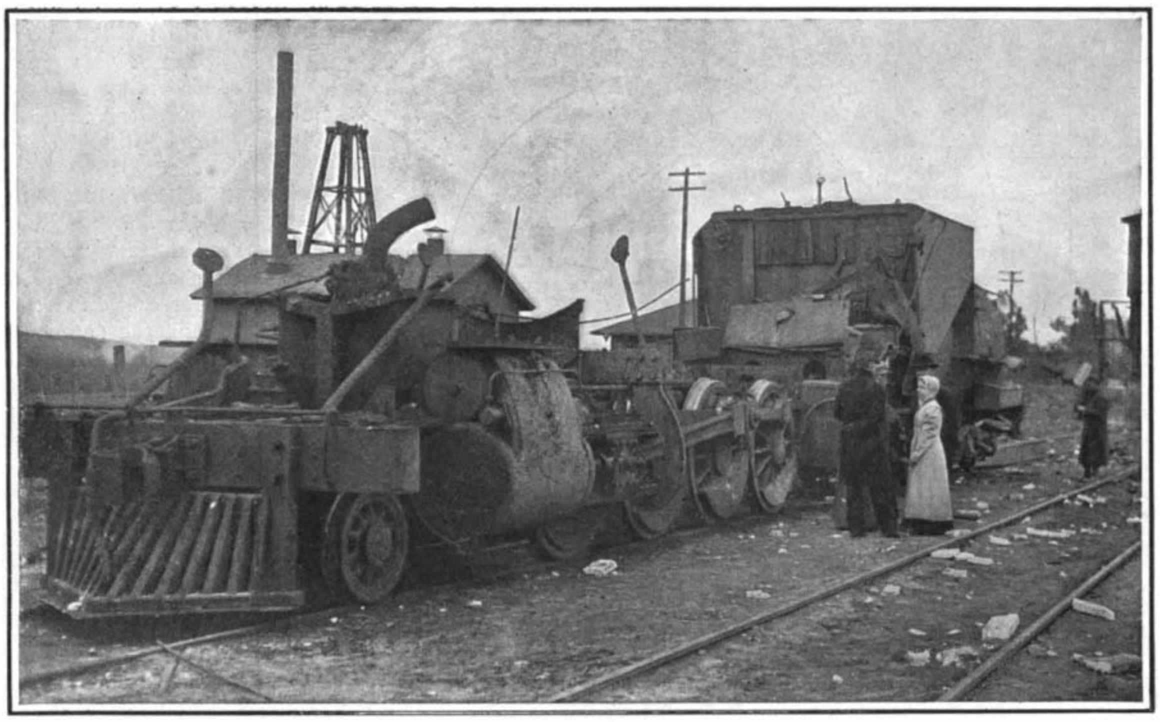
The getting of the boats in and out of the canal is done by having slips connected with the canal at certain points, in which the water would be held at a definite level. At the entrance to the main canal there would be no obstruction excepting the rail on one side, and this could be lifted to permit the ingress and egress of the boats. The wheel would be allowed to propel itself down the canal for a short distance, while boats were taken in and out of the canal proper.

Mr. Alexander Potter, the well-known consulting engineer and an expert in the subject of hydraulics, has made an examination of the plans for this type of lock, as well as of the various hydraulic questions which enter into the solution of the problem. Mr. Potter states: "In a canal built upon a grade of 4 per cent, boats 120 feet long can be passed through the canal where there is an available water supply of 12 cubic meters per second. Comparing this with the amount of water supplied in passing boats on a flight of locks such as those on the Erie Canal at Cohoes and at Lockport, the amount of water required for the Bartolomei system is no more than that required for the operation of the Erie Canal for the same tonnage.

"From a theoretical standpoint, there is no question that a movable canal lock designed on the Bartolomei principle will operate satisfactorily. The device will be self-regulating, that is to say, when the tendency of the wheel is to go too slowly, the head of the water back of the wheel will increase, thus creating a greater force to make it move faster; and when the tendency is for the wheel to move too fast, the head will fall, thus decreasing its speed.

