

# Companions of the Sun—II\*

## Some of the More Intimate Features of the Solar System

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PASSING over the minor planets for the present, we have now to consider briefly those four colossal orbs whose paths are far beyond that of Mars. They differ from the smaller major planets, not only in size, but also in constitution. They are much lighter than the smaller planets in proportion to their volume, and are in a much less solid state. Their size has probably prevented rapid cooling. They have a total of 24 moons whereas the four smaller major planets have, in all, only three moons. These four colossal planets include vast areas within their orbits. Neptune, the outermost, being nearly twenty times as far as Mars from the sun. The comparative areas included in their orbits is therefore almost one to four hundred.

*Jupiter* is far the largest of the planets. (Diameter, 84,000 miles.) It is larger, indeed, than all the others combined. How appropriate that this mighty sphere should have such a name! But is it not strange that Venus, who looks so much brighter, was not in pre-statistical days called Jupiter? Probably Venus was named first because of her greater brilliancy, and in virtue of her conspicuous beauty, received the name of the charming goddess, after which the only name worthy of the great planet we are now considering was that of the father of the gods.

Jupiter resembles the sun and Saturn in the fact that he is not solid at his surface. His equatorial regions, like theirs, float somewhat freely over the deeper layers of his body. The surface at the equator completes an axial revolution in less time than is required by the polar regions to complete theirs. This may not mean that Jupiter and the sun are slackening their pace. It may be explained by centrifugal forces. Jupiter's axis is perpendicular to his orbital plane, which is inclined to the ecliptic at an angle of only  $1^{\circ} 8''$ .

Seasons are absent from Jupiter's year, which is equal to about twelve of ours. He therefore passes eastward, as seen from earth, through about one zodiacal sign each year. The Jovian day is less than ten hours, or about twenty minutes less than the day of Saturn. Bodies weigh about two and a half times as much as on the earth and 20 per cent, more at the poles than at the equator. Jupiter and the poles of Saturn are the only places in the solar system, away from the sun itself, where bodies weigh heavier than on earth. There are 10,455 days in the Jovian year. A point at the earth's equator moves a little over 1,000 miles per hour, a similar point on Jupiter's equator moves about 26,000 miles per hour.

Jupiter has nine moons. The four largest were discovered by Galileo, being among the very first objects revealed by the aid of the telescope. The latest Jovian moon was discovered in 1914 by means of the photoplate, the object being too distant and too small to be seen with the largest telescope. This latest discovered satellite moves in an orbit whose diameter is about 32,000,000 miles. Its motion is, like that of the satellites of Uranus and Neptune, apparently retrograde.

The succession of transits, occultations, eclipses, etc., of Jupiter's moons as seen from earth are among the most interesting phenomena an amateur can study and observe. The author of this paper remembers gratefully the excellent three-inch achromatic telescope through which he had a first glimpse of Jupiter and his four great moons, and has almost tender reminiscence of the little, old gentleman who so graciously afforded him that great pleasure.

Interesting as the Jovian lunar phenomena are, as seen from the earth, they would be much more so if they could be viewed from the planet itself. At present we may but sigh and piously express the hope that some day all that is indestructible in death's tremendous adventure may be clothed in a body so ethereal as to defy all those chemical and physical changes which set barriers here to our complete freedom. If such a faith be well founded, and some of us think it is, we shall then see the beauties of the worlds that are now only ideal, we shall perceive the subtle forces that dwell beyond the violet rays and hear the music of the ultratonal harmonies.

From the disparity between the predicted and the observed times of eclipses of Jupiter's moons, a time element was found to exist in relation to the movement of light from one part of the universe to another. Before that, light had been supposed to move to any distance instantaneously, as we have up to the present sup-

posed gravitation to act. Even gravitation has recently been made the subject of question in relation to a time element.

*Saturn.* It is about 400,000,000 miles from the orbit of the earth to that of Jupiter. Another 400,000,000 miles brings us to the orbit of Saturn, the second largest of the planets, Jupiter is 1,300 times the volume of the earth. Saturn is 770 times the same volume. The body of Saturn (diameter, 73,000 miles) is not yet rigid and its axis is inclined to the plane of its orbit at an angle of  $27^{\circ}$ . The seasons are well marked in the Saturnian year, but each quarter lasts about seven terrestrial years. Bodies weigh more at the poles of Saturn and less at the equator than on our earth.

