Morning and Evening Stars for 1912

Positions of the Sun and Planets for the Coming Year

By Prof. Frederic R. Honey, Trinity College

THE return of the seasons from year to year shows no changes in the stars which are fixed in the heavens, and which in orderly course present to the observer the same aspects when the passage of time brings around another year. In reviewing the annual variations of our solar system in those changes of the planets which are popularly styled "morning and evening stars," it is worthy to note the situation of our great primary and his satellites, as that of isolation in space. Some idea of this isolation may be apprehended by recalling the fact that light from Alpha Centauri (the nearest fixed star) moving at the rate of over 186,000 miles a second, takes about four and one-third years to reach our system. Owing to the vast distance expressed in "light years" (i. e., the distance traversed by light in one year) the stars are for all practical purposes "fixed" to the observer not equipped with the means of detecting those minute changes due to parallax, and thus are always found in the same place in the heavens. In contrast to this fixity are the wandering habits of the seven planets and the seven hundred asteroids, which are continually changing their positions.

The Sun and Planets.

In the revolutions of the planets around our sun, which, like other so-called fixed stars, has a rapid motion in space, attention is called to the marked discrepancy in their relative sizes, and the significance of the earth in relation to the whole. Jupiter and Saturn, together containing over 92 per cent of the entire mass, leave about 7 per cent to be divided between Uranus and Neptune, with a fraction of 1 per cent for the four terrestrial planets and the asteroids.

In the accompanying plots the orbits are represented by their projections on the plane of the ecliptic; and on account of the limited dimensions of the drawings the deviation from the circle in some cases is scarcely appreciable. The planes of the orbits are inclined at small angles to the ecliptic, intersecting it at the lines of nodes $N N'$. If this page be placed in a horizontal position and regarded as the plane of the ecliptic, that part of space which is nearer the reader will be referred to as above, and that on the other side will be described as below that plane. This is obviously a convention for convenience of reference. The point N where the planet passes from the space below to that above is called the ascending, and N' is the descending node. The full line represents that part of the orbit which is above the ecliptic. P is perihelion, or point of nearest approach to the sun.

The Terrestrial Planets.—The Earth.

The earth, the largest of the terrestrial planets, has a mean velocity in its orbit of about $18\frac{1}{2}$ miles per second, which is increased at perihelion in January and diminished at aphelion in July. It moves a distance of nearly 1.6 million miles daily. The axis is inclined to the plane of the ecliptic at an angle of about

Plot 1.—Orbits of the major planets.

Plot 2.—Orbits of the terrestrial planets.

$66\frac{1}{2}$ degrees; but its direction when projected on that plane is not parallel to the axis of the orbit. The eccentricity of the orbit is $1/60$; thus the linear eccentricity (e) or actual distance between the sun's center and a , the center of the orbit, is a little over $1\frac{1}{2}$ million miles; as a consequence, the earth's distance from the sun in January is a little over three million miles less than in July. The positions of the earth and of all the terrestrial planets are shown in the drawing at intervals of four days at Greenwich noon; and inter-

mediate positions and dates are easily supplied by subdivision. The earth at a distance of 92.9 million miles from the sun rotates on its axis in the direction of the arrow (see position of January 1st). The sun is obviously above the horizon to an observer situated on the illuminated surface, and below the horizon to one who is on the unilluminated surface. To an observer who is on the line which separates the surfaces, the sun is either rising or setting. If this is clearly understood, there will be little difficulty in determining, from an inspection of the plot, the planets which rise before and those which set after the sun, i. e., the morning and evening stars for any day of the year.

Mercury.

