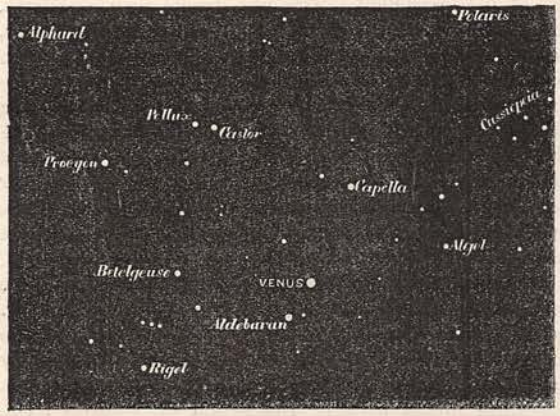
stars of the first magnitude, Alpha Cygni and Vega, shine above all others near them; and almost due east, and very near to the horizon, the chief stars in Aquila have just risen. The strictly circumpolar stars, in Draco and Cepheus, can be generally recognized east of the meridian between Polaris, Alpha Cygni, and Vega. The stars in Ursa Minor are now nearly all between the zenith and the pole, Kocab, or Beta Ursæ Minoris, being near the meridian.



POSITION OF VENUS AT 8 P.M., APRIL 15.

During April, 1868, the planet Venus is the evening star, and will be a very conspicuous object in Taurus in the western sky soon after sunset, and in the W.N.W. for some hours afterwards, exceeding in splendour the brightest of the fixed stars. She disappears below the horizon on April 1st. at 10.40 P.M., on the 15th at 11.16 P.M., and on the 30th at 11.42 P.M. Mercury and Mars are in unfavourable positions for observation, either with the naked eye or telescope, both planets rising only a short interval of time before the sun. Mercury will be at no great distance from Jupiter on the 13th, and from Mars on the 17th. Mars rises on the 1st at 5.11 A.M., and on the 30th at 4.42 A.M. On the 8th he will be in conjunction with Jupiter, when the two planets will be remarkably close to each other. Jupiter will be visible in the morning throughout the month, shortly before sunrise. On the 1st he rises at 5.15 A.M. or twenty-one minutes before the sun, and on the 30th at 3.33 A.M., or about an hour before sunrise. Jupiter will not, however, be well seen till after the middle of the month, when his four satellites will again be visible after having been lost in the rays of the sun since the beginning of February. Of the large planets, Saturn only can be favourably observed. On the 1st he rises about three-quarters of an hour before midnight in the south-east; on the 15th at 10.18 P.M., and on the 30th at 9.15 P.M. Saturn will be sure to attract attention. For several months he will be situated in the constellation Scorpio, and very near to the stars Beta Scorpii and Antares. The three objects will not differ much in magnitude, but the planet may be identified by its white and steady light, while that of Antares is of a reddish tinge, and Beta Scorpii is the smallest of the three.—Uranus can be easily seen with the aid of a telescope, and occasionally by the naked eye, in the absence of moonlight, when its exact position amongst the neighbouring stars is known. This planet sets at 2 A.M. on the 1st, and soon after midnight on the 30th.—The planet Neptune, though nearly equal in bulk to Uranus, is so far distant from us that it appears in the field of view of a telescope no greater than a star of the seventh or eighth magnitude. It is, therefore, always invisible to the unassisted eye, and, consequently, its movements can never be of much popular interest.

The moon will be in the constellation Cancer on the 1st and 2nd of April, and in Leo from the 2nd to the 4th. On the 3rd, at about 8 P.M., she will be very near the star Regulus. On the 5th she enters Virgo, continuing in this sign till the 7th. On the 8th and 9th she is in Libra, and on the 10th in Scorpio. After this day the moon is only visible in the morning hours till new moon. On the reappearance of the young crescent moon, she will be in the constellation Taurus, passing on through Gemini and Cancer by the end of the month. The star Aldebaran, in Taurus, will be very near to the moon on the morning of the 25th; and on the 30th, near midnight, Regulus will, for the second time this month, be very near the moon. The changes of the moon will take place as follows:—Full moon on the 7th at 7.17 A.M.; last quarter on the 14th, at 10.34 P.M.; new moon on the 22nd, at 8.20 P.M., and first quarter on the 29th, at 6.18 P.M.

