Home College Series.

Number ✻ *Seven.*

THE SUN.

BY

REV. C. M. WESTLAKE, M.S.

NEW YORK:
PHILLIPS & HUNT.
CINCINNATI:
WALDEN & STOWE.

THE "HOME COLLEGE SERIES" will contain one hundred short papers on a wide range of subjects—biographical, historical, scientific, literary, domestic, political, and religious. Indeed, the religious tone will characterize all of them. They are written for every body—for all whose leisure is limited, but who desire to use the minutes for the enrichment of life.

These papers contain seeds from the best gardens in all the world of human knowledge, and if dropped wisely into good soil, will bring forth harvests of beauty and value.

They are for the young—especially for young people (and older people, too) who are out of the schools, who are full of "business" and "cares," who are in danger of reading nothing, or of reading a sensational literature that is worse than nothing.

One of these papers a week read over and over, thought and talked about at "odd times," will give in one year a vast fund of information, an intellectual quickening, worth even more than the mere knowledge acquired, a taste for solid reading, many hours of simple and wholesome pleasure, and ability to talk intelligently and helpfully to one's friends.

Pastors may organize "Home College" classes, or "Lyceum Reading Unions," or "Chautauqua Literary and Scientific Circles," and help the young people to read and think and talk and live to worthier purpose.

A young man may have his own little "college" all by himself, read this series of tracts one after the other, (there will soon be one hundred of them ready,) examine himself on them by the "Thought-Outline to Help the Memory," and thus gain knowledge, and, what is better, a *love* of knowledge.

And what a young man may do in this respect, a young woman, and both old men and old women, may do.

J. H. VINCENT.

NEW YORK, *Jan.*, 1883.

THE SUN.

BY REV. C. M. WESTLAKE, M. S.

THE sun is a star. A star twinkles and shines by its own light; a planet does not twinkle, and shines by borrowed light. The sun dazzles the whole family of planets by its brightness, keeps them in bounds by its weight, and supports their inhabitants by its heat.

Relative importance of the Sun.

Something of the relative importance of stars and planets is drawn from the law of gravitation. Every atom of matter has an attraction for every other atom far or near. The strength or degree of attraction in any given instance is in proportion to the size, weight, and nearness of the attracting body.

Many stars are larger and brighter than the sun. To us the sun is the brightest and largest, because the nearest star. In size and weight, it is greatly more than the sum of all the planets. In these particulars, we find the superiority of its attracting force.

The keeping of the planets in their orbits, as they move around the sun, may be accredited to this superior attraction.

It cannot account for all planetary movements; but it does so to such an extent that each and every planet or world seems to be lifted momentarily, and swung perpetually by the sun.

The Earth as influenced by the Sun.

Our tiny globe is influenced to some extent by other bodies revolving in space, yet to such a degree that it seems entirely so by the sun. The other forces of the sun are in proportion to its force of attraction. These other forces are found in the sunbeam. To its powerful and kindly touch the earth is eagerly and most joyously responsive. It *is* so for good and most justifiable reasons. These reasons may be seen in the different properties found in a sunbeam. If you permit a sunbeam to pass through a prism, it will spread out into seven bright bands of color. This is called a spectrum. "Many spectrums make a rainbow. These seven colors, in their different combinations, furnish all the infinite shades of the flowers, the gorgeous plumages of the birds, and the endless tints of the landscape. But below the spectrum there is a ray called the calorific ray. You cannot see it, but you feel it when you place yourself in the sunlight. It warms you. Again, there is another ray called the actinic ray. It is above the spectrum, and can neither be seen nor felt; but it is that which draws with unerring pencil the faithful photographic likeness upon a plate so prepared as to be sensitive to its effects." Thus we find a sunbeam combines light-giving rays with heat-giving rays, and these, with others, equally distinct, which are productive of chemical influence.