In a plot which is limited to the dimensions of this page, the great eccentricity of Mercury's orbit illustrates more clearly than that of any other terrestrial or major planets the laws which govern all the planetary motions. The orbit is inclined at an angle of 7 degrees to the plane of the ecliptic, intersecting it at the line of nodes $N N'$. The eccentricity is a little over $1/5$ —making the linear eccentricity 7.4 million miles from the sun to b , the center of the orbit. Mercury makes the perihelion passage at the rate of

35 miles a second, at a distance of 28.6 million miles from the sun; this distance being increased to 43.4 million miles at aphelion, where the planet's velocity is reduced to 23 miles a second. Thus the first two of Kepler's laws are clearly illustrated: 1st, the planet's orbit is an ellipse; 2nd, the planet's radius vector sweeps out equal areas in equal times. The area of the triangle with the sun as a vertex, and a base equal to that part of the orbit traversed between the dates September 5th and September 13th, is equal to the area of the triangle with the same vertex, and a base equal to that part of the orbit included between the dates October 23rd and October 31st. Mercury's revolution is completed in very nearly 88 days (87.97); and on account of the rapid changes in the velocity of the planet, its position is shown for every second day. The reading of the date is adjusted to the position of the earth, to avoid turning the head whenever it is required to determine whether Mercury is morning or evening star. Four dates are attached to each position, because the planet makes more than four revolutions during the year.

Venus.

The orbit, which differs very little from a circle, is inclined at an angle of 3.4 degrees. Its eccentricity, the least of all the orbits, making the linear eccentricity less than half a million miles, brings the center very near the sun's surface, and is indistinguishable in the plot. In order to avoid confusion, only a part of the line of nodes $N N'$ is shown. On account of the small eccentricity, the planet moves with a nearly uniform velocity of 21.9 miles a second, at a mean distance of 67.2 mil-

(Concluded on page 275.)

LEGAL NOTICES

OVER 65 YEARS' EXPERIENCE

PATENTS

TRADE MARKS
DESIGNS
COPYRIGHTS & C.

INVENTORS are invited to communicate with Munn & Co., 361 Broadway, New York, or 625 F Street, Washington, D. C., in regard to securing valid patent protection for their inventions. Trade-Marks and Copyrights registered. Design Patents and Foreign Patents secured.

A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our Hand-Book on Patents will be sent free on request.

Ours is the oldest agency for securing patents; it was established over sixty-five years ago.

All patents secured through us are described without cost to patentee in the Scientific American.

MUNN & CO., 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AERONAUTICS

FLYING ALL WINTER—Greatest Money Maker in the World. We make you a Pilot in 10 lessons—\$250.—We stand all breakage. For further particulars address Stevens & Beatty, 222 9th Ave., N. Y.

BUSINESS OPPORTUNITIES

FREE SAMPLE goes with the first letter. Something new. Every firm wants it. Orders from \$1.00 to \$100.00. Nice pleasant business. Big demand everywhere. Write for free sample. Metallic Mfg. Co., 438 N. Clark, Chicago.

REPRESENTATIVES WANTED in every territory to sell high grade staple product on profit sharing basis to power plants of all description. Excellent side line. Full particulars on application to P. O. Box 404, Newark, N. J.

INSTRUCTION

AUTOMOBILE INSTRUCTION, four weeks' course covering shop and road work. Provision for out of town men. Send for Booklet S. West Side Y. M. C. A., 318 West 57th Street, New York.

WANTED

PATENT WANTED. Owners of processes for extraction of aluminum from kaolins; address particulars and royalty expected, W. C. Marshall, 308 Union Oil Building, Los Angeles, California.

MISCELLANEOUS

FREE TUITION BY MAIL.—Civil Service, Drawing, Engineering, Electric Wiring, Agricultural, Poultry, Normal, Academic, Bookkeeping, Shorthand Courses. Matriculation \$5. Tuition free to first applicants. Apply to CARNEGIE COLLEGE, ROGERS, OHIO.

MONEY-MAKING FARMS THROUGHOUT 16 states; improved, one to 1000 acres, \$100 to \$1000 an acre. Stock and tools included with many, to settle estates quickly. Mammoth illustrated Catalogue "No. 34" free. E. A. Strout, Station 15, 47 West 34th Street, New York City.