Our description of the positions of the stars at midnight on April 15th, will, with the diagrams, be also available on May 15th, at 10 P.M., on January 15th at 6 A.M., on February 15th at 4 A.M., and on March 15th at 2 A.M.

THE GAS WE BURN.

THE use of coal-gas for domestic purposes has been common in this country for more than fifty years, so that the proportion of our existing population, who can recall the aspect of London and other great towns as it was before gas became common, is but comparatively small. For the sake of those of our readers to whom the manufacture of gas is practically a mystery, we are going briefly to describe the processes by which the coal that warms our dwellings and cooks our food, is made also to yield us light within doors and without. London and London suburbs contain more than a score of gas factories, and there is hardly a town in England that does not boast its own gas-works. Everybody has seen the huge gasometers towering above the chimney-tops, and has encountered the gangs of sooty-faced men going to and fro at their labour; while few have had interest or curiosity enough to explore these resorts of curious industry, and to observe what is constantly going on there without pause or intermission, from one year's end to another.

On entering a gas-work we do not fail to remark that the several operations necessarily cover a considerable area of ground, not the least portion of which is occupied by the enormous circular vessels which are the storehouses of the gas when its manufacture is completed, and from which it passes into the mains, or street-pipes, by which it is led off, it may be to the distance of many miles, for the service of the public.

Passing on amid these monster vessels, and various smaller structures of somewhat similar form, among which are rows of tall pillars coupled together at the top, we follow our guide to the retort-house, where the business of making gas may be said to begin. The spectacle is sufficiently startling and impressive to one who witnesses it for the first time. It is night, and the stars are shining clearly, and so is the half-moon, in the cold blue sky aloft, and as you look up you see them glimmering through the lurid smoke and smother of the scene. At first you do not know what to make of it. You are in a kind of cavern some hundred yards long and not

ten wide, the walls of which are spouting fire in fifty places at once, and every now and then bursting out at some new point. Groups of men of weird aspect and frantic gestures, half-clad and begrimed with coal-dust, are poking with long pikes at the spouting flames, and raking forth masses of glowing matter, while others are thrusting fresh fuel into the fiery mouths and rapidly closing them up. After a while these operations begin to explain themselves. The fire-spouting holes are the mouths of the retorts in which the coal is burned. The retorts are hollow iron cases about seven feet long and rather cylindrical in shape, with a diameter of some fourteen inches or more. They are closed at the farther end, and are only opened at the mouth for the admission and withdrawal of the fuel. They are kept constantly at a red heat by means of fierce fires of coke, the furnaces being so contrived as to subject them all to a great, and, as near as possible, an equal heat. The retort is filled by means of a long iron scoop fitting its interior, by which the charge of coal is readily introduced, and, the scoop being inverted, is withdrawn empty: the right charge is about two-thirds of the quantity the retort would hold; it would not do to put in more, because the coal will be transformed into coke when it comes out, and will have increased about one-third in bulk, for which increase space must of course be allowed. The moment the charge of coal is introduced, so great is the heat it meets that it bursts into flame; and if now the mouth of the retort were suffered to remain open the coal would be consumed as coal is consumed in an ordinary grate, resulting only in flame and cinders. But flame cannot exist without air, and the mouth of the retort being closed up and the air excluded, the disengaged gas, which would be flame if air were present, escapes up a tube fixed over the mouth of the retort, which tube dips into the hydraulic main—a large iron pipe running along above the topmost retorts and communicating thus with every one of them. As the distillation of the coal goes on, a quantity of tar, ammoniacal liquor, and other matters, rises along with the gas through the connecting pipe, and flows over into the hydraulic main, which is so contrived as always to be about half-full of this semi-liquid stuff; the feeding-tubes from the retorts all dip below the surface of the liquid, by which arrangement any return of the gas is prevented when the charges of the retorts are drawn or they have to be repaired or otherwise interfered with.

