TALK WITH THE BOYS.

No. 2.—What becomes of gas when it is burned?

"Now, father, we want to know what becomes of the atoms that gas is composed of when the gas is burned."

"In order to explain that to you clearly, I must have some balls to represent atoms of oxygen. These must be made of some substance considerably heavier than the balls which we use for carbon, as the atoms of oxygen are a little more than eight times heavier than atoms of hydrogen, and are only half as large. Perhaps some very heavy wood will answer the purpose. Now, to illustrate what takes place when gas is burned, we will cut asunder one of the atoms of light carbureted hydrogen, which gives us, you see, two atoms of hydrogen and one of carbon. We next fasten, with the thread, one of the atoms of hydrogen to one atom of oxygen, and we have an atom of water (HO). Serve the other atom of hydrogen in the same way, and we have two atoms of water. Then unite the atom of carbon with two atoms of oxygen, and we have an atom of carbonic acid gas (CO^2). The oxygen comes from the air, of which it constitutes about one-quarter. The olefiant gas, in burning, is decomposed in the same way; its hydrogen and carbon combining with the oxygen of the air, and producing, also, water and carbonic acid. I do not care to confuse your minds by carrying you through these changes, but if you choose to go through them, you will find that the burning of one pound of illuminating gas takes up four pounds of oxygen, and produces about two pounds of water and three of carbonic acid."

"But, father, I do not see any water or carbonic acid about the burner. Where do they go to?"

"They become invisible, and float away in the atmosphere."

"What makes them invisible?"

"Nobody knows. We do not know why the air is invisible; we only know that it is so. If you go out in a high wind, you can feel the air; you know that there is a substance rushing against you, but it is not to be seen. We know that most substances are invisible when in the gaseous form; but why they should be so, we do not know. The water which is produced by burning gas is kept in the gaseous form by the intense heat, and, when it cools, is deposited in little drops, like fine dew on the windows or on the outside of a cold pitcher. The carbonic acid may be condensed into a liquid by subjecting it to a pressure of 540 pounds to the square inch."

"Let us see; the atom of carbonic acid consists of one atom of carbon, which weighs 6.04, and two atoms of oxygen, which weigh—8, did you say?"

"Yes; but more exactly, 8 and 13-1 000ths—decimally 8.013."

"Then two of oxygen make 16.026, and one of carbon (6040) added, makes 22.066, as the weight of an atom of carbonic acid."

"I have talked, Charles, with a good many of the graduates of our colleges who did not understand this matter of atomic weights half as well as you do already."

"I should think you were fastening the carbon ball to the oxygen as if you intended they should never be separated."

"That is the case in nature. When oxygen and carbon unite, it is no temporary connection, but a marriage for life. They cleave unto each other through summer and winter—in rain and shine—in heat and cold. They will literally pass through water and fire without dissolving their union. This peculiar couple play a very important part in the operations both of nature and of art, and we shall find no more interesting inquiry than to follow carbonic acid in some of its curious paths. Where shall we follow it? Shall we track it through our own bodies, in its course through the stomach, and blood, and heart, and lungs? Shall we trace its wonderful history away back through the hundreds of thousands of years before man was created, and see how its harp tooth was cutting down the rocks when the earth was rolling, a hot and slimy globe, without an inhabitant upon its surface? Or shall we first take a shorter course, and content ourselves with observing how it is absorbed by water and forced into the steam engine, and see what complicated contrivances have been invented for getting rid of it there? What do you say, John?"

"Tell us, sir, if you please, about the steam engine; I want to understand that more than anything else."

"Very well. That will lead us to investigate the relations of carbonic acid to water, and these are so constantly manifesting themselves in our food and drink, and in a thousand other connections, that I think this part of the history of carbonic acid will interest you more than any other part. But I have not yet explained to you how the light is produced when gas is burned. This is comparatively a late discovery, and is very curious. Though the union of oxygen with carbon is so strong, when it is once formed, these substances do not enter into combination as readily as oxygen and hydrogen. So, when gas issues from the jet and comes in contact with the oxygen of the air, the hydrogen is first burned; or, in other words, first enters into combination with oxygen. This produces an intense heat, which makes the carbon red-hot, or white-hot, and it is this hot carbon that gives most of the light. By making a draft from below, so as to consume the carbon at the same time with the hydrogen, illuminating gas may be burned with a very feeble light indeed. Now go to your play, and next Saturday we will follow the interesting couple—oxygen and hydrogen—in their wedded state of carbonic acid, right into the bowels of the steam engine."

TEMPERING STEEL.