These different properties of the sunbeam are employed to quicken the world into activity and fruitfulness. Nearly all the transformations and the displays of energy manifest in the world may be directly or indirectly traced to the sun. Electricity, magnetism, and chemical force are from it indirectly; while its direct agency is manifest in an infinite variety of forms.

The sun contributes abundance of energy to earth, air, and water. The animal and vegetable kingdoms alike depend on his bounty. "Leaves, flowers, and fruits are beings spun from light and air. Sunlight is the mother of color and perfume. It is only under the influence of light that plants are sensitive, endowed with periodic movements and capable of motion; in the dark they are rigid and appear to be asleep."

The enormous masses of coal buried under the surface of the earth by geological action are nothing more nor less than the product of an ancient vegetation which was, thousands of centuries ago, the direct effect of the sun's chemical force.

"Every fire that burns, and every lamp that shines, expend heat and light which originally belonged to the sun." Millions of ages before the invention of the steam-engine, the power it now displays flowed from the sun. All muscular power, whether of man or of animals, may be traced to the same source. Solar heat contributes to maintain the sea in a liquid state and the atmosphere in a gaseous condition; while the currents of the atmosphere and the sea, as well as the tempests which agitate the one and the other, may be traced in large part, at least, to its mechanical force. It is the power which in the hurricane snaps fetters of iron, uproots trees, and levels forests to the ground, which in the tempest, uniting the forces of wind and wave upon the threshing-floor of the sea, beats to pieces hundreds of vessels, tossing the chaff upon the shore, and storing the grain in the granary of the great deep. "The period of sun-spots" is possibly in some way more or less intimately connected with the disturbances of the magnetic needle and the electric currents of the earth, the auroras, cyclones, rainfalls, the productiveness of the earth, and the health of its inhabitants. "Sunshine comes to us in the form of heat, and leaves us in the form of heat; but between its coming and its going it has awakened the various forces of our globe."

Man's Religious Nature as affected by the Sun.

The question, To what extent has the sun affected the religious nature of man? is one of interest. Man at first possessed the knowledge and favor of the true God. By sin he fell from this, and sought other objects of worship. The most ancient heathen religions were based upon the worship of nature. In this it seems most fitting that the highest veneration should be paid to the sun. And, indeed, such we find to be the case.

It is quite probable that Buddhism, which has the largest following of any religion in the world—numbering its adherents by hundreds of millions—has its basis in sun-worship. Learned men regard the whole story of Buddha's life as a sun myth debased into prose. The worship of the sun is the only religion which has been able in India to rival that of Vishnu and Siva.

At Multan, in the Punjab, was at one time a temple erected to the sun, which was the most celebrated in India. To this day the sun fills a large space in the prayers of the Hindus. In one of India's sacred books (Manu, iii, 75, 76) we find this sentiment: "By sacrifice the house master sustains this movable and immovable world. Cast into the fire the offering goes into the sun; from the sun is produced the rain; from the rain the nourishment; from the latter the creatures are produced."

In all pagan systems of religion the first and most important god is Sura, the sun, as the supposed source of heat, generation, and growth. Even the Christian religion, though far from giving divine honor to the sun, indirectly pays tribute to the bright orb of day. Christ is denominated "the day-dawn from on high," "the bright and morning star."

Being the fountain of light, heat, and life to the Church, he is fitly called "the Sun of righteousness."

David, with the thought of his quickening and comforting power, exclaims, "The Lord God is a sun!" Isaiah, exhibiting the state of the Church, "in a perfection which approaches nearest to the divine," declares: "The sun shall be no more thy light by day; neither for brightness shall the moon give light unto thee; but the Lord shall be unto thee an everlasting light, and thy God thy glory."

Early beliefs as to the Sun's nature change with the growth of solar science through important discoveries.