We have said that the retorts are somewhat cylindrical in shape: we may add that the shapes vary in different factories, and also for different objects. Some are strictly circular; a cross-section of others would show them in a greater or less degree oval; others, again, are waggon-shaped; while many are known from their form as "kidney-shaped." The waggon, or ⊔ shaped, appear to be very generally used. The retorts are arranged in sets, and a set may consist of three, five, seven, or nine, according to the size of the furnaces and the convenience which space may afford for their arrangement. Each set of retorts has its own furnace or furnaces, and its own working gang. The time during which the retorts are kept burning will depend in some degree on the nature of the coal used, and may vary from six to eight hours, though the operation may be greatly accelerated in cases of urgent need. It is not advisable to continue the distillation too long, because the best gas is that which is first produced, while that obtainable after a certain lapse of time would be so bad as to be not merely valueless but detrimental. To ensure good distillation, the retorts should be heated to a red heat, and maintained at a regular temperature. If the retorts are not sufficiently heated at first, the gas given off would burn with only a feeble light; and if they are allowed to get too hot, the produce may be gases that give still less light, or even nitrogen and carbonic acid, which extinguish flame.

As the gas, together with the tar, ammonia, etc., flows from the retort-tubes into the hydraulic main, the heavier matters are led off through a pipe in the main conducting to a tar-cistern, generally underground, the pipe being so adjusted as to leave the main always half-full of the tarry fluid. The gas, by its own elasticity, forces its way from the main into coolers or condensers, consisting for the most part of a series of tall, upright pipes, enclosed in larger ones, the spaces between the outer and inner pipes being filled with water flowing through in a cool stream. The pipes through which the gas circulates open at the bottom into a kind of chest or tank, in separate divisions, into which the tar condensed on the cool surface of the pipes trickles down, and whence it can be drained off into the tar-cistern at pleasure.

On entering the condensers the gas is at about the temperature of 120 deg., and it cools down to 60 deg. before leaving them. Though it has parted with the mass of its impurity in the condensers, it is not yet by any means in a fit condition for use, as many injurious gases are mixed with it, the action of which on the luxurious contents of some of our dwellings, and on our own sensations, would be anything but agreeable. These noxious elements have therefore to be removed by purification; and it is in this department of gas-making that the greatest difficulties have been encountered, and the most valuable improvements have been effected. Up to a comparatively recent period, the purification of coal-gas was accomplished almost entirely by the use of lime or lime and water. The gas was passed in the purifiers through lime-water, or through layers of lime slightly moistened; and, as a large quantity of lime was necessarily used, and immense masses of it became saturated with foul gases, the odours it gave off were disgusting beyond expression; and it was this vile fetor which in past years rendered the very neighbourhood of a gas-work unbearable. The necessity for perpetuating such a nuisance, however, no longer exists, and in some of the London gas-works the whole manufacture is conducted throughout without the prevalence of any disagreeable smell, and even with less annoyance from that source than one meets with in average workshops.* This improvement has been brought about by the substitution of oxide of iron instead of lime in the purifiers, or rather, of an artificial compound containing such chemical constituents of oxide of iron as have the required purifying power. The substance looks like sawdust dyed brown; it is almost odourless before use, and even after use, when it has taken up the impurities of the gas, and is stained by them to a dense black, it may be freely handled without unpleasantness.