INQUIRY COLUMN

Inquiry No. 9247.—Wanted, to buy a Parueler aerated water.

Inquiry No. 9254.—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

Inquiry No. 9255.—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be cheap and fully proved.

Inquiry No. 9256.—Wanted addresses of parties having Pichblende deposits, if able to ship ore.

Inquiry No. 9257.—Wanted addresses of firms selling second-hand water turbines.

Inquiry No. 9258.—Wanted addresses of parties having gem materials to offer in any part of the world.

Inquiry No. 9259.—Wanted to buy a machine for removing the coating of a filament.

Inquiry No. 9260.—Wanted addresses of parties able to ship corundum, garnet, flint, emery or any material suitable as an abrasive.

Inquiry No. 9261.—Wanted, a manufacturer to make card games.

Inquiry No. 9262.—Wanted, to buy a glass which is a conductor of electricity, and the address of the makers of the same.

Inquiry No. 9263.—Wanted, name and address of manufacturer of pantalon stretchers with clamps, which is capable of being folded up.

Inquiry No. 9264.—Wanted, the name and address of manufacturers of Date Pitting Machines.

Nulite Portable Parlor Lamp

The cheapest, best and most beautiful light obtainable for town or country. Makes and burns its own gas; 300 C. P. 5 hours for 1 cent. Can be used anywhere with amazing results. Low in price. Thoroughly reliable. Many new and exclusive features. Best proposition of the year for agents. Write today for full details.

NATIONAL STAMPING & ELECTRIC WORKS
412 S. Clinton Street, Chicago

For Sale

Outright or on Royalty, U.S. Patent No. 1,014,889. Issued Jan. 16, 1912. An entirely new invention, a Portable Stand, a cheap and sanitary article designed to provide a complete and convenient place for hanging any and all cooking utensils. All offers will be considered—open, to the best. For further particulars, address: Geo. L. McDonald, Paragould, Ark.

Incorporate Your PATENTS and BUSINESS in ARIZONA

Laws the most liberal. Expense the least. Hold meetings, transact business anywhere. Blanks, By-Laws and forms for making stock full-paid for cash, property or services, free. President Stoddard, FORMER SECRETARY OF ARIZONA, resident agent for many thousand companies. Reference: Any bank in Arizona.

STODDARD INCORPORATING COMPANY, Box 8000
PHOENIX, ARIZONA

Morning and Evening Stars

(Concluded from page 267.)

lion miles, and accomplishes a revolution in 224.7 days. On August 12th the planet reaches nearly the same position as that of January 1st; the difference is the distance traversed in 7/10 of a day. The dates indicated without the orbit refer to the first revolution, and those within to the second revolution.

Mars.

The orbit is inclined to the ecliptic at an angle of 1.85 degrees. The mean orbit radius is 141.5 million miles, and the eccentricity is less than 1/10, making the actual distance from the sun to C, the center of the orbit, 13.2 million miles. At perihelion Mars' distance from the sun is, therefore, reduced to 128.3 million miles; and at aphelion is increased to 154.7 million miles. At a mean velocity of 15 miles a second, Mars accomplishes his revolution in 1.88 years.

The Asteroids.

The orbits of the asteroids are situated between those of Mars and Jupiter. Since these little bodies are too small for naked eye observation—the diameter of the largest being not more than 500 miles—it is not necessary for the purpose of this article to do more than allude to them as filling a gap in the solar system.

The Major Planets.

Since the diameter of Neptune's orbit is thirty times that of the earth, it is not possible to represent the orbits of all the planets to the same scale satisfactorily within the limits of this page. The orbits of the terrestrial and major planets are therefore shown in separate plots, and the scale of the latter is very much smaller than that of the terrestrial planets. The difference of the scales will be seen by comparing the orbits of the earth and Mars in the two plots; in this way the continuity of the solar system will be apparent.

Jupiter.

