



VII. Further experiments on the combustion of explosive mixtures confined by wire-gauze; with some observations on flame

Sir H. Davy LL.D. F.R.S. V.P.R.I.

To cite this article: Sir H. Davy LL.D. F.R.S. V.P.R.I. (1816) VII. Further experiments on the combustion of explosive mixtures confined by wire-gauze; with some observations on flame , Philosophical Magazine Series 1, 48:219, 24-27, DOI: [10.1080/14786441608637601](https://doi.org/10.1080/14786441608637601)

To link to this article: <http://dx.doi.org/10.1080/14786441608637601>



Published online: 27 Jul 2009.



Submit your article to this journal [↗](#)



Article views: 2



View related articles [↗](#)

if a shot was fired through their brain." This was evidently the rushing in of the air through the Eustachian tube.

There are now several diving-bells in use. Besides the one at Howth, there is one at Holyhead, one at Ramsgate, and one at Plymouth. They are constructed under the superintendence of Mr. Rennie, on Mr. Sineaton's plan, entirely of cast iron, in the form of an oblong chest open at bottom.—(See Dr. Brewster's Encyclopedia, article *Diving Bell*.)

The one in which I descended is six feet long by four feet wide, and six feet high, with twelve patent glass-lights, as used in ships' decks, on the top. A descent in a diving-bell of this construction may be undertaken without any inconvenience, except the above described sensation in the ears. I was for half an hour under water more than twenty feet deep, and had light more than enough to write and read. A constant supply of fresh air is given by means of a forcing pump, and the respiration is not in the least affected. The signals to the men, who manage the bell above the water, are given by means of striking with a hammer once, twice or more times against the inside of the bell. The number of strokes tells them in what direction you wish to be moved. A diving-bell of the above dimensions may hold four men.

I wish much that some deaf person or persons, whose deafness is owing to the cause above stated, might try the diving-bell; and should they be benefited by it, hydraulic or other pressure engines might be constructed to obtain the same end in houses or hospitals.

VII. *Further Experiments on the Combustion of explosive Mixtures confined by Wire-gauze; with some Observations on Flame.* By Sir H. DAVY, LL.D. F.R.S. V.P.R.I.*

I HAVE pursued my inquiries respecting the limits of the size of the apertures and of the wire in the metallic gauze, which I have applied to secure the coal miners from the explosions of fire-damp. Gauze made of brass wire $\frac{1}{80}$ of an inch in thickness, and containing only ten apertures to the inch, or 100 apertures in the square inch, employed in the usual way as a guard of flame, did not communicate explosion in a mixture of one part of coal gas and 12 parts of air, as long as it was cool; but as soon as the top became hot, an explosion took place.

A quick lateral motion likewise enabled it to communicate explosion.

Gauze made of the same wire, containing 14 apertures to the

* From the Philosophical Transactions for 1816, part i.

inch, or 196 to the square inch, did not communicate explosion till it became strongly red hot, when it was no longer safe in explosive mixtures of coal gas; but no motion that could be given to it, by shaking it in a close jar, produced explosion.

Iron wire-gauze of $\frac{1}{16}$, and containing 240 apertures in the square inch, was safe in explosive mixtures of coal gas, till it became strongly red hot at the top.

Iron wire-gauze of $\frac{1}{32}$, and of 24 apertures to the inch, or of 576 to the square inch, appeared safe under all circumstances in explosive mixtures of coal gas. I kept up a continual flame in a cylinder of this kind, eight inches high and two inches in diameter, for a quarter of an hour, varying the proportions of coal gas and air as far as was compatible with their inflammation; the top of the cylinder, for some minutes, was strongly red hot; but though the mixed gas was passed rapidly through it by pressure from a gasometer and a pair of double bellows, so as to make it a species of blast furnace, yet no explosion took place.

I mentioned in my last communication to the Society, that a flame confined in a cylinder of very fine wire-gauze did not explode a mixture of oxygen and hydrogen, but that the gases burnt in it with great vivacity. I have repeated this experiment in nearly a pint of the most explosive mixture of the two gases: they burnt violently within the cylinder; but, though the upper part became nearly white hot, yet no explosion was communicated, and it was necessary to withdraw the cylinder to prevent the brass wire from being melted.

These results are best explained by considering the nature of the flame of combustible bodies, which, in all cases, must be considered as the combustion of an *explosive mixture* of inflammable gas, or vapour and air; for it cannot be regarded as a mere combustion at the surface of contact of the inflammable matter: and the fact is proved by holding a taper or a piece of burning phosphorus within a large flame made by the combustion of alcohol, the flame of the candle or of the phosphorus will appear in the centre of the other flame, proving that there is oxygen even in its interior part.