The purifiers, into which the gas passes after leaving the condensers, are large rectangular vessels, wide as the floor of a room, about three feet in depth, and fitted up interiorly with three stages on floors one above the other, the stages consisting of laths of wood, very narrow and nearly touching each other, and the whole stage being divided into sections, so as to be easily removed when necessary. On these several floorings of lath the brown oxide is spread loosely to the depth of an inch or more, and the lid of the purifier is then let down,

* At the Equitable Gas-works, for instance, the processes of gas-making are gone through, not merely without annoyance to the neighbourhood, but almost without any perceptible odour in any part of the premises.

making all gas-tight. The gas, turned into the purifier from below, rises through the several layers of oxide, parting with its impurity as it goes. Above the topmost layer an open pipe leads away from the first purifier to the second, where the gas passes through a second series of the oxide-laden floors of lath; and from the second purifier to a third, and from a third, if need be, to a fourth. When the purifying power of the oxide is exhausted it is withdrawn, and is exposed to the action of the atmosphere, by spreading it thinly on the floor of an upper room. No foul smell results from such exposure, as there would be in the case of lime; yet the oxide, from being as black as ink, recovers its bright brown colour by degrees, and recovers also, to a considerable extent, its purifying power. It is but right to state here that lime is still used for the final purifying process, as applied to the best gas—the gas which is made of cannel coal, which is rendered as pure as it is possible to render it, and is supplied to the dwellings of the upper classes.

After passing through the purifiers, with their many strata of iron-oxide, or lime, the gas is so far cleansed that it might be stored for use, and left to get rid of the ammonia which it still contains, by contact with the water in the gasometer. But though the water would absorb the ammonia if the gas were kept long enough, it will not do so very quickly; and hence it becomes necessary to get rid of the ammonia in some other way. This is done most satisfactorily by means of what is called the "scrubber," which is nothing more than a tall tank as big as an average haystack; the tank is filled with lumps of coke, over and through which water is constantly trickling from a perforated tube at the top. The gas, being let in at the bottom of the tank, as it rises meets the descending water, with which every particle of it comes into contact, owing to the extensive surface of the wet coke, and the ammonia is thoroughly taken up by the water, which thus acquires a commercial value.

The manufacture of the gas is completed with its satisfactory purification; but hardly less onerous and responsible is the business of storing it, and of dispensing it to the public.

The gas, after purification, is stored in the large circular gasometers which are such conspicuous objects in every gas-work; but before it is conveyed into them it has to be passed through the station-meter, which registers the quantity of gas made in any given period, from an hour to a month or more, and which, being furnished with dial-plates and moving indexes, shows the rate at which gas is being made at all hours of the day and night throughout the year. At those establishments where two different qualities of gas are made, there must be of course two station-meters, as well as two lines of street mains.

The gasometer has not only to store up the gas as fast as it is made, but to weigh upon it with sufficient pressure to force it along the street pipes, so that it may issue from the jets at a uniform rate and burn with a steady flame. The gasometer is a large cylinder, sometimes of enormous dimensions, formed of iron plates riveted together and strengthened with internal rods and bars, and closed at the top, while it hangs or floats with its open end in a cistern of water just large enough to receive it. Whatever the size of the cylinder, its form is invariably the same, its height being just one half its diameter, such being the form which gives the greatest capacity; in practice, however, a little is added to the height, to prevent the escape of gas when the cylinder rises to its greatest elevation in the water. Years ago it was rare to see a gasometer more than forty or fifty feet in diameter, and we remember when the erection of one of sixty feet was recorded as a triumph; at the present time there are cylinders of a hundred and fifty feet diameter, and more than that—the largest containing over half a million of cubic feet of gas when full.

The gas enters the gasometer through a pipe leading from the purifiers, and rising centrally above the water in the tank. As it comes in it forces up the cylinder, which continues to rise slowly, in spite of its vast weight, forced up by the elastic power of the gas, which in many cases is fanned onwards from the purifiers by a steam-engine. Close to the pipe through which the gas enters is another pipe of about the same diameter, connected with the street mains, and along which, urged by the pressure of the mass of the cylinder, it rushes with a force which can be regulated by increasing or diminishing the superincumbent weight, but which must be sufficient to propel it through the smallest pipes at the greatest distance it has to travel. Ingenious contrivances are had recourse to in order to maintain a uniform pressure —not an easy thing when we reflect that, as the gas becomes exhausted, the gas-holder, by dipping into the water, must part with some considerable portion of its propelling weight at the very time when it is most wanted. In the case of very large gas-holders this business is managed much more easily than in the case of smaller ones—it being possible, by a careful adjustment of weight and bulk, to make them self-regulating.