The most distinctive feature of this planet in his unique system of rings. These are in the plane of Saturn's moons, with the exception of the outermost moon which is apparently retrograde in motion. The rings consist of meteors. From the centre of the planet to the circumference of its outer ring there are, first, the 36,500 miles of the radius of Saturn. From the surface of the sphere to the inner margin of the inner rings is 9,000 miles. This, which is known as the crepe ring, is 12,500 miles in width and runs into the middle ring which is 17,000 miles wide. Outside the middle ring is a space of one thousand miles before the outer ring, 10,000 mile wide, is reached.

As Saturn's orbit is inclined to the ecliptic at an angle of  $2^{\circ} 30'$  we should always see the Saturnian rings as a linear projection were it not for the inclination of his axis to the plane of his orbit. This leaning towards us of one or other of his poles shows us sometimes the north, at others the south, side of the rings and occasionally at the transition point, the linear configuration is seen. Only the most powerful telescopes will show the rings at all when they lie edgewise to the plane of our vision.

Saturn has ten moons, only one of which (Titan) is larger than ours. The first four, like our own and some of the moons of Jupiter, have been proven to turn always the same surface towards their primary. As no exception to this rule has been found, it is likely that it obtains in the cases of all moons. The ninth moon of Saturn (Phoebe) has technically a retrograde motion.

*Uranus and Neptune.* Nearly 1,000,000,000 miles beyond the path of Saturn is that lone track where Uranus runs his silent course and from which he beckons his farthest frontier signals to our unassisted vision. Thus between the orbits of Saturn and Uranus, the entire solar system as far out as Jupiter and his farthest moon might easily perform all their revolutions. The same may be said of the space between the orbits of Uranus and Neptune. These two planets might well be called the lonely worlds, since each of them is more than ten sun distances from any other planet.

Uranus appears as a faint green star and is 65 times as large as the earth. The spectroscope reveals a substance in the Uranian atmosphere not known to us on earth. Uranus has four moons and Neptune one. They are all smaller than our moon. These planets and their moons were long supposed to have a retrograde motion, i.e., the planets were supposed to rotate and the moons to revolve in a direction contrary to that usually followed by other moons and planets. It is now thought that the inclination of the planets to the plane of their orbits is more than ninety degrees and that therefore their motions follow the general rule.

Technically speaking, the motions of these planets and moons are retrograde, but an interesting theory is gaining favor which claims that this was originally the direction in which all moons and planets revolved, and that the west-to-east movement was a later development. Ten pounds on earth would weigh nine on Uranus, and a few ounces less on Neptune.

*Neptune.* The story of how Adams and LeVerrier worked out the position of Neptune mathematically before the planet had as yet been seen, basing their calculations upon the reported deviations of Uranus from his predicted course, is well known as one of the most brilliant achievements in the history of science. In such subtle manner does the human mind come into a real harmony with that unseen Force that swings the balanced worlds. Such vivid and conspicuous results of our investigations of law would almost tempt one, with Pythagoras, to strain the ear and listen for "the music of the spheres." Like Uranus, Neptune has a far-reaching atmosphere.

*The Minor Planets.* Beyond the orbit of Mars, yet within that of Jupiter, lie several hundreds of bodies, all of them less than 500 miles in diameter, known as the minor planets. The theory has been advanced that these are the fragments of a shattered major planet that has been broken up and scattered in detail throughout this region. The irregular shapes and motions of many of these small bodies seem to support such a theory. The presence of such a planet was long suspected in this region, a fact which lends further support to such an idea.

Certain analogies as to the distances of the respective planets from the sun (Bode's Law) led a number of astronomers at the beginning of the nineteenth century to suspect the presence of an undiscovered planet between the Maritan and Jovian orbits. They instituted a methodical search, but an outsider, Piazzi of Palermo, was the first to discover a new planet. This was named Ceres. Others were soon discovered and named after the classical goddesses till such names were exhausted. Other names have since been used, but resort is now had to numbers, for over 800 of these minor planets have been discovered, catalogued, and marked on the "zodiacal way-bill." They vary in diameter from a few hundred yards to about 500 miles. Only one of them, Vesta, the third largest in size, can be seen by the unaided eye, and then only under the most favorable conditions. Its diameter is about 240 miles.

The orbits of the minor planets are inclined to the ecliptic variously up to  $30^{\circ}$ . They move in very eccentric orbits. Their combined volumes are not equal to more than one-fourth that of the earth, and it may be far less. Gravity on the surface of such small bodies is quite inconsiderable, and it is believed that a human arm might, even on the largest of them, cast a stone into space so forcibly that it would never return.

The most interesting of all these minor planets is Eros. It is the only one within the orbit of Mars. It approaches the earth more nearly than any other planet, major or minor. Its next nearest approach will be in 1938, when it will be within 13,500,000 miles. It rotates in five and a half hours. Its diameter is probably about twenty miles.