The heat communicated by flame must depend upon its mass; this is shown by the fact that the top of a slender cylinder of wire-gauze hardly ever becomes dull red in the experiment on an explosive mixture, whilst in a larger cylinder, made of the same material, the central part of the top soon becomes bright red. A large quantity of cold air thrown upon a small flame, lowers its heat beyond the explosive point, and in extinguishing a flame by blowing upon it, the effect is probably principally produced

produced by this cause, assisted by a dilution of the explosive mixture.

If a piece of wire-gauze sieve is held over a flame of a lamp or of coal gas, it prevents the flame from passing it, and the phenomenon is precisely similar to that exhibited by the wire-gauze cylinders; the air passing through is found very hot, for it will convert paper into charcoal; and it is an explosive mixture, for it will inflame if a lighted taper is presented to it; but it is cooled below the explosive point by passing through wires even red hot, and by being mixed with a considerable quantity of air comparatively cold. The real temperature of visible flame is perhaps as high as any we are acquainted with. Mr. Tennant was in the habit of showing an experiment, which demonstrates the intensity of its heat. He used to fuse a small filament of platinum in the flame of a common candle; and it is proved by many facts, that a stream of air may be made to render a metallic body white hot, yet not be itself luminous.

A considerable mass of heated metal is required to inflame even coal gas, or the contact of the same mixture with an extensive heated surface. An iron wire of $\frac{1}{16}$ of an inch and eight inches long, red hot, when held perpendicularly in a stream of coal gas, did not inflame it, nor did a short wire of one sixth of an inch produce the effect held horizontally; but wire of the same size, when six inches of it were red hot, and when it was held perpendicularly in a bottle, containing an explosive mixture, so that heat was successively communicated to portions of the gas, produced its explosion.

A certain degree of mechanical force which rapidly throws portions of cold explosive mixture upon flame, prevents explosions at the point of contact: thus on pressing an explosive mixture of coal gas from a syringe, or a gum elastic bottle, it burns only at some distance from the aperture from which it is disengaged.

Taking all these circumstances into account, there appears no difficulty in explaining the combustion of explosive mixtures within and not without the cylinders; for a current is established from below upwards, and the hottest part of the cylinder is where the results of combustion, the water, carbonic acid, or azote, which are not inflammable, pass out. The gas which enters is not sufficiently heated on the outside of the wire, to be exploded; and as the gases are no where confined, there can be no mechanical force pressing currents of flame towards the same point.

It will be needless to enter into further illustrations of the theoretical part of the subject: and I shall conclude this paper by stating what I am sure will be gratifying to the Society, that the

the cylinder lamps have been tried in two of the most dangerous mines near Newcastle, with perfect success; and from the communications I have had from the collieries, there is every reason to believe that they will be immediately adopted in all the mines in that neighbourhood, where there is any danger from fire-damp.

VIII. *Account of a Calculus voided by a Female.*

To Mr. Tilloch.

SIR, — A FEW weeks since I was requested by a respectable surgeon to examine a fragment of calculus voided by a female patient of his. The fragment weighed about three grains and a half, had somewhat of a rhomboidal figure; was evidently convex on the one side, and concave on the other. The convex surface was considerably nodulated, but the concave was smooth. When viewed with a magnifier, it showed distinct marks of stratification of alternate layers of a grayish and dirty yellow coloured substance. On being heated to redness before the blowpipe it lost nearly $\cdot 3$ of its weight; that is, after it had been kept in the heat of boiling water for some time: by urging the heat still further it fell to powder, lost its former colour, and gained a slight tinge of red, losing more than $\cdot 1$ more of its weight.

I was then induced to try the effect of acids on this substance, and accordingly took a portion of it which had been treated as above, and found it to dissolve in muriatic acid without effervescence, leaving but the smallest possible quantity, which I conceived to be animal matter. I then took a portion of the substance as it was voided, which dissolved also in muriatic acid, but with considerable effervescence. I was at first unwilling to attribute the effervescence to carbonic acid; but upon examination by letting up lime-water into the gas in a test tube standing over mercury, I was convinced of its being the case. The solutions were next examined, and were found to contain lime, phosphoric acid, and iron. Therefore the calculus is composed of carbonate and phosphate of lime, and oxide of iron, with a very minute portion of animal matter; for when the residuum, which was found to be insoluble in muriatic acid, was separated and heated to redness on a slip of platina, it exhibited distinctly the peculiar smell of burnt feathers or other animal substances*.

I am not exactly aware, whether the carbonate of lime has

* From the figure of the fragment, as well as that which I have since received, it has evidently been detached from a nucleus apparently of $\frac{3}{4}$ ths of an inch in diameter.

hitherto