The large consumption of gas in London necessitates the keeping of an immense store on hand; and, at the same time, the dearness of land renders the multiplication of gasometers expensive, and, in confined areas, impossible. To meet this difficulty, gasometers are often constructed on the telescopic principle. The telescope-gasometer consists of two, three, or more concentric cylinders, the bottoms and tops of which, except the top of the uppermost, are furnished with flanges turned in opposite directions, the flange turning outwards and upwards at the bottom, and inwards and downwards at the top. The uppermost cylinder is covered at the top, but the others are open both at top and bottom. Supposing the gasometer to be empty, all the cylinders will be sunk in the cistern, like the tubes of a telescope in its case; when the gas is introduced, the innermost cylinder will rise first, and when its bottom reaches nearly to the surface of the water, its curved flange lays hold of the flange of the next cylinder, which also rises; and when this has advanced sufficiently high, it lifts the next. The escape of gas and the admission of air are prevented by the lower flange of each cylinder taking up a quantity of water, which acts as a water-lute. By means of this bold and ingenious contrivance, it is evident that two, three, or more gasometers are made to occupy but the area of one.

We need not follow the gas after it leaves the gasometer on its devious journey through the streets and far-stretching suburbs. The means and the methods of its distribution are well known, and need not be here described. We may conclude this brief sketch with one or two items of a statistical kind.

In burning coal for making gas, the quantity of gas produced varies greatly with the description of coal used, the coal from some districts yielding twice as much gas as that from others. Taking the average of the coal used in London, we are quite within the mark in stating that each ton produces ten thousand cubic feet of gas. The other saleable products are fifteen hundred pounds of coke and twelve gallons of tar, not to mention the

ammoniacal liquor. Of the coke, about one-fourth is used for heating the retorts, the remaining three-fourths being sold, and contributing, by its sale, very largely to the profits of the trade. From the tar various products are obtained by distillation. Considering the price we pay for gas, and connecting that with the value of the secondary products, it would appear that the profits of gas-making must be abnormally large; but, on the other hand, we must take into account the cost of production, represented not so much by the price of coal and the wages of the workers, as by the enormous capital invested in the necessary plant, and buried for the most part in the ground. The gas mains of the various London companies at the present time, taken in the aggregate, are not much less than three thousand miles in length. There is hardly any other species of manual industry carried on at so great an outlay.

It would be interesting to know what is the actual quantity of gas produced in London in the course of a year. We have seen no recent estimate, but in 1848 the quantity made was 3,200 millions of cubic feet, and the price paid for it by the public was £700,000. Now it has been stated that the quantity of gas required for the consumption of London doubles every ten years; if this be so, the present rate of production must be more than 12,000 millions of cubic feet per year, and the consumption of coal must amount to 1,200,000 tons. The price paid for the gas would not, however, be proportionately so large, the cost of it to the consumer having been considerably reduced of late years.

SPRING DAYS.*

Spring days, sweet spring days, my quiet heart and rested eye tell me that there is no fear but that I enjoy you still!

"For lo, the winter is past,
The rain is over and gone:
The flowers appear on the earth;
The time of the singing of birds is come,
And the voice of the turtle is heard in our land."