"There are certain problems in connection with this interesting device which have not been worked out by the inventor in sufficient detail; among these may be mentioned a mechanism for arresting the lateral motion of the wheel and for reversing the same; also prompt removal of the water wheel to permit egress from and ingress to the movable canal lock by the boats. While these problems may at first appear difficult, they can be readily mastered. The structural details of the wheel have not been worked out for a large scale, but this also is a problem capable of proper solution.

"In places where this invention can replace a flight of locks, there is no question that there will be a saving in the time of the passage of a boat through the locks, and its adoption would result in an economy of construction. Where ample water is not available, the value of the invention is of course greatly reduced."



The locomotive after the boiler had been blown away.

EXPLOSIVE ENERGY OF A BOILER.

The accompanying photographs illustrate in a striking manner what a magazine of explosive energy a steam boiler may be. They represent the wreckage of a locomotive, the boiler of which exploded at Beaumont, Cal., on the 12th of last month.

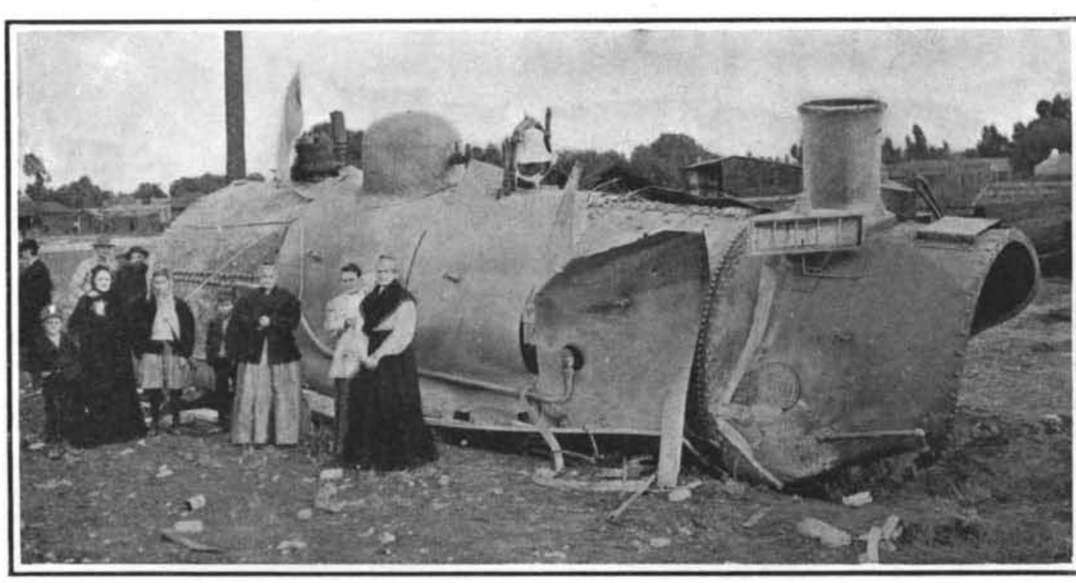
The boiler was wrenched from the trucks and shot upward and forward, turning end over end several times, according to an eye-witness, before it fell on its forward head 65 yards from its trucks, striking an empty oil-tank car. From this it ricocheted another 30 feet, turning end over end, alighting on its firebox end and again 40 feet before coming to rest in the position shown.

When the boiler struck the oil tank it drove in the head of the latter, twisted its steel frame, and drove two of its truck wheels down through the rails, which were broken in four places.

The front end of the locomotive, with its smoke-box door, was blown clean off, alighting 100 yards ahead of the engine and bounding over a pile of ties onto a side-track.