*Comets and Meteors.* Comets are aggregations of meteors, dust and vapor, and meteors are particles of disintegrated comets. Comets are the product of irregular or so-called accidental cosmic action. Meteors are cosmic debris resulting from attractions and repulsions that must be almost constantly active in one or other part of the heavens. The meteors are dead bodies left on the battlefields in the great war of the worlds.

The breaking up of Biela's comet in 1846 is a well-known incident in the history of the subject. The comet returned in two parts widely separated in 1852, and in 1872 as a meteoric shower which was unquestionably a part of the comet.

Comets and meteors are all probably of solar origin. This theory is strongly sustained by the fact that no element or substance foreign to our system has ever been found in any of these celestial adventurers. So far as has been ascertained, they all move in closed or elliptical courses. The solar system, therefore the earth's atmosphere, is moving constantly in one direction. If comets and meteors were not all of solar origin, they would assail the earth's atmosphere chiefly from that portion of the heavens which confronts it in its onward course. There would at least be a distinct preponderance of these bodies seen from that direction. But no such preponderance is found.

The distinctive features of comets are thus reduced to their peculiar phenomena, and their amazingly eccentric courses. The nucleus of a comet consists of an agglomeration of meteors, the coma, of dust and vapor; and the tail, which is acquired only when near the sun, is the product of radiant and electric energies (acting on microscopic particles) in excess of the force of gravity, thus giving a direction always from the sun. The tail appears only when the comet comes near enough to the sun to be subject to its radiant and electric forces, and disappears when it passes beyond those influences.

The periods of comets—the cometary year—varies from a few months in some cases to thousands of years in others. Their courses reach often far beyond the orbit of Neptune, but no one knows how far some of them go. The lustre of a comet is enhanced if its advent occurs during a maximum sunspot period, therefore, also, during a period of maximum auroal display. The

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latest appearance of Halley's comet occurred when there was little sunspot activity, and the appearance was disappointing to some. Perhaps it might have been more stupendous had the sun been more active at the time. It is probable that comets and meteors keep always the same face sunward.

*Meteors* are uncharted masses of adventitious matter floating in space around the sun. Coming within the earth's influence, they are drawn into its atmosphere, where the friction may melt them and turn them into vapor, or failing complete vaporization on account of their size, they may fall to the ground or into the sea, but in a few cases they pass through a part of the earth's atmosphere and out again into space.

In the case of the meteors of February 9th, 1913, when several groups of large meteors passed over the western hemisphere and the mid-Atlantic ocean, it is not known certainly whether they reached the earth's surface and were lost in the sea, or passed out of the atmosphere and went on their way. The latter is perhaps the more probable theory. They were very large and were observed for some thousands of miles before they disappeared. Their height has been variously estimated at from 25 to 45 miles. They made a distinct sound which took some time to reach the ear because of their distance away. This sound was in most cases not heard till after the meteors that produced them were out of sight. The comparatively slow procedure of these objects across the sky was remarkable, and the whole picture so ably dealt with by Prof. Chant and others in the *Journal* of May-June, 1913, was one of the most startling and remarkable seen by the eyes of the present generation.

Many specimen meteorites are on exhibition at various centres. They are composed chiefly of stone and iron.

### Sisal

THE price of this product is likely to rule high in the future, and the success of Germany in East Africa should stimulate exertions in our territories. It is said that no failure of a crop has ever been heard of on suitable land. Provided the soil is rich in lime and not swampy, poor and gravelly lands are very suitable, and therefore estates which have been worn out by sugar and such other crops will give good yields. The reason of the advantage of poor soils is that the life of the plant is much longer, running to ten to fifteen years.

The *Queensland Agricultural Journal* advises that the plants to form a plantation should not be higher than 10 or 12 inches, or even less. Older plants take a much longer time to start growing. When planting, all dry leaves at the base of the young plant should be taken off as in the case of pineapples, and the main roots cut off and pared as closely to the trunk as possible. They must be planted perpendicularly, and only the lower portion of the trunk must be covered. The distance apart in the field is a question of soil. In rich soil the rows may be 10 feet apart, and the plants at intervals of 6 or 7 feet. In poor ground 8 feet by 6 feet is as close as the plants should be set. Roadways should be left at intervals of five chains.

Once a field is planted, it may be practically left to itself, as there is probably no crop, except the castor-oil plant, which requires less care to bring it to perfection than sisal. At the same time, a little care is needed at the outset until the plants are robust. No weeds should be allowed to grow, nor any to overtop the sisal plants, as they require all possible light, air, and sun. Tall weeds may be mown down.

