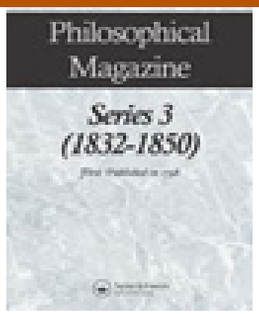

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XVI. On the ventilation of the coal-mine goaf

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conclusions have, in fact, been drawn from the conditions of equilibrium of an *element* of the mass, conditions, the analytical expression of which is only equivalent to the differential equations of the problem. The quantities involved in the preceding results are X_1, Y_1 and f_1. The directions in which the couples depending on f_1 act is determined by the observed fact of the central being greater than the lateral motion; the facts of the forces X_1 and Y_1 being pressures or tensions are inferred, and without any risk, as I conceive, of essential error, from the form and inclination of the glacial valley. And these are the points on which our conclusions depend; they are in a great degree independent of the actual values of the above forces. It would seem impossible to draw any accurate conclusions depending on less ambiguous circumstances. It may, however, be remarked that the whole investigation is tacitly based on the assumption of the continuity of the mass being preserved in the same sense as in the ordinary investigations of the motion of fluids. In the case before us the assumption has been, that, while a continuous mass having elasticity changes its form by the application of external forces, the particles which constitute an element of the mass, such as $p'q'r's'$ (fig. 6), in its original state of no constraint, continue to constitute a separate element, $p_1q_1r_1s_1$, during the whole change of form up to the state bordering on fracture. It is the common assumption on which all mathematical investigations of this nature are founded, and it is one which appears to me to possess the strongest *à priori* claims to our confidence, except under particular conditions with respect to the constitution of the mass. But I must reserve any further observations on this point for my next communication, in which, after this detailed exposition of my own views of the mechanics of the problem, I shall have some comments to make on those of Prof. Forbes.

I am, Gentlemen,
Your obedient Servant,
W. Hopkins.

Cambridge, January 6, 1845.

Erratum in Mr. Hopkins's *First Paper.*
Page 15, line 2, *for* $\omega \sin \alpha$ *read* $\omega(\sin\alpha - \sin\beta) = \omega \sin \alpha$.

XVI. *On the Ventilation of the Coal-Mine Goaf.* By Michael Faraday, *Esq.*, *D.C.L.*, *F.R.S.*

To Richard Taylor, Esq.

Dear Sir,

YOU have honoured the Report by Mr. Lyell and myself with a place in the Philosophical Magazine, p. 16, and this induces me to send for insertion also, certain considera-

tions which have occurred to me since the Report was written, and also some practical results which were brought generally before our members here at the last Friday Evening Meeting. I need hardly say that the Report proposes to draw away the lower aërial contents of the goaf by an iron pipe laid down in one or other of the ways of the mine, and either entering into the return way, or having a fanner or bellows or other blowing apparatus upon it. The points I wish to speak to now are, first, the draught, and next the nature and place of the pipe.

By experiments which I have made with a small furnace, flue and pipes of 6 inches diameter and less, I am quite satisfied that such a draught as that of the return at the Haswell mine would be sufficient to effect that which we propose in the Report without the use of any extra blowing or withdrawing apparatus, so that the plan is so far relieved from the necessity of keeping a man or boy working at such a machine.

With regard to the pipe, I think that instead of laying it down in the flue of the mine, it had better be hung up or sustained upon props in the open space of that way or passage which may be chosen for its direction. If then any derangement of position occur it can easily be remedied. I have had pipes 6 inches in diameter, made both of air-proof cloth and common sheet-iron; the former were kept open by whalebone rings run round them at equal distances of 2 feet, and answered in my trials exceedingly well. Square trunks, also made by nailing four boards together with copper or iron nails, are easily available as tubes. Such tubes it may be said when placed as proposed in the air would easily be deranged by falls. No doubt a fall might destroy a part of the tube, but if it did there seems to be no great difficulty in restoring it; and further, if a judicious selection were made for the direction of the tube, there appears no reason why the roof over it cannot be as well and securely propped up as the roof of the mothergate, the rolley way, or any other important part.

Finally, it is not necessary, on the principle proposed, that the goaf end of the tube should always be at the very extremity of the goaf towards the rise, but only that it should be 3, 4, or more feet above its upper edge; so that a jud or two may sometimes be drawn in advance before the goaf end of the pipe need be readjusted. Apparently there can be no difficulty in selecting the place of the goaf end of the pipe so that there shall be no interference with the general plan upon which the coal itself is worked.

I am, my dear Sir,

Your faithful Servant,

Royal Institution, January 20, 1845. M. Faraday.