A small piece of wreckage was shot straight up in the air, and descended upon the tender with sufficient force to cut a clean, smooth, perpendicular slot, 12 inches long, through the side of the water tank, emptying the tank of water. The force of the explosion wrecked a freight car standing on a siding opposite the engine, although the car apparently was not struck by any heavy part of the locomotive.

A local board of inquiry reported the explosion as being due to low water, stating that the crown sheet of the boiler must have been 7 inches uncovered, although the evidence indicating this is not mentioned and must have been difficult to determine. Evidence of stoppage or other failure of the water-gage was inconclusive, so that it is difficult to see how the en-



Portion of boiler after being blown 265 feet through the air.

Oil-tank car struck by the boiler in its flight.

EXPLOSIVE ENERGY OF A BOILER.

gineer, a careful and steady man, who was, unfortunately, killed, could have permitted his water to get so low without being aware of the fact.

The rupture of the crown sheet was, however, sufficiently evident as the probable initial failure; and the turning of the boiler end over end in its flight is further evidence of one end having been thrown violently upward.

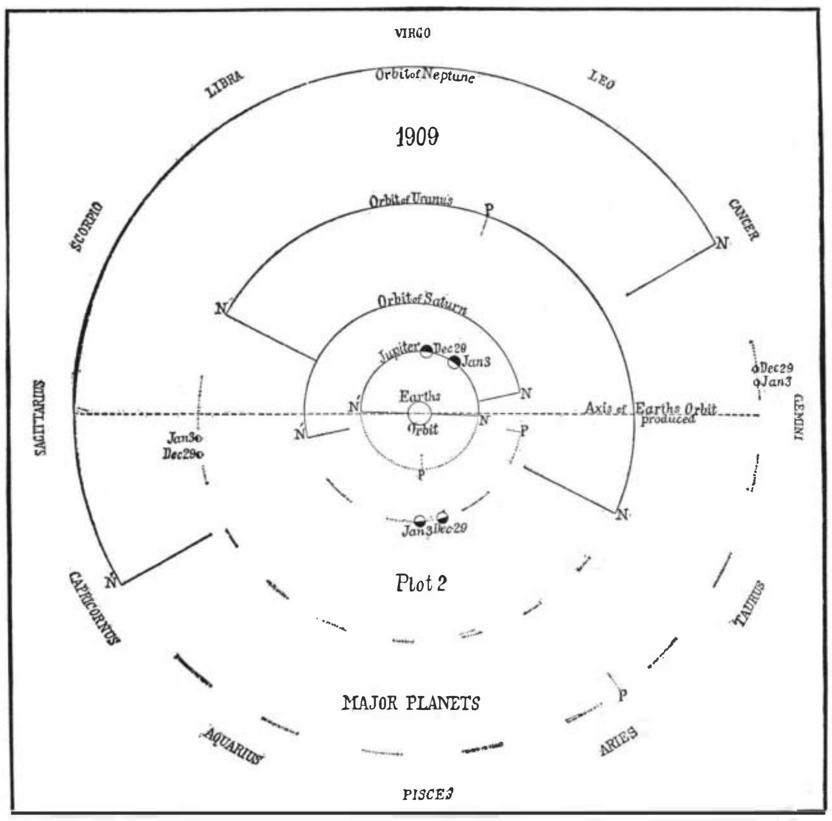
MORNING AND EVENING STARS FOR 1909.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

The observer of the heavens whose purpose is to become familiar with the positions of the stars in their apparent daily revolution around the earth will be greatly assisted by a star map. A star map gives the positions of the fixed stars; the celestial equator, from which declinations are measured; the first meridian, whose intersection with the celestial equator is the point from which right ascensions are determined; and the ecliptic, or intersection of the plane of the earth's orbit with the celestial sphere. It is desirable to locate these circles approximately by actual observation. This is easily done by observing a number of conspicuous stars which in the star map are near the circle whose position is sought. For example a line stretched across the heavens from Polaris to β Cassiopeiæ will give approximately the first meridian. This is the leader of the five stars which form the irregular W. If this line be extended in the opposite direction, it will pass between γ and δ of Ursa Major, and divide the northern heavens into two equal parts. The fixed stars appear to revolve around the earth, rising and setting nearly four minutes earlier each day. Their distances from the earth are so great that to the ordinary observer their apparent positions are not disturbed during the year by the motion of our planet in its orbit at the rate of eighteen and a half miles a second; and it is only necessary to observe them often enough to become familiar with their places in the heavens.

