



XIII. On mixed gases

James Ivory K.H. M.A. Hon. M.R.I.A.

To cite this article: James Ivory K.H. M.A. Hon. M.R.I.A. (1842) XIII. On mixed gases , Philosophical Magazine Series 3, 20:129, 81-83, DOI: [10.1080/14786444208650528](https://doi.org/10.1080/14786444208650528)

To link to this article: <http://dx.doi.org/10.1080/14786444208650528>



Published online: 01 Jun 2009.



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



Article views: 2



View related articles [↗](#)

THE
LONDON, EDINBURGH AND DUBLIN
PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE.

[THIRD SERIES.]

FEBRUARY 1842.

XIII. *On Mixed Gases.* By JAMES IVORY, K.H., M.A., Hon. M.R.I.A., Instit. Reg. Sc. Paris, et Reg. Soc. Götting. Correspond.*

THE subject of mixed gases is of great importance in many physical researches; and, in particular, the atmosphere being a mixture of gases, the inquiry into its constitution essentially depends upon the knowledge of the laws according to which elastic fluids combine in the same volume. But although the subject has been often discussed, it is still embarrassed by several difficulties which it is very desirable to clear up.

Suppose a gas contained in an envelop, the pressure, density, and volume being p, ρ, v , and the temperature θ : conceive that the envelop is extended on all sides, the enlarged volume being V ; in consequence the gas will expand, and after a little time all motion will cease, and the elastic fluid will assume a state of rest and equilibrium, exerting the same pressure at every point of the envelop. Now, when the volume of the gas was v , the pressure was p ; wherefore when the volume is enlarged to V , the pressure will be lessened to $p \cdot \frac{v}{V}$, which is the exact measure of the elastic force of the expanded fluid, and the pressure at every point of the envelop.

Let us now take a different gas, which has no chemical action on the other, the pressure and density being p', v' , the temperature θ as before, and the volume $v' = V - v$, so that the sum of the two volumes v and v' is equal to the volume of the envelop. If this new gas be introduced into

* Communicated by the Author.

the same envelop as the first, it will expand by its elasticity, and will force its way by continued agitations through the obstruction of the quiescent gas, in like manner as this expanded through a vacuum; the only difference being that the agitations will continue longer in one case than in the other. After a time, as there is no mutual action of the particles of the two fluids, all the agitations will cease; the first gas will resume its state of rest; and the new gas will be diffused with a uniform density and pressure through the envelop.

We have next to inquire, What is the elastic force of the combined gases, or which is the same thing, what is the external pressure that must be applied at the common surface, in order to confine them both without change of volume. When the first gas alone was contained in the envelop, we have found that the elastic force of the expanded gas was

$p \cdot \frac{v}{V}$: but when both gases are present in the envelop, the pres-

sure $p \cdot \frac{v}{V}$ upon the space of the envelop equal to the unit of

surface, which space is equally in contact with both fluids, will cause a compression of the second gas as well as of the first. As the two fluids are separately in equilibrium and have no mutual action upon another, it is easy to discover that the same compressive force applied on the same space of the common

surface will transmit pressures equal to $p \cdot \frac{v}{V}$ to the particles

of both fluids. But the elastic force of the particles of the second gas being p' when the volume is v' , it will be $p' \cdot \frac{v'}{V}$,

when the volume is V ; to which adding $p \cdot \frac{v}{V}$, the increase of elasticity caused by the action of the first gas on the envelop, the sum $p' \cdot \frac{v'}{V} + p \cdot \frac{v}{V}$ will be the whole elastic

force of the particles of the second gas. As the two fluids are similar and interchangeable in their conditions, the like reasoning will show that the whole elastic force of the particles of the first gas, caused by the action of both gases on the envelop, is $p \cdot \frac{v}{V} + p' \cdot \frac{v'}{V}$. Wherefore, if P represent the

elastic force of the mixture, we shall have

$$P = p \cdot \frac{v}{V} + p' \cdot \frac{v'}{V}.$$

The foregoing view is in accordance with that part of the

theory of Dalton, now so far universally adopted, which regards the separate condition of different gases, not acting chemically upon one another, when they are confined in the same envelop: every gas is in equilibrium by the elastic force of its own particles, as would be the case if it occupied by itself the whole space of the envelop. It also agrees with the fact that no change of temperature is produced by the expansion of the gases in mixing; for the agitations caused by the second gas in forcing its way through the first one, which is quiescent and in equilibrium, are attended by alternate condensations and dilatations that produce neither gain nor loss of heat.

In what regards the elasticity of the mixture, the result obtained above likewise agrees with the usual theory, but not with the opinion of Dalton. According to the usual theory the elastic force of the mixture is equal to the sum of the elasticities of the constituent gases, supposing that these elasticities are reduced to the volume of the mixture, which is equivalent to what P stands for.

When several elastic fluids are mixed in the same envelop, Dalton is of opinion that the elastic force which every one impresses on the envelop is independent of the action of all the rest, and the same it would be if these were not present. But in forming this opinion the illustrious philosopher has not remarked that, as every space of the envelop is in contact with all the fluids, a pressure on any such space, produced by whatever cause, will necessarily be transmitted with equal energy to all the particles of the several fluids. Thus, when all the conditions of the question are taken into account, it appears that every particle within the envelop has the same elastic energy impressed upon it as in the case of a simple gas: if it were not so there could not possibly be an equilibrium of the whole mass. In corroboration of this it may be observed that only one sound is propagated through a mixture of gases such as we have been considering; whereas if every gas were separately in equilibrium, without any mutual action of the several fluids, there would be as many different sounds moving with different velocities as there are gases in the mixture.

XIV. *Notice of the Discovery of some remains of the Ichthyosaurus in Ireland.* By JAMES BRYCE, Jun., M.A., F.G.S.

To the Editors of the Philosophical Magazine and Journal.

GENTLEMEN,

IN May 1831 I published in your Magazine a short notice of the discovery of remains of the Plesiosaurus in this neighbourhood*. Since that time detached saurian vertebræ

* They were discovered by Mr. John H. Smythe of Carnmoney.