The more early conceptions of the sun were very crude. Ascertained facts were few, conjectures were numerous. Xenophanes, of Colophon, taught that the sun was lit and extinguished every day, like coals. Anaximenes declared that it was flat, like a leaf. Men generally believed the earth to be the center of the universe, and that every twenty-four hours sun, moon, and stars went circling around us for our sole and particular concern. Since then the sun has sprung into independent existence before the telescope and spectroscope. What if modern science *has* shown more mysteries in the sun than it has explained? It has also corrected wrong impressions, banished false theories, and contributed largely toward a proper construction of its nature and powers. It has measured the sun's distance, weighed it in the balance, and glimpsed the forces at work on its surface. The first practical step in this direction was taken by Galileo, in the month of October, 1610, when he began the work of the telescope on the sun. It is probable he invented, and quite certain he first showed the world how to make, the telescope. With this invention dawned the golden age of astronomy. In its use the universe was infinitely expanded, and a period was inaugurated the most interesting and momentous in the scientific history of the world.

What the telescope was to Galileo, the spectroscope is, in a subordinate sense, to the men of science of to-day. Following up the researches of Galileo and Kepler, Sir Isaac Newton achieved immortality by his discovery of the law of gravitation. With him, also, in his classical researches on the action of a prism upon sunlight, was the birth of "spectrum analysis," the basis of all spectroscopic discoveries.

This was nearly two centuries ago, and it is only during the last twenty years that spectrum analysis has been applied to solar physics. It is the work of the spectroscope to present a visible analysis of a beam of light. The spectroscope is a younger sister of the telescope. A powerful telescope will magnify an object a thousand times, thus enabling us to see it as if it were a thousand times nearer than it is. This it does by gathering together the scattered rays of light into a focus.

The spectroscope tears up these rays of light into ribbons, sorts them, sifts them, and enables us to read in these little, slender, bright or dark lines, some of the mysteries of far-distant suns. By its means of late a great deal has been attempted about the motion and speed of the stars coming toward or going from us, and how one star differeth from another star in glory and substance. It tells us something of the nature of comets and nebulæ, the movements taking place on the sun and of its chemical constitution. While in the "analysis of substances it is delicate to the detection of the millionth of a grain."

The telescope and spectroscope, with other astronomical instruments, speak of "man's finest mechanism, highest thought and broadest exercise of the creative faculty." In their manufacture and use the most exact measurement and refinement of calculation is required, and most desirable results are obtained.

The usefulness of practical astronomy and the perfection it has attained may be judged from this consideration. Take an astronomer blindfolded to any part of the globe, give him the instruments of his profession, and, if the stars be visible, before twenty-four hours he can tell you within a short distance where he is in latitude and longitude.

The Sun's relative distance from the Earth—size and weight.

With these instruments we compute the sun to be distant from the earth 92,000,000 of miles. This is obtained by finding the sun's "parallax;" the more accurate way being, perhaps, from observations of the "transit" of Venus. From the apparent breadth of the sun's disk or face its mean diameter is found to be 860,000 miles. We say mean diameter, because the sun's disk varies slightly in size according to the earth's distance from the sun, being largest about January first, when we are nearest to it, and smallest about July first, when we are farthest from it.

Knowing from actual experiments the velocity of light, 191,000 miles per second, we find it takes 8 minutes for light to reach us from the sun; 3½ years from the nearest fixed star, on an average of 15½ years from the brightest and nearest, or stars of the first magnitude; 120 years from a star of the sixth magnitude; 3,500 years from one of the twelfth magnitude; and so on with others still more distant.

If a star of the twelfth magnitude were destroyed we would still continue to see it for 3,500 years. Thus we have some idea of the relative distance of the stars, and that the sun is very much the nearest one. Yet this nearness is only comparative. "If a man had an arm long enough to reach the sun it would be 135 years before he knew he was burned." Were it possible to run an express train from the earth to the sun, going night and day at the rate of 30 miles an hour, and starting January 1, 1883, it would not reach its destination for about 337 years, or some time in the year 2220.

