must be some connection between the two classes of phenomena. The nature of this connection has been differently explained by different writers. But the purpose of this note is not to criticise existing theories, but to propose one, which I believe to be new, and to be capable of explaining why a sudden volcanic eruption must ordinarily be accompanied by earthquake shocks of greater or less violence (not necessarily always sensible), and why earthquakes may occur without any contemporaneous outburst.

In the preface to his "Physikalische Geologie," Bischof suggests that the phenomena observed in the laboratory should be taken as our guides to explain what happens in nature. Let us see, then, if in the laboratory we meet with any phenomena analogous to volcanoes and earthquakes.

When a reaction has to be performed in a sealed tube, and it is expected that much gas will be evolved, and consequently the pressure in the tube be much increased, it is one of the commonest precautions to draw out the tube to a capillary orifice before closing it. When this precaution has been neglected, and even although the point be allowed to blow itself out in the flame of a lamp, an explosion not unfrequently attends the attempt to open it. Let us consider the circumstances.

We have a tube whose walls are being pushed out by a very high pressure from within, which, however, it resists; but at the moment that this pressure is suddenly relieved at one point, the tube bursts. What is the cause of the explosion? It clearly cannot be the mere reduction of pressure. As long as the pressure was equally distributed over the walls of the vessel, we have seen that it was successfully resisted; as soon, however, as it was suddenly relieved at one point, a great inequality in the tension of the gas in the immediate vicinity of this point would be the result, the gas immediately at the opening assuming at once the atmospheric pressure, while that at, say, the eighth of an inch from it is at the tension of the gas in the tube. The practical effect of this sudden inequality of pressure would be to produce a tug on the mass of elastic fluid, which would cause the walls momentarily to tend to collapse, and this tendency to collapse would be transmitted through the glass as a wave. This wave would to a certain extent distort, and therefore weaken, the walls; and consequently, if the pressure inside were great enough, it would burst them; if not, the only effect would be that a shock would traverse the walls of the vessel, and the pressure would relieve itself by the orifice.

Now, suppose the vessel to be a subterraneous cavity containing an atmosphere of very great tension, and that suddenly the envelope gives way at one point, what will be the result? Just as in the case of the glass tube, the sudden relief of pressure will, in the way indicated above, cause the walls to experience a momentary collapsing impulse, which will be propagated as a wave until extinguished by the imperfect elasticity of the crust. The sudden outburst will be a volcanic eruption, and the consequent collapsing shock will be an earthquake, which either will or will not be accompanied by rending of the crust, according to the strength of the walls and the greatness of the pressure.

It is, however, not necessary that there should be a visible volcanic eruption. For, suppose two such subterraneous cavities at different pressures, separated from one another by a wall weaker than that which separates either of them from the outside of the earth; then, if the pressure in the one becomes so great as to burst the barrier between the two, the result will be an earthquake. And similarly, the pressure in the two thus united cavities may go on increasing until they burst into a third, and so on until they come to a vent, which is either open or weak enough to yield to the pressure. In this way an earthquake and an eruption may be in intimate connection with one another, although a considerable interval of time intervene between the occurrences, and the localities affected be at great distances from each other. And it is possible that some connection of this kind may have existed between the earthquake of Antioch and the eruption of Vesuvius, both having been extreme in their violence. Indeed, the whole series of disturbances, commencing with the earthquake in California and terminating with the eruption of Vesuvius, noticed by Mr. Corfield in NATURE of May 23, may possibly find an explanation under this theory.

The effect of sudden relief of pressure in weakening the walls of vessels explains many cases of explosion which otherwise appear anomalous. Thus, high-pressure boilers have been frequently observed to burst at the moment when the engineer turns on the steam.

In conclusion, the above sketched theory assumes nothing but what we know to be fact. We know that, at least in the neighbourhood of volcanoes, there must be subterraneous cavities whose atmosphere is at an exceedingly high-pressure, for we not only see it emitted from the vent, but it projects enormous masses of rock high into the air, thus testifying to the energy with which it was endowed. Further, given this high-pressure atmosphere, it is certain that, on its being suddenly relieved, it would communicate a shock to the crust, and this, on being felt outside, would be described as an earthquake. I think it is therefore clear that some earthquakes must be produced in this way. Of course this does not include the possibility of there being other causes of concussion which might produce similar effects.

Edinburgh, June 10 J. Y. BUCHANAN

On the Cohesion of Figures of Creosote, Carbolic and Cresylic Acids

WITH reference to the note by Mr. J. H. Spalding contained in NATURE of June 13, I am reminded by my friend Mr. Rodwell that some five or six years ago I showed him the cohesion figure of carbolic acid. A crystal of this acid was taken up on the end of a platinum spatula, and gently delivered to the surface of clean water contained in a clean glass; the crystal gave a few jerks, then suddenly liquified, and displayed its highly characteristic figure so well described by your correspondent. I may further remark that I showed this figure in the chemical section of the British Association, at Manchester, in September 1861, and a drawing of it is given in the plate which accompanies my paper in the *Philosophical Magazine* for October of that year. In this paper it is described as "an exaggerated form of the figure of creosote; the water seems to tear it to pieces; the crispations are amazingly active, and the disc quickly breaks up and disappears. Indeed, while a drop of creosote will endure five minutes on the surface of an ounce of distilled water in a small glass, a drop of carbolic acid will last only a few seconds on the same quantity of water. The cohesion figure is however quite characteristic of the substance, and cannot be for a moment mistaken for any other substance that I have examined."

Creosote, carbolic and cresylic acids, and newly-distilled oil of cloves, give remarkable figures of the same type, each of which is characteristic of the substance.

Mr. Spalding remarks that warm water destroys all action, by lessening, as he supposes, the adhesion of the liquids. I am sorry to have to object to this remark, but I have no doubt that Mr. Spalding was led to make it by employing unclean water or an unclean recipient. If distilled or even ordinary tap water be heated over a spirit lamp in a clean flask, and be poured into a clean vessel, the surface of the water is active at all degrees between the temperature of the air and just below boiling. On the surface of cold water a drop of creosote passes through the following changes:—(1) As soon as the drop is placed on the surface of the water the figure is formed for an instant; (2) it splits open and forms a kind of brittle arc, which (3) is shivered into a number of separate discs, each of which is a perfect cohesion figure of creosote. These figures perform their evolutions independently of each other, sailing about with rapidity, but never clashing with or disturbing each other. In the *Philosophical Magazine* for June 1867, figures are given of these different phases of the figure.

Now, if the water be heated to 100° Fah., or from that to 150°, a drop of creosote deposited on its surface produces a good active figure, but it does not split open or form the brittle arc above referred to; it sails slowly over the surface, firing off volleys of small globules in radial lines, and only when much wasted does it split into smaller systems. All this is what might be expected from the diminished surface-tension occasioned by the heat. Indeed, it is a beautiful illustration of the slight diminution of surface-tension in hot water as compared with cold. In consequence of not splitting open, the duration of the figure is greater on the surface of hot water as compared with cold.

Carbolic and cresylic acids are also very active on hot water, at all temperatures up to 210° Fah. C. TOMLINSON

Highgate, N.

Hereditary Instinct

WILL you allow me to recount to your readers what appears to me to be a striking instance of the transmission of impression in animals?

A few years ago I bought in Skye a perfectly uneducated Skye terrier. The first accomplishment which I taught him was