The plot shows that the planet is above the ecliptic and approaching the descending node. Jupiter's orbit is inclined at an angle of 1.3 degrees; the eccentricity is nearly 1/20—i. e., the center of the orbit is 233 million miles from the sun—and at a mean distance of 483.3 million miles, Jupiter, with a velocity of 8.1 miles per second, completes a revolution in 11.86 years. At perihelion the planet comes within 460 million miles of the sun; and at aphelion this distance is increased to 506.6 million miles.

Saturn.

Saturn has a velocity of six miles a second; and at a mean distance of 886 million miles makes a revolution in 29.46 years. The orbit is inclined at an angle of nearly 2.5 degrees, with an eccentricity of a little over 1/20, which reduces the distance to about 836 million miles at perihelion, and increases it to about 936 million miles at aphelion. The planet is now below the ecliptic and approaching perihelion.

Uranus.

The linear eccentricity of the orbit is the greatest in the solar system. This is on account of the vast distance of the planet from the sun, which is over nineteen times that of the earth. The eccentricity is less than 1/20. The distance from the sun to the center of the orbit is 82.5 million miles. With a velocity of 4.2 miles a second, Uranus makes a revolution in 84.2 years.

Neptune.

The outermost planet completes its long period of 164.78 years at a velocity of 3.4 miles per second; and at a distance of 2,791.6 million miles. The eccentricity is less than 1/100, and as a consequence, notwithstanding the great distance of the planet from the center of our system, the distance from the center of the orbit is only 25,000,000 miles.

Conjunctions and Oppositions.

The table gives the dates of all the conjunctions and oppositions for the year 1912; and the plot of the terrestrial planets shows the positions of the earth and of the planet when a conjunction or opposition occurs, the hour of the day corresponding with the measurement of the orbit. The arrow indicates the direction in which a planet is seen. Jupiter's positions are given at intervals of 28 days;

Dioxogen

For Burns and Scalds

BURNS and scalds heal slowly. They are especially susceptible to infection.

Dioxogen freely applied to a burn or scald promptly relieves the pain, prevents infection, hastens the healing process and often saves tissue that without it would be lost.

That is only one of a hundred uses of Dioxogen.

People who know Dioxogen are never without it.

Dioxogen is a germicide—a germ destroyer—not merely an antiseptic. It is absolutely harmless too.

Three Sizes: Small (5 1/2 oz.) 25c. Medium (10 3/4 oz.) 50c. Large (20 oz.) 75c.

Dioxogen, 98 Front St., New York City

HOW TO BUILD A 5 H. P. GAS ENGINE AT HOME

In Scientific American Supplements, 1641 and 1642, E. F. Lake describes simply and thoroughly how a five horse power gas engine can be built at home. Complete working drawings are published, with exact dimensions of each part. Price by mail for the two Supplements, 20c. Order from your newsdealer or from MUNN & COMPANY, Inc. Publishers 361 BROADWAY, NEW YORK

YOU will recognize at once the excellence of the new Spring Styles of

von Gal made

Hats

"CORRECT STYLES FOR MEN."

They maintain the reputation which these famous hats enjoy among men from ocean to ocean. The expression of the best in hat designing, they are accepted, season after season, as the leading men's stiff and soft hats of America.

Put into these hats is the utmost value that you can obtain at the price you pay—an honesty of workmanship, quality of material and perfection of detail that you can get in no other hats at the price. Guaranteed by your dealer and by us.

Prices \$3, \$4 and \$5. At your dealer's, or if he cannot supply you, write for Spring and Summer Style Book A, and we will fill your order direct from factory if you indicate style wanted and give hat size, your height, weight and waist measure. Add 25c to cover expressage.

We are Makers of the **von Gal** Celebrated \$3 Hat

Factories:
Danbury, Conn.
Niagara Falls,
Ontario, Canada
Straw Hat Factory:
Baltimore, Md.

Hawes von Gal
INCORPORATED
Panama Factory: New York

Offices and Sales-rooms:
1178 Broadway
New York
48 Summer Street
Boston