In about twelve months suckers will begin to appear, and in 24 months these will be produced at the rate of 100 per plant. These must all be removed for two reasons. One is that they deprive the mother plant of the nutriment it requires to produce large leaves and plentiful fiber. The other is that the suckers are valuable either for extending the area under sisal or for sale to intending planters. To plant up 100 acres 60,000 to 100,000 suckers are needed.

The life of the sisal plant is intimately connected with the production of the flower-stalk, technically called the "pole." The life of the agave (sisal plant) is a comparatively long one, but the long life may be materially shortened by injudicious management. The sign of the termination of its existence is the sending up of the pole. This happens when the plant arrives at the cutting stage and the leaves are left uncut. It may also be the result of over-cutting. Much judgment is required, therefore, to ensure that no pole shall appear for 10, 12, or 15 years. When the pole has appeared, it should be notched and bent over as soon as it appears, in order that all the leaves on the plant should be ripened before it dies. In this way the plant is kept available for yielding fiber a year later than it otherwise would be. Immature leaves should not be cut. As a general rule, the ripening leaves gradually fall from the erect to the horizontal

position on the plant. Then are the leaves to be cut. It should not be lost sight of that when a mature plant sends up its pole all its suckers at once follow suit and send up slender poles. Hence suckers from a poled plant should never be used in forming a plantation, as it will probably not be six months before the pole appears.

According to conditions of climate, soil, and the kind of plant, the first leaves will mature in from three to four years. For harvesting the leaves, account must be taken of their length and state of ripeness. The length of the fiber is one important factor in its fitness for the market. The least length admissible is 2 feet 6 inches, and every additional length increases its value. It is not advisable, however, to cut leaves until they have attained a length of three feet. These leaves will average about three pounds in weight, but they frequently attain a weight in the Brisbane district of from five pounds to seven pounds. If left long after the leaf has reached the horizontal position—i.e. at right angles to the trunk—the leaf droops to the ground, acquires yellow spots, and, when machined, much of the fiber is broken off short at these spots, and is only salable as tow. The unripe leaves produce a brilliantly white fiber, but these, as stated, must not be cut. The number of ripe leaves per plant when from three to four years old will vary from ten to twenty, according to conditions of planting, rising in subsequent years to forty or fifty. This does not mean that forty or fifty leaves are at once cut from each plant, but it refers to the aggregate of the year's operations. The leaves are cut with a curved knife. Proper cutting consists in cutting the leaves as close as possible to the trunk. Loose cutting results in a considerable loss of the strongest part of the fiber. If three inches of each 40 leaves are left on the plant there is a loss of 10 feet on each plant, or 10,000 feet on an acre. This is a matter well worthy of attention by sisal planters. One man should cut and tie up an average of 1,200 leaves a day.

As to yield of fiber, on average poor soils, plants 7 feet by 8 feet (799 to the acre), 7 pounds of fiber per plant, or 5,630 pounds per acre, is obtainable; but it is well to reckon on only 15 cwt. or 1 ton of marketable fiber per acre. One ton of sisal fiber is worth, in England, from £55 to £60. Once the plants have arrived at the cutting stage, no other labor is required in the field except the cutters and carters.

Machining is performed as soon as possible after the leaves are cut, as, if two or three days elapse, the fiber will be spotted and consequently of reduced value. The fiber is extracted by various machines, cheap and expensive, but all work by means of drums and beaters, which, as the leaves are passed in, beat off in one action the whole of the fleshy part of the leaves, leaving the fiber, except for drying, practically ready for market. The cheapest machines cost about £40, and require a two-horse-power oil-engine. They are made by J. Wilson engineer, Elizabeth Street, Brisbane. Other machines are made in Manchester, costing before the war about £75 and upwards. The American automatic machines, in which the leaves are laid on a carrier side by side, and pass continuously into the machine, coming out as pure fiber as fast as the leaves can be fed, cost from £400 up to £1,000, and will clean from 70,000 to 150,000 leaves daily. These require from 20 to 45-horse-power engines. The capacity of the Wilson machine is about 160 pounds of fiber per day.

Finally, there is no particular time for harvesting sisal leaves. The work may go on all the year round. One thing should be attended to—when the plants have been cut once, a sucker should be allowed to grow up near the parent plant, so that when the latter dies the new plant will have arrived at the cutting stage, thus avoiding the replanting of the field.—*The Colonial Journal*.