A train going at the above-mentioned speed would accomplish the circuit of our earth in a little over a month, where in the same manner it would require about 10 years to make the circuit of the sun. The mass or weight of the sun is 326,000 times greater than that of our earth; but, as the matter of which the sun is composed is less dense than that of the earth—as wood is less dense than iron—it is equal in volume or size to 1,245,000 earths. It weighs a a little more than a globe of coals of the same dimensions, much less than such a globe of phosphorus. "It would require 108 globes, like the earth, in a line to measure the sun's diameter, and 339 to be strung like the beads of a necklace, to encircle his waist." "It has 700 times the mass of all the planets, asteroids, and satellites put together. Thus all these bodies are controlled through its greater power of attraction." "Apply the principle that attraction is in proportion to the mass, and a man who weighs 150 pounds on the earth weighs 396 on Jupiter, and only 58 on

Mars; while on the asteroids he could play with bowlders for marbles, hurl hills like Milton's angels, leap into the fifth story windows with ease, tumble over precipices without harm, and go around the little worlds in seven jumps." On the moon he would weigh 2 pounds; but on the sun he would weigh 2 tons, and would need the strength of Hercules to bear the burden of his own body.

The constituent parts of the Sun, and the reasons assigned for the Sun's phenomena.

The sun's photosphere, sierra, prominences, corona, spots, faculæ, and cyclones, are some of the more remarkable of its phenomena. The photosphere or "light-sphere" is the round shining disk seen by all, and dazzling the eye by its intense brightness. With its edge or "limb" terminates all that can be seen by the unaided eye.

By the aid of the telescope, during a total eclipse of the sun, we see mounting above this edge the chromosphere, which one has named the "sierra," and another has described as "a quivering flame of fire." Until quite lately the stormy flames and outbursts on the limb of the sun were only discernible during a total eclipse, but now with the spectroscope they may be detected at any time.

Outside the chromosphere and its flaming red "prominences" is the corona, of which little indeed is known, as it can be studied only during the rare moments of total eclipses of the sun. In such an eclipse, the moon passing between the earth and the sun, its center comes exactly over the sun's center, and the globe of the moon, black as ink, is seen as it were hanging in mid air, surrounded by a crown of soft silvery light. This light extends to a height greater than the semi-diameter of the sun, and is known as the solar corona. It consists of two parts, the inner and brighter, the outer and fainter corona. The outer edge is generally blurred and indistinct, fading gently away. The shape is changeful, and oftentimes strangely awe-inspiring, shooting out of the central darkness like swinging luminous banners of ghostly light.

The distinctive feature of its spectrum is a single green line not identified with that of any earthly substance. It also bears those lines indicating the presence of hydrogen. The corona is probably detached particles of matter wholly vaporized by intense heat thrown out by the sun, and held a greater or less time by "electric influence or force of orbital revolution."

The corona was noticed as far back as the time of Kepler, but only within a century was attention attracted to the chromosphere with its "rose-colored" prominences, protuberances or flames of most fantastic forms. The chromosphere, lying between the corona and the photosphere, is denominated the atmosphere of the sun. Hydrogen is the principle material of its upper part, while near its base are found the vapors of many metals. It may be considered an ocean of heaving, crimson-flame billows around the edge of the sun, hotter than the fiercest furnace, and deeper than the diameter of the earth. It is swept by hurricanes of flame with a velocity of 100 miles per second, and agitated by storms of fire exceeding the wildest imagination of the human mind. Fiery jets of vapor many times the size of our earth leap upward to an incredible distance.

On September 7, 1871, Professor Young, of Princeton College, ascertained by careful measurements an immense mass of rolling and ever-changing flame, at one time to have risen to the height of 50,000 miles, supporting, as it were on a pyramid of fire, a cloud of red hydrogen, which rose to the distance of 200,000 miles from the limb or edge of the sun. Thus we see the sun's "appearance of ever-during calm is delusive." That silent, placid, shining orb of light is in reality an inconceivably immense roaring, seething, tumultuous furnace of fire and flame, of heat and radiance. But all its parts are not agitated alike.

