To make out by experiment that air is not a simple body, by burning a taper under a bell-jar over water, etc., or a piece of phosphorus, but is made up of oxygen and nitrogen, about 1/5th in bulk being oxygen and 4/5ths nitrogen; also the different compounds which this forms with oxygen, etc.

That water is not a simple substance, but composed of two elements, oxygen and hydrogen, in the proportion of 1 to 2 in volume and 8 to 1 in weight; and when analysed, that the two simple elements can be again reunited to form water.

The hot iron which the blacksmith plunges into his watertrough decomposes the water—the oxygen of the water uniting with the iron and forming an oxyde of iron, which is sometimes seen as a flaky substance on the surface, the hydrogen being set free, mixed with some impurity which gives it an offensive smell: the same when the kettle boils over, or water is thrown into the fire.

That salt is made up of a vapour called chlorine and a metal called sodium—that sulphur, mercury, and the metals, as far as yet known, are simple substances, and to point out the more common ones—to explain and make them understand what is meant by a salt made up of a base and an acid, etc.—the way in which acids and alkalies act upon vegetable colours—how they neutralise each other, test for them, etc.

In order to form definite notions of the relative weight and substances of such bodies as the gases, of matters the existence of which is not evident to the sight, it will be necessary to have recourse to the balance: this, in the case of common air, may easily be done by exhausting the ordinary brass bottle, the volume of which is a quart, by means of the air-pump; in the case of the following, the weights would be found—

Atmospheric air.......	21 2/5 gr.	.... 1 1/5
Hydrogen............	1 1½	.... 1/12
Oxygen	23 4/5	.... 1½
Nitrogen............	21 4/5	.... 1 1/1
Carbonic acid........	32 2/3	.... 1 9/10

The simple fact of showing how these invisible substances can be handled—those which are heavier than common air, poured from one vessel to another, like water—can be pumped out, and even, by a dexterous manipulator, ladled out by the hands, proving that the transfer is really made by testing in the ordinary way, is of itself most instructive.

The teacher might easily show this in the case of carbonic-acid gas, by taking a quantity of bruised chalk or limestone, powdered marble, or bruised oyster shells—place them in the bottom of an open vessel (a rather tall glass one would be best), then pour sulphuric acid diluted with water upon them, when this gas would be copiously given off—would rest at the lower part of the vessel, rising as the quantity increased—then letting a lighted taper be gradually lowered, the point to which the gas had risen would soon be seen by the taper becoming dim, and when sunk a little further it would entirely go out.

To know that the gas given off from the substances above named is actually carbonic acid, it would not be sufficient merely to know that it is heavier than common air: but it must also be shown that it will not support combustion—will make lime water turbid—and is an acid, by turning vegetable blues red.

It is also instructive to collect this gas by displacement—making it in a vessel into which a bent tube will fit, giving it a direction into any vessel into which the gas can descend, and thus displace the air of the atmosphere. It will be found very instructive to perform this experiment in the following way: balance a glass jar at one end of a scale-beam, and then allow the carbonic acid to displace the air of the atmosphere; the end of the beam on which the jar is suspended will very soon begin to descend, thus showing the pouring in a heavier air than the one which previously occupied it—a thing not evident to the sight, but made so in this way: restore the equilibrium by means of pieces of paper—test the height to which the carbonic-acid gas has risen, by dipping in a lighted taper.

Also show that it is a compound substance formed by the chemical union of carbon, a solid, with oxygen—that one atom of carbon unites with two of oxygen, the chemical equivalents of which are 6 and 16, forming a compound substance of which 22 is the equivalent—the resulting gas not being an increase in volume over the oxygen with which the carbon united, but an increase of specific gravity, by the interpenetration of the substances.

For instance, if the exact quantity of carbon were burnt in a jar containing the exact quantity of oxygen with which the carbon would unite, the result would be carbonic-acid, equal in volume to the volume of oxygen, but of course specifically heavier, and having all the properties of the former, the solid carbon thus united having become invisible.

This carbon may be thrown down again, and would show itself in a volume of smoke—the black and restored carbon.

The mode of weighing a gas lighter than the air of the atmosphere, would be by inverting the jar, having the open mouth downwards, and placed at the end of the balance as before—in the case of hydrogen, for instance, allowing it to ascend the inverted jar, it will soon be shewn by the other end of the balance descending—it may be shown to be hydrogen by ladling it out and bringing a lighted taper into contact with it.

The following experiment, which is easily made, would show the change which atmospheric air undergoes by being passed through the lungs.

Take a jar with an air-tight stopper, and such as is used for pneumatic purposes—if open at the lower end, it must be placed over water—take out the stopper and place the mouth over the opening—inhale and exhale the air several times by breathing with the mouth over the opening, and taking care that no air from the atmosphere gets in; put in the stopper, and then test the air—it will be found to have all the properties of carbonic-acid—will put out a light, make lime water turbid, etc.

It is found that lungs of an ordinary capacity will take in about 160 cubic inches of air, and the greatest about 295. A man of five feet one inch takes in about 160, and eight additional cubic inches for every inch in height is found to be a very near approximation to what really takes place in life.

The same may be done by breathing through a bent tube into an inverted jar; the upper end of which is closed; this, after having passed through the lungs and breathed out, will ascend, being heated and mixed with watery vapour, and on raising a lighted taper towards the top of the vessel or depressing the vessel upon the taper, it will be extinguished.

The reason why this gas breathed out by animals ascends, the gas itself at the temperature of the atmosphere being heavier than common air, is, that it comes from the animal heated, and is mixed with watery vapour.

As a curious result of the chemical inquiries of the present age, it has been ascertained, that the quantity of carbonic acid, breathed out by a healthy man in 24 hours is about 13¾ oz., of which about 7 oz., is solid carbon; about 63 oz. by a cow, and about 70 oz. by a horse; and that an approximate calculation founded on this would give about 500 tons, breathed out by the population of London; and that the quantity of carbon breathed out by the whole animal race would be sufficient to supply all the vegetable world on the surface of the globe.

It has been ascertained by a Swedish philosopher experimenting on a healthy man about thirty-five years of age, confined in a small chamber into which air entered by a hole on one side, and examining it after it passed through at the other, that the carbon ejected per hour was 105 grs. fasting; 190 grs. after breakfast; 130 when hungry; 165 two hours after dinner; 160 after tea: and 100 sleeping; making about 7 oz. daily.

The mode of making common coal gas—the process which is going on in the burning of the gas, or of a candle—how the water which is formed during the combustion—the carbonic acid, etc.—is returned through the atmosphere again to assume the form of vegetable life, etc.—that a given weight of wood, for instance, or of any other combustible body, when consumed, if all the parts were collected, would weigh more even than the wood, and why?—that when they burn wood on their own fires, elm will leave more ashes than beech—beech than oak—oak than willow, etc., and that consequently these trees during their growth carry away different quantities of inorganic matter from the soil—that leaves make more ashes than straw—straw than grain.

These are things not difficult to understand—but they ought to be taught by experiment, and all that is required may, by a person at all well acquainted with the subject, be done at very little expense. There are numberless ways of showing the principle of many of these things, not only in the arts, etc., which would apply more particularly to towns, but in the common every-day things of life, whether in town or country, and calling attention to them when an experiment is performed, is of more service in an educational point of view than those without experience are at all aware of.

Many examples might be brought forward where even the remarks of ordinary workmen have led to discoveries of a most important kind; but the two following, from Sir John Herschel's "Discourse on Natural Philosophy," are particularly striking; a soap-manufacturer remarks that the residuum of his ley, when exhausted of the alkali for which he employs it, produces a cor-