Each variety of steel requires a different degree of heat, preparatory to plunging it in cold water, for the purpose of hardening. As it is very difficult to tell the degree of heat to which a piece of steel has been raised in a fire, the process called tempering provides for the difficulty. The steel is first heated in a clear fire to the highest temperature it will bear without being permanently injured, and is then cooled so as to impart to it the greatest hardness. It is then ground or polished so as to show a bright surface, and gently reheated until the bright surface shows a certain color. The colors produced by the increasing heat on the bright surface are, in succession, yellow, brown, purple, light blue, dark blue and black. These shades are used for the following purposes:—Yellow for lancets, razors, pen-knives, cold chisels and miners' tools; brown for scissors, chisels, axes, carpenters' tools and pocket-knives; purple for table-knives, saws, swords, gun locks, drill bits and bore bits for iron and metals; and blue for springs, small swords, &c. Articles which are to be softer are made still darker; but when the black shade is reached the steel is annealed and soft. These colors are the result of oxydation. The increasing thickness of the film of oxyd which accumulates on the bright surface of the steel is less and less apparent as the heat increases. Steel receives by sudden cooling that extreme degree of hardness combined with tenacity, which places it so incalculably beyond every other material for the manufacture of cutting tools; especially as it likewise admits of a regular gradation from extreme hardness to its softest state when subsequently reheated or tempered. Steel therefore assumes a place in the economy of manufactures unapproachable by any other material; consequently we may safely say that without it, it would be impossible to produce nearly all our finished works in metal and other hard substances.

In the process of hardening steel, water is by no means essential, as the sole object is to extract its heat rapidly; and the following are examples, commencing with the condition of extreme hardness, and ending with the reverse condition.

A thin heated blade placed between the cold hammer and anvil, or other good conductors of heat, becomes perfectly hard. A nearly similar variety of conditions might be referred to, as existing in cast iron in its ordinary state, for some cast iron may be rendered externally as hard as steel, such as chilled iron castings, which are cast in iron molds.

At the zinc-paint works near Bethlehem, Pa., some 30 or 40 furnaces are in operation. The zinc ore yields 40 per cent of metal. This being subjected to an incandescent heat, the pure zinc descends, in vacuo, in the form of a fiery vapor, smoke and gas, and after passing through great pipes and receivers, it falls like a snow-shower as a white powder, which is the dry and perfect material for paint.

A COLUMN OF VARIETIES.

Ten cubic yards of hay in a stack will weigh about one tun.

The beautiful cosmetic called "violet powder" is composed of fine starch, scented with orris root. It is, perhaps, the safest powder which can be applied to the skin.

There are about 70 parts of starch in every 100 parts of fine dry flour. By the common processes of manufacture, about 25 per cent of this starch, at least, is lost; there is therefore a wide margin for improving the starch manufacture.

Many persons frequently require a dull, black varnish for the interior metal-work of telescopes and boxes. Such a varnish is made by simply adding lampblack to any spirit varnish. It should be dried in a cool place. About three ounces of shellac, dissolved in a pint of alcohol, with lampblack sufficient to color it, will answer every purpose.

In a letter to the Boston *Commercial Bulletin*, Donald McKay states that, by the middle of next year, when the vessels now constructing for the British navy shall be furnished, they will count 735 vessels, with 17,099 guns and a steam power of 132,786 horses. In guns, the French navy is only about half as strong as the English.

The New York and Erie Railroad Company have recently placed upon their road the most comfortable and perfect sleeping-car, probably, in the world. The entire length of the car, including the platform, is 65 feet, and it is 11 feet wide and 8 feet high. It has seats for 60 passengers, which seats can easily be changed into double or single berths, to accommodate 52 sleepers.

Oak trees in the French forests have been attacked this year by a strange disease. They are covered from the top branches to the roots with caterpillars, which form a coating some inches thick. In some localities, the municipal authorities have published a notice forbidding children to enter the woods. These insects, at the approach of a human being, cover the face, neck and body, and their sting has, in many instances, produced fever.

The *Spirit of the Times* gives the following rule for finding the weight of live animals:—"Take the girth behind the fore-arms in inches, and square it; take the length from the top of the shoulder in inches, and multiply the square of the girth by it; multiply that product by the decimal ·07958, and divide that product by 576, which gives the weight in stones of 14 lbs. each. The same rule applies to all classes of animals when thoroughly fat."

Magic pictures have been heard of which, when viewed in a certain point through a lens, exhibit an object perfectly different from that seen by the naked eye. Nicoron tells us that he executed at Paris, and deposited in the library of the Minimes, a picture of this kind. When seen by the naked eye, it represented 15 portraits of Turkish sultans; but, when viewed through the glass, it was a portrait of Louis XIII! This is as wonderful as the stereoscope.

During the past century, the cattle plague or murrain has made fearful havoc. In Germany alone, 28,000,000 head of cattle were carried off by it; and in the whole of Europe (including Russia, but exclusive of Siberia and Tartary), upwards of 200,000,000 have died of this pest. The special symptoms of this disease, in its early stage, are said to be a husky cough, which is increased, particularly after the cattle have been watered or moved about; less inclination for food, indifference as to chewing the cud, dullness of the hair and its rough appearance in particular places, and fever after these symptoms have continued for some time.

A thermometer does not indicate the amount of heat in a body, but merely its intensity and changes. Three divisions of measuring temperatures are used, viz.: Fahrenheit's, Reaumur's and centigrade. The former is in general use in the United States; the latter in France, and it is, like the French measures, the most convenient. In Fahrenheit's scale, the freezing point is called 32° and the boiling point 212°; when, therefore, the mercury stands at 0°, or zero, it is 32° below the freezing point. In Reaumur's scale, the freezing point is called 0° and the boiling point is called 80°. In the centigrade, the freezing point is 0° and the boiling point 100°.

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