The photosphere, which radiates both light and heat, is in striking contrast to the gaseous chromosphere, being subject to no sensible change of level, though its *particles are* in a state of continual change. The interior of the sun is now generally supposed to be composed mainly of such materials as form the crust of the earth, yet in a vaporized condition, and so intensely heated as to be incapable of chemical union. This vapor is compressed into the smallest possible space—since gravitation is 27 times greater there than it is on earth—by its own weight and that of the outer layers. The loss of heat by radiation from its surface results in condensing these vapors on the outside to a comparatively dense fluid thousands of miles deep, constituting a "cloud-shell," which we call the photosphere.

Start where we will in the study of the sun's phenomena, we *end* with those of its photosphere. Here the greatest marvels are found, and possibly in their solution lies the key to all that remains. The first remarkable thing seen on the sun's surface, when we look at it with a telescope, is dark spots.

To Galileo we owe the discovery of these dark spots and his important deduction of the sun's rotation and its period. Instead of turning on his axis once in 24 hours, like the earth, the sun turns once in the course of about 25 days. These spots, singularly like the limitations of our cyclones, are limited to those parts nearest the sun's equator. They seem to float in the photosphere. Perpetual change is taking place: new spots forming, old ones vanishing; one spot breaking into two; two spots joining into one. Even in a single hour great alterations have been noticed. These spots consist of three parts: the penumbra or half shade; inside the penumbra a still darker shade called the umbra; and inside this again the central blackness or nucleus. The question has been asked, What is the nature of these spots? Among the first attempts to answer this question was, that "they are dark souls of unrighteous angels and men, weltering on that sea of fire." In a different epoch they were represented as "ashes or scoriæ, the refuse of the fuel which sustained the mighty solar conflagration." Of all theories which have been offered, the following seems to be the most highly approved: "Sun-spots are cavities or hollows in the photosphere, and the different shades represent different depths." They are of all dimensions, from the scarcely visible pores to the most enormous spots.

Some of these are chasms so large that, as far as surface extent is concerned, they might swallow up 20 or 30 worlds like our earth. Aside from these spots, the sun's surface is mottled with luminous masses resembling "rice-grains;" but these rice-grains are as large as a continent.

The most brilliant parts of the sun are termed *faculæ.* And we have good reason for supposing they are matter, hot and bright, which has been thrown up into the atmosphere of the sun. We may see them as projected upon the sun's surface, or, better still, as extended beyond the sun's surface and projected on the sky, as they are more noticeable when near the edge of the solar disk, or about "spots" approaching the edge.

Some of these faculæ are complicated ridges from 4,000 miles broad to 40,000 long. Those vast jets of flame and hydrogen cloud of the chromosphere, reaching such enormous heights, are but the upper parts of the same appearances of which faculæ form the lower parts. This appearance is sometimes like that of a gigantic fiery tree, whose top is something over 100,000 miles above the edge of the solar disk, whose branches grow at the rate of 150 miles a second. To account for these marvels of the sun, recourse is had to solar currents.

The same thing is going on in the sun as on the earth in the way of ascending and descending currents. But in the *sun* the ascending currents are uprushes of intensely hot metallic vapors lighter than its atmosphere. In a colder region becoming condensed—so great is the sun's attraction —they sweep down with terrific force, cleaving the great dark chasms in the photosphere. "They carry down into the depths of the solar mass the cooler materials of the upper layers, consisting principally of hydrogen, and thus produce in their center a decided extinction of light and heat, as long as the giratory movement continues."

This extinction of light and heat is a sun-spot; for coldness on the sun means darkness wherever it appears. At the base of this cyclone of terrific power, the hydrogen set free and reheated at a great depth, sweeps up with equal force around the whirlpool, appearing as *faculæ* on the photosphere, and as the pyramids and spires of flame above the chromosphere.

