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**The young man's book of amusement**

**Halifax, 1848**

Pneumatics

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the different spectators, some of whom thought he had come to life. About an hour was spent in these operations.

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### PNEUMATICS.

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#### *The Air Pump.*

It will be advisable in the first place to describe the way in which the Air Pump is usually constructed. In the frontispiece, Fig. 15, represents the cheapest form, and in its action it exactly resembles the common sucking pump. Within each of the two strong brass barrels in front is fixed (at the bottom) a valve, opening upwards; these valves communicate with a concealed pipe leading to the hole under the glass receiver. The barrels also include moveable pistons, with valves opening upwards. To the upper parts of the pistons are attached rack-work, (part of which is elevated in the cut,) these racks are moved up and down by means of a little cog wheel turned round by a handle affixed. A little beneath the pistons is a small screw which serves to re-admit air into the receiver when it is in a state of exhaustion. When the Air-Pump is to be used, *a slip of wet leather should be placed under the edge of the receiver*, be-

cause the plate is liable to be scratched, and the smallest unevenness between the receiver and the plate would prevent the success of any experiment.

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#### *The Shower of Fire.*

Place on the top of the air-pump a small circular plate, pierced with holes, and supporting a small cylindrical receiver, terminating in a hemisphere, and cover the whole with a larger receiver, having a hole in its summit, to admit a glass funnel filled with mercury. The funnel must shut with a stopper, so as to open when necessary. Then exhaust the air from the receiver, and open the funnel which contains the mercury, which will run down, and falling on the convex summit of the interior receiver, will be thrown up in small luminous drops, so as to resemble a shower of fire.

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#### *Bottles broken by Air.*

Take a square bottle of thin glass, of any size. Apply it to the hole in the air pump, and exhaust the air. The bottle will sustain the weight of the external air as long as it is able, but at length it will suddenly burst into very small particles, and with a loud explosion.

An opposite effect will be produced, if the mouth

of a bottle be sealed so close that no air can escape; then place it in the receiver, and exhaust the air from its surface. The air which is confined within the bottle, when the external air is drawn off, will act so powerfully as to break the bottle into pieces.

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*Water boiled by Air.*

Take water made so warm that you can just bear your hand in it, but that has not been boiled; put it under the receiver, and exhaust the air. Bubbles of air will soon be seen to rise, at first very small, but presently become larger, and will be at last so great, and rise with so much rapidity, as to give the water the appearance of boiling. This will continue till the air is let into the receiver, when it will instantly cease.

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*Glass broken by Air.*

Lay a square of glass on the top of an open receiver, and exhaust the air. The weight of the external air will press on the glass, and smash it to atoms.

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*The Hand fixed by Air.*

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the air be exhausted, it will be fixed as if pressed by a weight of sixty pounds.

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*The Floating Stone.*

To a piece of cork tie a small stone that will just sink it; and putting it in a vessel of water, place it under the receiver. Then exhausting the receiver, the bubbles of air will expand from its pores, and adhering to its surface, will render it, together with the stone, lighter than water, and consequently they will rise to the surface, and float.

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*Feather and Guinea.*

It is sometimes imagined that mass for mass, a pound of gold would be heavier than a pound of feathers; and hence the paradoxical experiment of "which is heaviest?" And yet we may place a guinea and feather under such circumstances that they will both arrive at the ground at the same instant of time when discharged from a proper apparatus. Fig. 16 shews the glass receiver and plate of the Air-Pump by which the air must be withdrawn, and it will then be seen that it is the air alone that makes the difference in their descent.

*Withered Fruit Restored.*

Take a shrivelled apple, and placing it under the receiver, exhaust the air. The apple will immediately be plumped up, and look as fresh as when first gathered; for this reason, that the pressure of the external air being taken off, the air in the apple extends it so much so that it will sometimes burst. If the air be let into the receiver, the apple will be restored to its original shrivelled state.