The positions of the members of our planetary system are not so easily determined. The planets revolve around the sun with varying velocities, and are continually changing their places relative to each other and to the earth.

The plots herewith presented have been designed to assist the observer in seeing at a glance which of the planets are above the horizon before sunrise; and those which are above after sunset. The orbits of the four terrestrial planets are shown in Plot 1; those of the four major planets in Plot 2. The plane of the earth's orbit, or the plane of the ecliptic, may for convenience be regarded as horizontal. This is obviously an assumption, because the positions of the heavenly bodies are relative, and there is in reality no plane of reference. It is convenient, however, to place this page horizontally, and to regard it as representing the plane of the ecliptic. When a planet is on one side of this plane it will be described as above, and when on the other side as below this plane.



PLOT II.—SHOWING THE POSITIONS OF THE MAJOR PLANETS FOR THE YEAR 1909.

THE EARTH.

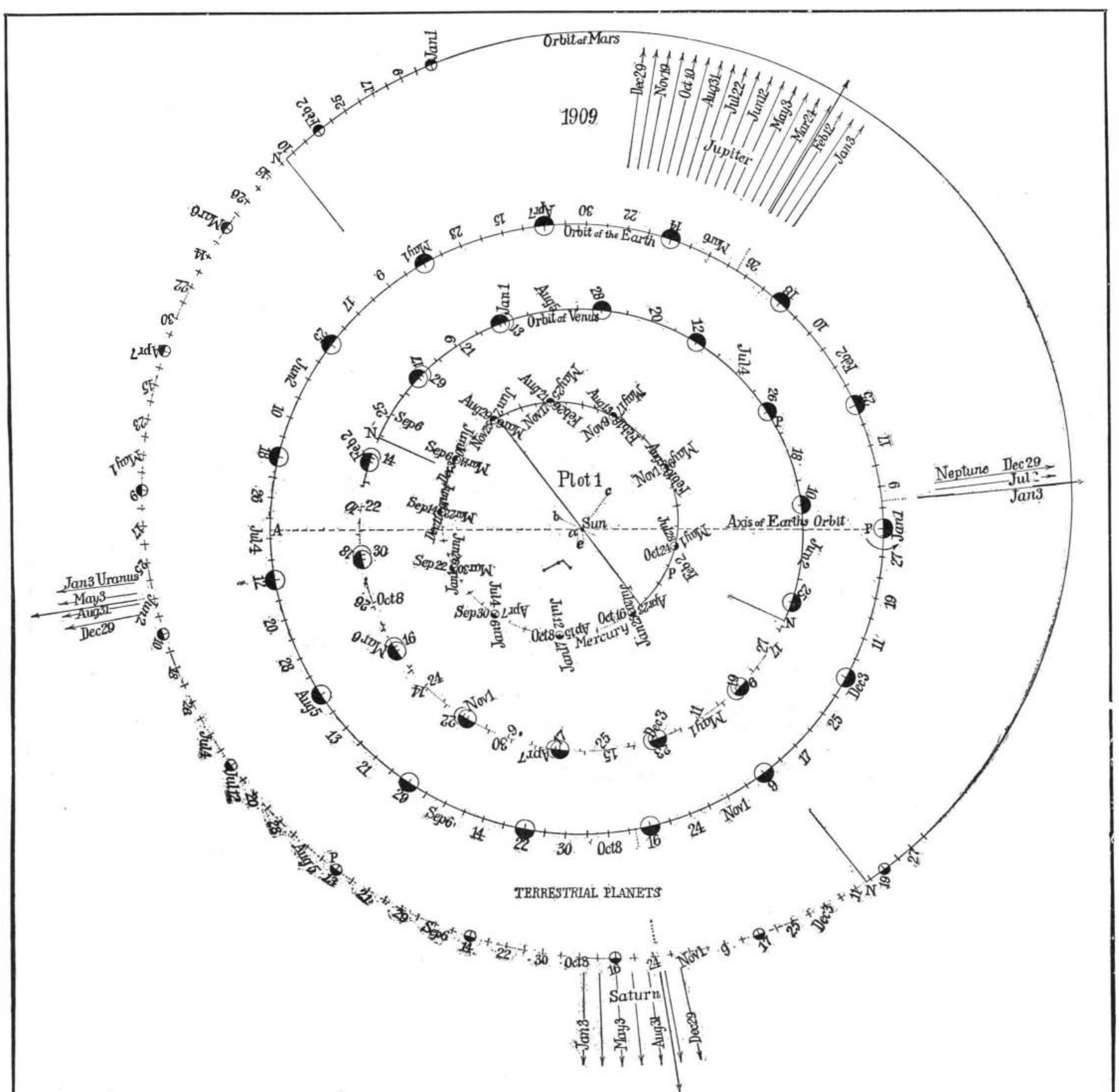
Since observations of the planets are made from the earth, a brief description of the terrestrial orbit (Plot 1) is first in order. It is an ellipse with the sun at one focus. The distance from this focus to *a*, the center of the orbit (= *e*) is a little over one and a half million miles. At *P*, the point of nearest approach, or perihelion, the earth's distance from the sun is nearly 91½ million miles. At *A*, the other extremity of the orbit's axis when the earth is at aphelion, this distance is increased to nearly 94½ million miles. Since the earth makes one revolution around the sun in 365¼ days, the average distance it moves each day is 360 ÷ 365.25 deg., or a little less than 1 deg. This average is equal to nearly 1,600,000 miles a day, allowing for an increase of velocity at perihelion in January; and a diminution at aphelion in July. The earth's rotation on its axis is absolutely uniform; i. e., the length of the sidereal day does not vary a fraction of a second; but its velocity in its orbit is continually changing. The earth's position is plotted for every fourth day at Greenwich noon; and the date is attached for every eighth day. Intermediate positions, which are omitted in the plot, may easily be interpolated by subdivisions.