"The velocities indicated by these movements are incredible. An up-rush and down-rush at the sides has been measured of 20 miles a second; a side-rush or whirl of 120 miles a second." These solar cyclones rage from a few days to half a year. They sweep over regions more vast than the space occupied by a score of such worlds as ours. "The sides approach each other at the rate of 20,000 miles an hour. The advancing sides strike together. The rising wave of fire leaps thousands of miles into space. The blazing surge falls again into the incandescent sea, rolls over mountains as the ocean over pebbles, and all this for age after age without sign of exhaustion or diminution."

The Sun's probable past and future, and source of power.

At the period of the greatest number of spots on the sun, it is supposed, we get less light than when it is free from them. Thus, we find it belongs to the class of variable stars, and has a period of 11 years. Infinite variety fills the sky. We behold suns of all ages and grades. The stars are of different colors and degrees of brightness, differing from each other and from the sun only in special modifications, and not in general structure. Is it not fair to presume the probable past and future of the sun are the probable past and future of every star in the firmament of heaven?

What is the probable future of the sun? is a question modern science is scarcely prepared to answer. We are not certain as to the nature of its interior. If the condensation of matter has stored up its heat, possibly millions of years hence, with all its planets welded into its mass, the sun will roll a cold, black ball through infinite space. If the interior is gaseous, then, according to a well-known law of physics, the more heat it loses the hotter it becomes. But, while the diminution of the solar heat by less than one fourth its amount would probably make our earth so cold that all the water on its surface would freeze, an increase by much more than one half would probably boil the water all away.

The balance of causes securing the physical equilibrium of our planet, it must be admitted, are very delicately adjusted. The modern discoveries of the conservation of force or energy, and the mutual convertibility of heat and energy, only carry the question forward another stage in its history. The enormous volumes of heat thrown off by the sun—of which the earth receives so small a part in proportion to the whole amount—can be supplied only by a continuous expenditure of energy. Therefore, any theory as to the sun's origin and future must account for that energy. Energy is of different grades. Each grade is potentially overcome by the higher grades, and all are submissive to the highest. We talk of energy of motion, energy of position, energy of person, energy of mind.

But what is the *highest, the all-controlling Energy?* One by one we feel along the links of the chain of causation till we reach the last, and find *nothing*, if we do not stand in the presence of *Him* to whom "all power is given in heaven and on earth," and "who upholdeth all things by the word of his power."

Standing before him and the works of his hands we are led to say, "The rainbow flowers of the footstool and the starry flowers of the throne" alike declare the glory of Him whose "countenance was as the sun shineth in his strength."

The Sun a symbol of God.

The sun, as the grand center of attraction and the ultimate source of light and heat and every form of power existing in the world, is a striking and impressive emblem of God. Christ, who said, "I am the light of the world," was seen by Paul at midday, shining with a light above the brightness of the sun. To the eye of faith the sun of nature shines with the glory of "the Sun of Righteousness." Hence we say—

"Well might the sun in darkness hide,
And shut his glories in,
When Christ, the mighty Maker, died,
For man, the creature's sin."

It was sin that veiled the heavens in darkness at noonday of the crucifixion. It is sin that keeps many from receiving "the light of the knowledge of God in the face of Jesus Christ." A silk thread stretched across the glass of a telescope will not only entirely cover a star, but also cover so much of the heavens that the star, if a small one and near the pole, will remain obscured for several seconds. Thus a thread *appears* to be larger in diameter than a star, than a *sun*, shining upon other worlds as our sun shines upon this world.

A sun is thus hidden because of *the great distance* we are from it. Sin has so separated us from God that trifles serve to obscure the "Sun of Righteousness."

The alternation of night and day is explained by the position of the earth in its relation to the sun. Man's relation to Christ determines his condition before God. Within the

Arctic circle of the north there is unbroken night in winter, because this icy region is then turned away from the sun. But in summer its position is so changed that it has a "midnight sun," and one continuous day.