*The Magic Bell.*

Fix a small bell to the wire that goes through the top of the receiver. If you shake the wire, the bell will ring while the air is in the receiver; but when the air is drawn off, the sound will by degrees become faint, till at last not the least noise can be heard. As you let the air in again, the sound returns.

*The Mercurial Wand.*

Take a piece of stick, cut it even at each end with a penknife, and immerse it in a vessel of mercury. When the air is pumped out of the receiver, it will at the same time come out of the pores of the wood through the mercury, as will be visible at each end

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of the stick. When the air is again let into the receiver, it falls on the surface of the mercury, and forces it into the pores of the wood to possess the place of air.

When the rod is taken out, it will be found considerably heavier than before, and that it has changed its colour, being now all over of a blueish hue. If cut transversely, the quicksilver will be seen to glitter in every part of it.

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*Feathers heavier than Lead.*

At one end of a fine balance, hang a piece of lead, and at the other as many feathers as will poise it; then place the balance in the receiver. As the air is exhausted, the feathers will appear to overweigh the lead, and when all the air is drawn off, the feathers will preponderate, and the lead ascend.

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*The Self-moving Wheel.*

Take a circle of tin, about ten inches in diameter, or of any other size that will go into the receiver, and to its circumference fix a number of tin vanes, each about an inch square. Let this wheel be placed between two upright pieces on an axis, whose extremities are quite small, so that the wheel may turn in a vertical position with the least possible force. Place the wheel and axis in the receiver, and ex-

haust the air. Let there be a small pipe with a cock ; one end of the pipe to be outside the top of the receiver, and the other to come directly over the vanes of the wheel.

When the air is exhausted, turn the cock, and a current will rush against the vanes of the wheel, and set it in motion, which will increase, till the receiver is filled with air.

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*The Artificial Halo.*

Place a candle on one side of a receiver, and let the spectator place himself at a distance from the other side. Directly the air begins to be exhausted, the light of the candle will be refracted in circles of various colours.

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*Vegetable Air Bubbles.*

Put a small branch of a tree with its leaves, or part of a small plant, in a vessel of water, and placing the vessel in the receiver exhaust the air. When the pressure of the external air is taken off, the spring of that contained in the air vessels of the plant, by expanding the particles, will make them rise from the orifices of all the vessels for a long time together, and produce a most beautiful appearance.

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*A Fountain to play by the pressure of Air.*

To produce a fountain in vacuo, it is merely necessary to exhaust a glass receiver by means of the air-pump, and when that is effected, to place the lower end of the stop cock in a basin of water, which will be driven up in a continuous jet by the pressure of the air. The apparatus is represented at Fig. 18.

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*Effect of the Air respired from the Lungs.*

Half fill a wine glass with fresh prepared lime water or barytic water, and breathe into the fluid for a few minutes, by means of a tobacco pipe or glass tube, air from the lungs. The lime water will speedily become turbid, and a white precipitate fall to the bottom of the glass.

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*The Exploded Bladder.*

Take a glass pipe open at both ends, to one of which tie fast a wet bladder, and let it dry. Then place it on the plate of the pump. While the air presses the bladder equally on both sides, it will lie even and straight; but as soon as the air is exhausted, the bladder will become more stretched; it will soon yield to the incumbent pressure, and burst with a loud

explosion. To make this experiment more easy, one part of the bladder should be scraped with a knife, and some of its external fibres taken off.

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*Magic Fountain.*

Take a tall glass tube, hermetically sealed both at top and bottom, by means of a brass cap screwed on to a stop cock, and that to the plate of the pump. When the air is exhausted, turn the cock, take the tube off the plate, and plunge it into a basin of mercury or water. Then the cock being again turned, the fluid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

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*The Cemented Bladder.*

Tie the neck of the bladder to a stop-cock which is to be screwed to the plate of the pump, and the air exhausted from the bladder; then turn the stop-cock to prevent the re-entrance of the air, and unscrew the whole from the pump. The bladder will be transformed into two flat skins, so closely applied together, that the strongest man cannot raise them half an inch from each other; for an ordinary sized bladder, of six inches across the widest part, will have one side pressed upon the other with a force equal to 396 pounds' weight.

