teacher, writer, or purveyor of literature, with the mental and moral training of the youth of our day. The formation of high moral standards, of a noble manhood and womanhood, is of infinitely greater importance than any proficiency in scientific facts or theories.

Looked at simply from the point of view of the effect in the formation of character, can any one doubt whether the old or the new ideas on science and ethics are the better? The youth who is taught from his earliest years to believe in God and a future life, is brought continually under the influence of the strongest conceivable, the strongest possible, motive to seek purity of heart and life. If the ever present conviction "Thou God seest me," inwrought into the deepest fibres of mind and conscience, cannot overcome temptations and tendencies to depravity, nothing can. Beside the force of such a notion as this, all considerations of mere caution and propriety and utility, become utterly futile, insignificant, puerile. And, it must be confessed that, while it is far from universally true, there is too much truth in the assumption that the difference between the old fashioned and the modern systems of instruction, bestrides this distance. All merely materialistic and utilitarian doctrines of science are of the earth earthy, and tend inevitably to shut up the sight within the narrow horizon of this poor life. The good old teachings were redolent of Heaven and immortality.

But, it may be asked, is not this begging the question? The modern philosopher will cry "Yes. Instead of teaching the young to search after truth and truth only, you are trying to scare them from the path of independent investigation. Truth is the great object of science, the highest end of all research, and in order to pursue the truth with single eye we must put aside all preconceived notions and creeds." To this it may be replied that the scientist is the man who begs the question when he assumes that we have no road to truth but through the outer senses, no source or criterion of truth but outward observation and logical inference. The very fact that some of the deductions of modern science contravene both the immemorial traditions of the race, and the highest instincts, or intuitions, of the soul, is their scientific condemnation; as the other fact that they demonstrably tend in the direction indicated by Ruskin, is their ethical condemnation. But we did not set out to be metaphysical, though we do want our readers to think about the tremendous all that is suggested by Ruskin's paragraph.

Special.

ELEMENTARY CHEMISTRY.

ATMOSPHERIC AIR.—*Continued.*

Diffusion of Gases.

The uniformity of composition of the atmosphere is partly due to the operation of winds, but it mainly depends upon DIFFUSION, *by which gases mix in opposition to gravitation, and when mixed remain so.* This may be illustrated by the following experiments:—

Exp. 4.—Fill a bottle with carbon dioxide, and leave it mouth upwards. In about half an hour introduce a burning taper; it will not be extinguished, thus proving that the gas has escaped from the vessel. The carbon dioxide, though heavier, has *diffused* into the air above, although the latter is lighter.

Diffusion between gases takes place if they are separated by a porous partition. A partition made of plaster of Paris is very suitable for experiments on diffusion.

Exp. 5.—Take a glass funnel, the mouth of which is about 6 or 8 cm. wide. Place upon the table a plate of glass somewhat larger than the funnel, and pour over it soft plaster of Paris, so as to form a layer 2, or at most 3, mm. thick. Press the funnel upon it, and leave it in this position for half an hour. Remove the plaster round the funnel with a knife, and blow through the tube; by this means the funnel may be easily lifted. Leave the glass plate in the sun or in a warm place for an hour, then remove the disc and place it upon three small corks, and leave it for a day or two, so as to dry thoroughly. Now heat the rim of the funnel over the spirit-lamp till hot enough to melt sealing wax, and place a layer of the wax round the rim. When this layer has partially hardened, make it thicker with a piece of sealing-wax heated over the spirit-lamp; then heat the whole uniformly, and invert it over the plaster. Now place the funnel, stem upwards, upon a glass plate, and fill it with carbon dioxide by displacement; then lift it together with the glass plate, dip the end in water, and remove the plate. The carbon dioxide will now pass out through the plaster wall, but the lighter air flowing inward with greater velocity, increases the volume of the gas contained in the funnel; the consequence is that bubbles of gas escape from the end of the funnel and rise through the water. Again, place the funnel in an upright position, and while still covered with the glass plate fill it with hydrogen by displacement, and dip the end into water; the lighter gas will diffuse outwards more rapidly than the heavier enters inwards. The volume of the gas in the interior diminishes and in the course of a few seconds the water rises to about half the height of the funnel.

For the experiment with carbon dioxide, the funnel should dip only a few millimetres into the water, so as not to obstruct unnecessarily the escaping gas bubbles. With hydrogen the tube must dip somewhat deeper, or the end of it would be above the surface of the water when the latter rises in the funnel.

Graham found that hydrogen diffuses four times as fast as oxygen. Now, the densities of these gases are as 1 : 16; but their diffusive rates are as 4 : 1. This applies to the diffusion of all gases. Hence we have the following law:—

Graham's Law of Gaseous Diffusion.—*The diffusive rates of two masses of gas in contact are inversely proportional to the square roots of their densities.*

It is mainly owing to this gaseous diffusion that gases of such different weights as those which form the atmosphere are kept uniformly distributed instead of forming layers with the heaviest at the bottom. In obedience to this law the heavier gases are compelled to rise, and the lighter ones to fall, until the proportions of them are all the same throughout.