"Thus the changes in our night and day, our summer and winter, are not changes in the sun, but are changes of the earth's relations to the sun. And just so it is with the relation of man to God. God is unchanged—*men* change! We of the earth have our moods, our spiritual phases. God is ever the same—*the unchangeable One.* We turn away from him and we are in darkness; we turn to him and we are enlightened." It is said some of the people within the limits of the frigid zone, at the close of the night of many months, when it is time for the sun to appear, go up to the tops of the loftiest elevations, striving who shall get the first sight. They abandon their usual avocations, forget their accustomed delights, clothe themselves in their best apparel, and when it is visible they embrace each other with joy, and cry, "Ecce Sol!" "Behold the Sun." When "the Dayspring from on high," hath visited us with wondering joy and adoring love, we cry, "Behold the true light, which lighteth every man that cometh into the world."

"As by the light of opening day
The stars are all concealed,
So earthly pleasures fade away
When Jesus is revealed."

"If once all the lamps that are lighted,
Should steadily blaze in a line,
Wide over the land and the ocean,
What a girdle of glory would shine!
How all the dark places would brighten!
How the mists would roll up and away!
How the earth would laugh out in her gladness!
To hail the millennial day!"

"In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep." "And God said, Let there be light: and there was light."—Gen. i, 1–3.

"And God made two great lights; the greater light to rule the day, and the lesser light to rule the night: he made the stars also."—Gen. i, 16.

"Is not God in the height of heaven? and behold the height of the stars how high they are!"—Job xxii, 12.

"He telleth the number of the stars; he calleth them all by their names."—Psa. cxlvii, 4.

"Take the earth and grind it into the smallest sand, and scatter it throughout space, and there will not be a grain for each star."—Agassiz.

"The heavens number out the glory of the strong God." —David.

> "The heavens are a point from the pen of his perfection;
> The world is a rosebud from the bower of his beauty;
> The sun is a spark from the light of his wisdom;
> And the sky a bubble on the sea of his power."
>
> —Sir W. Jones.

"All God's flowers are rosebuds in language. And whether they are violets, or snow-flakes, or clustered suns, filling immensity with their mingled hues, if held to the heart instead of the ear, they will speak in their own language the constant syllable and power of love."—H. W. Warren, D. D.

THE SUN.

[THOUGHT OUTLINE TO HELP THE MEMORY.]

1. Stars and Planets? Relative importance of the Sun? Power of Sun over the Earth? What is a "Spectrum?" Calorific and actinic rays? Effects of Sun?
2. Man's religious nature and the Sun? Buddhism? Bible?
3. Early conceptions of the Sun? Value of telescope and spectroscope? Size of Sun? Distance from earth? Mass or weight? Some of the "phenomena" of the Sun? Define: Photosphere, corona, spots, faculæ, cyclones.
4. Probable future of the Sun? The Sun as a symbol of God?

TRACTS.

Home College Series.

Price, each, 5 cents. Per 100, for cash, $3 50.

The "HOME COLLEGE SERIES" will contain short papers on a wide range of subjects—biographical, historical, scientific, literary, domestic, political, and religious. Indeed, the religious tone will characterize all of them. They are written for every body—for all whose leisure is limited, but who desire to use the minutes for the enrichment of life.

NOW READY.

No.