This exquisite poetry has its voice of delight for me, and as I shut my eyes it brings a change over the bare boughs and the winter land. I dream of the chill black hedges and trees, flushing first into redness, and then "a million emeralds burst from the ruby buds." I dream of the birds coming back, one after one, until the poetry of the flowers is all set to music. And I go out into the land to behold, not only to dream of and image, these things. I watch for the delicious green, tasselling the earliest larch (there is one every year a fortnight in advance of the others) in the clump of those trees beside the road on my way home. I look, in a warm patch that I know, for the first primroses, and when I find them mildly and quietly gazing up at me from the moss, and ivy and broken sticks, and dead leaves, a surprise, although I was expecting them, and a dim reflection of that old child-joy bring with a rush to my heart again those "thoughts that do often lie too deep for tears." And in the garden I wander through the bare shrubberies, varied with bright box, and gather in my harvest there. The little Queen Elizabeth aconites, gold-crowned in their wide-frilled green collars; these are no more scant, and just breaking with bent head through cracking frosty ground. They have carpeted the brown beds, and are even waxing old and past now. The snowdrops have but left a straggler here and there; and the miniature golden volcano of the crocus has spent its columns of fire. The hazels are draped with slender, drooping catkins; the sweetbriar is letting the soft sweet-breathed leaves here and there out of the clenched hand of the bud. The cherry-tree is preparing to dress itself almost in angels' clothing, white and glistening, and delicious with all soft recesses of clear grey shadow, seen against the mild blue sky. The long branches of the horse-chestnut trees, laid low upon the lawn, are lighting up all over with the ravishing crumpled emerald that bursts like light out of the brown sticky bud; as sometimes holy heavenly thoughts may come from one whose first look we disliked; or as God's dear lessons unfold out of the dark sheath of trouble. The fairy almond-tree—of so tender a hue that you might fantastically imagine it a cherry-tree blushing—casts a light scarf over a dark corner of the shrubbery. The laburnum is preparing for the summer, and is all hung with tiny green festoons. Against the blue sky, on a bare sycamore branch, that stretches out straight from the trunk, a glad-voiced thrush seems thanking God that the spring days are come. Wedged tight into three branching boughs, near the stem of a box-tree, I find a warm secure nest, filled with five little blue-green eggs. It is still a delight to me to find a nest; a delight, if not now a rapture, an intoxication.

All these I see on one spring day or another, as I walk into my garden, or out into the changing lanes. All these I see, and all these I love. But I see them, and I love them tenderly and quietly, not with the wonder and the glee of life's early spring days. I am sad, partly because I know that a great deal of that old wondering ecstatic thrill has gone.

"The rainbow comes and goes
And lovely is the rose,
The moon doth with delight
Look round her when the heavens are bare;
Waters on a starry night
Are beautiful and fair;
The sunshine is a glorious birth;
But yet I know, where'er I go,
That there hath passed away a glory from the earth."

It must be so, naturally, if only from the mere fact that things must lose their newness, and so their wonder, to the eye and the heart. Do what you will, you must become accustomed to things. And the scent of a hyacinth or of the may will cease when familiar to be the wonderful enchanting things that childhood held them to be. And the *thirtieth* time that we see, to notice, the first snowdrop bursting through the pale green sheath above the brown bed, is a different thing from the *third* time. We appreciate delights keenly when we are young, seek the same in later years, but never find them; and then all our life remember the search more or less regretfully. So Wordsworth, the old man, addresses the cuckoo that brought back his young days and his young thoughts by its magic voice:—

"Thou bringest unto me a tale
Of visionary hours.

"Thrice welcome, darling of the Spring!
Even yet thou art to me
No bird, but an invisible thing,
A voice, a mystery:

"To seek thee did I often rove
Through woods and on the green;
And thou wert still a hope, a love;
Still longed for, never seen.

"And I can listen to thee yet;
Can lie upon the plain
And listen, till I do beget
That golden time again."

* From "The Harvest of a Quiet Eye; Leisure Thoughts for Busy Lives." Published by the Religious Tract Society. A book of which Mr. Ruskin says, "I never saw anything more gracefully and rightly done—more harmoniously pleasant in text and illustration."