MERCURY.

The inclination of the plane of Mercury's orbit and its eccentricity are greater than those of any of the planets cxcept the asteroids or minor planets. The plane is inclined to that of the ecliptic at an angle of 7 deg. The distance from the sun to *b*, the center of the orbit, is nearly 7½ million miles; that is, when the planet is making the perihelion passage, *P*, at a velocity of 35 miles a second, its distance from the sun is nearly 15 million miles less than at aphelion, when the velocity is reduced to 23 miles a second. Mercury performs his revolution around the sun at a mean distance of 36 million miles in very nearly 88 days (= 87.97). Owing to the very rapid changes in the planet's velocity, its position is shown at intervals of two days; and the increased velocity at perihelion as compared with that at aphelion is apparent in the plot. The date is attached for every eighth day; and since Mercury makes more than four revolutions during the year, there are four dates for each position.

VENUS.

The plane of Venus's orbit is inclined at an angle of 3.4 deg. The distance from the center of the orbit to the sun is about half a million miles, which is barely recognizable in a plot of these dimensions. The planet's mean distance from the sun is 67.2 million miles. This distance is diminished by a half million miles at perihelion (*P*), and increased by the same distance at aphelion. Venus revolves around the sun in 224.7 days, and her position is shown in the plot for every fourth day. On August 13th the planet will reach a posi-



PLOT 1.—SHOWING POSITIONS OF TERRESTRIAL PLANETS FOR 1909.