### Pruning Fruit Tree Roots

FORTUNATELY for fruit cultivators, the cutting of a root has a different effect on growth to the cutting of the top. Cut a root, and it generally breaks into a number of weaker and more fibrous roots. The large root does not only break into several smaller ones of the same character, but into numerous roots of a different sort. Forks and fangs, earth borers, and rock cleavers give place to masses of fibre that mount up and skim the surface filth, instead of penetrating into the grosser regions of stagnant water or infertile subsoil. If these favorable results do not follow the first cut of the knife, they are sure to follow in the end if the process is skilfully performed. But the great end must never be lost sight of. The roots are pruned less to produce their numbers, or shorten their length, than to modify their character; and, in short, change them from barren into fertile roots. When this is done the top will follow the lead of the roots as a matter of course.

A change of place is almost as important as a modification of character. Roots are very much more the creatures of circumstances than is generally supposed.

If badly placed, they deteriorate; if well placed, they will improve. Depth of root is important for timber growing. Could the tap root of oaks go down as fast and far as the top goes up, we should doubtless have much finer and straighter timber than we have. As the tap roots get stocked—split or broken into fibres—the top becomes stunted and spreading, and takes to the bearing of acorns instead of timber-making. This stage would have been reached much sooner had the tap roots either been cut off or turned in a horizontal direction. This is exactly what the cultivator does with the roots of fruit trees. He turns them sideways and keeps them near to the surface, and the change of place checks sterility and establishes fertility.

Root medium and the character of the root run likewise exerts a powerful influence on growth. Certain soils, either from their mechanical state, chemical composition, or mineral constituents, favor sterility; others induce fertility. It is somewhat difficult to give specific instructions or definitions of what to avoid or choose. So much may be said; all cohesive, extra retentive, or over-rich soils are to be avoided for fruit-growing. Neither are those at the opposite extremes, such as sand gravel, or peat to be chosen. The soil above all others for fruit culture is a wholesome virgin loam from an old pasture or common, on which the herbage is short and close, and adhesive enough to hang together in spadefuls. Such soil, smelling almost as sweet, though, of course, different from new-made hay furnishes the finest medium or root-run for nearly all plants, and for the development of fertility in fruit trees.

It is not necessary that anything should be added to it, as overdoses of rich food may induce the balance of vital force into sterile ways. Sand or clay will not be needed if the loam is of the right sort. In such a medium the roots of the most approved stocks will branch and re-branch until the entire soil is a network of fibers, the top responding in sympathy and acting in concert therewith.

Now that it is the custom to graft or bud many of the most popular of our trees and shrubs, it is often found that the host does not contain sufficient vigor to absorb the robust strength thrown up in the sap of the rooting stock, consequently robbers appear in the form of suckers. They are frequently seen among roses, and when the leaves are on can be readily distinguished on most of the H. P.'s and Teas because they carry seven small leaves instead of five larger ones. They are often cut off just level with the ground, but this method only adds to the trouble for it is necessary that they are cut away at their base. In the case of fruit trees the plum is, perhaps the greatest culprit as suckers are often produced yards away from the trunk, and if they are topped in the manner already mentioned they will increase and become very detrimental to the fruitfulness of the tree.—*Garden*.

### Catalytic Decomposition of Benzoyl Chloride

BENZOYL chloride when passed with a current of hydrogen over finely divided nickel at 270°-280° C. furnishes to the extent of about 50 per cent a mixture of benzene and toluene, and about 40 per cent of diphenyl. The mechanism of the formation of the latter is obscure, but it appears to be conditioned by the formation of nickel chloride on the surface of the catalyst, and is not suppressed even when an excess of hydrogen is employed. With copper as catalyst benzoyl chloride is decomposed up to about 40 per cent into benzoic anhydride, the remainder being unchanged. A similar conversion occurs at 420°-450° C. with the chlorides of barium and thorium, with simultaneous deposition of carbon on the catalyst, and formation of carbon monoxide and hydrogen chloride. The manner of formation of the anhydride remains uncertain.—Note in *Journal of the Society of Chemical Industry* on a paper by A. MAILHE and F. DE GODOX in *Bulletin Society of Chemists*.

### Rainfall with Air Temperature Below the Freezing-point

THIRTY-SIX cases of this phenomenon have been picked out from the records of three observatories in Japan. In the large majority of cases air temperature lay between 0 and -2° C. There were three instances with temperature below -5° C. The cases occur mostly in the early morning or at night, rarely in the daytime. In general the phenomenon can be explained by assuming the existence of a temperature inversion, the temperature a little distance above the surface being above the freezing-point. On the other hand, the author has shown from thermodynamical considerations that when condensation takes place continuously in highly supersaturated ascending air both snow crystals and raindrops are formed even though the air temperature is many degrees below the freezing-point and this may be the explanation of the phenomenon in some cases.—Note in *Science Abstracts* on an article by S. TAKAYAMA in *Monthly Weather Rev.*