1. **Thomas Carlyle.** By Daniel Wise, D.D.
2. **William Wordsworth.** By Daniel Wise, D.D.
3. **Egypt.** By J. I. Boswell.
4. **Henry Wordsworth Longfellow.** By Daniel Wise, D.D.
5. **Rome.** By J. I. Boswell.
6. **England.** By J. I. Boswell.
7. **The Sun.** By C. M. Westlake, M.S.
8. **Washington Irving.** By Daniel Wise, D.D.
9. **Political Economy.** By G. M. Steele, D.D.
10. **Art in Egypt.** By Edward A. Rand.
11. **Greece.** By J. I. Boswell.
12. **Christ as a Teacher.** By Bishop E. Thomson.
13. **George Herbert.** By Daniel Wise, D.D.
14. **Daniel the Uncompromising Young Man.** By C. H. Payne, D.D.
15. **The Moon.** By C. M. Westlake, M.S.
16. **The Rain.** By Miss Carrie E. Dennen.
17. **Joseph Addison.** By Daniel Wise, D.D.
18. **Edmund Spenser.** By Daniel Wise, D.D.
19. **China and Japan.** By J. I. Boswell.
20. **The Planets.** By C. M. Westlake, M.S.
21. **William Hickling Prescott.** By Daniel Wise, D.D.
22. **Wise Sayings of the Common Folk.**
23. **William Shakespeare.** By Daniel Wise, D.D.
24. **Geometry.**
25. **The Stars.** By C. M. Westlake, M.S.
26. **John Milton.** By Daniel Wise, D.D.
27. **Penmanship.**
28. **Housekeeper's Guide.**
29. **Themistocles and Pericles.** (From Plutarch.)
30. **Alexander.** (From Plutarch.)
31. **Coriolanus and Maximus.** (From Plutarch.)
32. **Demosthenes and Alcibiades.** (From Plutarch.)
33. **The Gracchi.** (From Plutarch.)
34. **Cæsar and Cicero.** (From Plutarch.)
35. **Palestine.** By J. I. Boswell.
36. **Readings from William Wordsworth.**
37. **The Watch and the Clock.** By Alfred Taylor.
38. **A Set of Tools.** By Alfred Taylor.
39. **Diamonds and other Precious Stones.** By Alfred Taylor.
40. **Memory Practice.**
41. **Gold and Silver.** By Alfred Taylor.
42. **Meteors.** By C. M. Westlake, M.S.
43. **Aerolites.** By C. M. Westlake, M.S.
44. **France.** By J. I. Boswell.
45. **Euphrates Valley.** By J. I. Boswell.
46. **United States.** By J. I. Boswell.
47. **The Ocean.** By Miss Carrie R. Dennen.
48. **Two Weeks in the Yosemite and Vicinity.** By J. M. Buckley, D.D.
49. **Keep Good Company.** By Samuel Smiles.
50. **Ten Days in Switzerland.** By H. B. Ridgaway, D.D.
51. **Art in the Far East.** By E. A. Rand.
52. **Readings from Cowper.**
53. **Plant Life.** By Mrs. V. C. Phœbus.
54. **Words.** By Mrs. V. C. Phœbus.
55. **Readings from Oliver Goldsmith.**
56. **Art in Greece.** Part I.
57. **Art in Italy.** Part I.
58. **Art in Germany.**
59. **Art in France.**
60. **Art in England.**
61. **Art in America.**
62. **Readings from Tennyson.**
63. **Readings from Milton.** Part I.
64. **Thomas Chalmers.** By Daniel Wise, D.D.
65. **Rufus Choate.**
66. **The Temperance Movement *versus* The Liquor System.**
67. **Germany.** By J. I. Boswell.
68. **Readings from Milton.** Part II.
69. **Reading and Readers.** By H. C. Farrar, A.B.
70. **The Cary Sisters.** By Miss Jennie M. Bingham.
71. **A Few Facts about Chemistry.** By Mrs. V. C. Phœbus.
72. **A Few Facts about Geology.** By Mrs. V. C. Phœbus.
73. **A Few Facts about Zoology.** By Mrs. V. C. Phœbus.
74. **Hugh Miller.** By Mrs. V. C. Phœbus.
75. **Daniel Webster.** By Dr. C. Adams.
76. **The World of Science.**
77. **Comets.** By C. M. Westlake, M.S.
78. **Art in Greece.** Part II.
79. **Art in Italy.** Part II.
80. **Art in Land of Saracens.**
81. **Art in Northern Europe.** Part I.
82. **Art in Northern Europe.** Part II.
83. **Art in Western Asia.** By E. C. Rand.

Published by Phillips & Hunt, New York; Walden & Stowe, Cincinnati, Ohio.