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*The Animated Bacchus.*

Construct a figure of Bacchus, seated on a cask ; let his belly be formed by a bladder, and let a tube proceed from his mouth to the cask. Fill this tube with coloured water or wine, then place the whole under the receiver. Exhaust the air, and the liquor will be thrown up into his mouth. While he is drinking, his belly will expand.

*The Artificial Balloon.*

Take a bladder containing only a small quantity of air, and a piece of lead to it, sufficient to sink it, if immersed in water. Put this apparatus into a jar of water, and place the whole under a receiver. Then exhaust the air, and the bladder will expand, become a balloon lighter than the fluid in which it floats, and ascend, carrying the weight with it.

*Curious Experiment with a Viper.*

Many natural philosophers, in their eagerness to display the powers of science, have overlooked one of the first duties of life, humanity ; and, with this view, have tortured and killed many harmless animals, to exemplify the amazing effects of the air-

pump. We, however, will not stain the pages of this little work, by recommending any such species of cruelty, which in many instances can merely gratify curiosity: but as our readers might like to read the effect on animals, we extract from the learned Boyle, an account of his experiment with a viper.

He took a newly-caught viper, and shutting it up in a small receiver, extracted the air. At first, upon the air being drawn away, the viper began to swell: a short time after, it gaped and opened its jaws; it then resumed its former lankness, and began to move up and down within the receiver, as if to seek for air. After a while, it foamed a little, leaving the foam sticking to the inside of the glass: soon after, the body and neck became prodigiously swelled, and blistered on its back. Within an hour and a half from the time the receiver was exhausted, the distended viper moved, being yet alive, though its jaws remained quite stretched: its black tongue reached beyond the mouth, which had also become black in the inside; in this situation it continued for three hours; but on the air being re-admitted, the viper's mouth was presently closed, and soon after opened again; and these motions continued some time, as if there were still some remains of life.

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*New Method of Congealing Water.*

A celebrated gentleman gives the following account of his interesting experiment on this subject:

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—into a metal vase half filled with water, I poured very gently an equal quantity of ether, so that no mixture might take place in the two liquids. The vase was placed under the receiver of an air-pump, which was so fixed upon its support, as to remain quite steady when the air was pumped out. At the first stroke of the piston the ether became in a state of ebullition, it was evaporated in less than a minute, and the water remained converted into ice. The experiment was made in an apartment, the temperature of which was 16 deg. R.

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*Experiments with Sparrows.*

Count Morozzo placed successively several full-grown sparrows under a glass receiver, inverted over water. It was filled with atmospheric air, and afterwards with vital air. He found

First.—That in *atmospheric air*

	HOURS.	MIN.
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The first sparrow lived.....	3	.. 0
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The second sparrow lived.....	0	.. 3
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The third sparrow lived.....	0	.. 1
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The water rose in the vessels eight lines during the life of the first; four during the life of the second; and the third produced no absorption.

Second.—In *vital air or oxygen.*

	HOURS.	MIN.
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The first sparrow lived.....	5	.. 23
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The second.....	2	.. 10
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The third.....	1	.. 30
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The fourth.....	1	.. 10
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	HOURS.	MIN.
The fifth .....	0	30
The sixth .....	0	47
The seventh .....	0	27
The eighth .....	0	30
The ninth .....	0	22
The tenth .....	0	21

The above experiments elicit the following conclusions:—

1. That an animal will live longer in vital than in atmospheric air.—2. That, one animal can live in air, in which another has died.—3. That, independently of air, some respect must be had to the constitution of the animal; for the sixth lived 47 minutes, the fifth only thirty.—4. That there is either an absorption of air, or the production of a new kind of air which is absorbed by the water as it rises.

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## HYDROSTATICS AND HYDRAULICS.

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### *The Pressure of Water.*

THE pressure of water may be known to every one who will only take the trouble to look at the cock of a water-butt when turned; if the tub or cistern be full, the water runs with much greater velocity

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