



On the interpretation of mariotte's law

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mate resemblance between the gypsum of the lagoons and the abnormal gypsum beds of secondary regions.

If the silicification of the Macigno which we have noticed in the neighbourhood of the solfatara of Pereta should appear an exaggerated application of the theory brought forward, the verification of it may be traced in the lagoons of Sasso, where the solution of the silex of the freestone and its redeposition are manifest in all places where circumstances allow of this double transformation. The Fumacci of Sasso rise, to the south of the establishments, from beneath a vast mantle of fine-grained freestone, over which passes the mountain road connecting the valley of the Cornia with the Province of Sienna. At intervals the road is interrupted by isolated boiling pools or shallow cavities, which exert a metamorphic action upon the region which they traverse. The first evidence of alteration is apparent in the colour of the rock, which from blackish-gray becomes white. It is cracked in all directions. The vapours follow quickly these lines of separation, attack the silica of the macigno, dissolving it out, and immediately depositing it under a gelatinous form. The gelatinous mass becomes opaque in the air and assumes the resin-like appearance peculiar to hydrated silica. In connexion with this we observe imbedded in a siliceous cement, nuclei of a white micaceous sandstone unaltered at the centre, causing a breccia appearance. This kind of breccia is finally, by the complete solution of the nuclei, converted into a grayish rock entirely siliceous, which resounds under the hammer like clink-stone, and resembles exactly by its aspect and its roughness of touch, porcelain biscuit. Sometimes the solution is more rapid, and then the rock is formed of an agglutination of little grains analogous to those of an ancient quartz rock and possessing its tenacity and hardness. Examined with a glass, each grain is composed of an independent particle or driblet of hydrated silica, and they seem to have collected as viscous tears, such as would have adhered together in hardening. Breislak observed at the solfatara of Pozzuoli fragments of decomposed lava bound together by a siliceous substance almost vitreous; but in the lagoon of Sasso the solution and permanent regeneration of silica, effected at the expense of the macigno, are carried on upon a vast scale and over a space of great extent.—*Bull. Soc. Géol. de France*, Dec., 1848, 147; and Silliman's *American Journal of Science* for May, 1850.

ON THE INTERPRETATION OF MARIOTTE'S LAW. BY LIEUT.

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It is readily demonstrated that in any entirely *homogeneous* medium, the component parts of which act on each other by forces varying as any function of the distance, Mariotte's law must prevail. Both elastic tension and cohesive force will necessarily vary as the density, in a medium assumed as homogeneous, quite irrespective of the law of force, the variation being expressed in terms of distance between the component parts of the medium. Whether the force be attractive or repulsive, varying inversely with the first or hundredth power of the distance, the result is the same; that *entire homogeneity makes Mariotte's law necessary*.

To prove this: assume a perfectly homogeneous medium whose parts exert forces varying as any function of the distance. Assume in this an origin of coordinates, three coordinate axes, X , Y and Z , and three constant elementary distances, dx , dy , dz . Conceive each axis graduated by laying off its element successively from the origin outward. Through each point of graduation on either axis pass a plane parallel to the other axes: do this for each axis. The space around the origin is thus divided into elementary parallelepipeds, each of which contains a like portion of the homogeneous medium.

The force of elastic tension or of cohesion is measured by the resultant action on a unit of surface of the plane X , Y , by all the forces acting in the positive direction of the axis Z , between the parts on opposite sides of the plane X , Y . This resultant is balanced by an equal one acting in the negative direction of the axis Z . To make up this resultant, a certain number of the elementary portions of the medium conspire. It may therefore be equated with a series, each term of which expresses the positive component along the axis Z , of the force exerted between two elementary portions of the medium on opposite sides of the plane X , Y .

If now the density of the medium be varied, each term of this series will vary in the same ratio, since the quantity of matter in each elementary volume varies as the density. The density thus governs each term of the series, by fixing the quantity of matter in each elementary volume. If we call the ratio of the varying density to a standard density N , each term of the series contains N as a simple factor; or the whole series varies as N . Hence the resultant or entire elastic tension or cohesion varies as N , or as the density. This result is entirely independent of any particular law of relation between the forces and distances; and will always be true so long as the elementary volumes can be assumed as homogeneous. As dx , dy , dz can always be taken indefinitely less than the radius of sensible activity of any assumed force, the demonstration can only fail by the parts failing to be homogeneous.

It will be seen by the above, that any inference of the law of repulsive force between ultimate atoms or molecules, cannot be correctly drawn from Mariotte's law, for this leaves the primary forces involved wholly indeterminate. We are by no means authorized to conclude, that in elastic fluids, where the pressure varies as the density, the molecules repel each other directly as the distance.

The demonstration now given has a singular bearing on the atomic theory of material constitution. We know experimentally that Mariotte's law does not prevail uniformly in elastic media, while in liquids and solids it has no show of application. Hence we are bound to infer *non-homogeneousness*. Now how can homogeneousness be interrupted, except through something like an atomic constitution of media? A laminated, filamental, or molecular structure alone can produce heterogeneousness. The two first would confer special properties in certain directions, which are not found in fact. Hence a molecular constitution of matter seems entailed as an inference, from the bare fact that Mariotte's law is not universal. According to the view now presented, the elasticity of gases varies as the density, because the quantity of matter within the sphere of

sensible activity varies in that ratio. As they approach the point of liquefaction, other considerations derived from the special atomic constitutions of the media must be introduced. The entire absence of a limit to the division of parts would produce that homogeneity from which Mariotte's law becomes an inevitable inference. Such an inference, as applied to media in general, being contrary to the fact, a limit to actual division of parts must be admitted. *Any other theory than one of ultimate molecules, separated by spaces, seems to impose inferences conflicting with facts, throwing us back irresistibly into the theory of true molecular structure.*—Silliman's *American Journal*, May, 1850.

Boston, April, 1850.

EFFECTS OF ATMOSPHERIC ELECTRICITY UPON THE WIRES OF THE MAGNETIC TELEGRAPH.

The *Revue Scientifique* for December last contains an interesting article by M. Baumgartner on the subject of the effects of atmospheric electricity upon the wires of the magnetic telegraph. The following are the most interesting of his results:—

1. The needle rarely coincides with the point which is determined by its astatic state and the tension of its suspension thread; almost always it deviates more or less from this point, which proves that it is influenced by an electric current.

2. The variations are of two kinds; there are some which reach 50° , others extend over $\frac{1}{2}^\circ$ or $8'$. The first are less frequent; they differ so often in direction and intensity that it is impossible to deduce a law for them. On the contrary, the small deviations appear connected by a very simple law.

The observations made at Vienna and at Gratz appear to show that, during the day, the electric currents move from Vienna and from Gratz to Semmering, which is more elevated. This direction is inverse during the night. It appears that this change of direction takes place after the rising and setting of the sun.

3. The regular current is less disturbed by the irregular currents when the air is dry and the sky is serene, than when the weather is rainy.

4. In general, the current is more intense with short than with very long conductors; often, even, the current of the longer chain is opposed to the current of the shorter chain.

Where there is a difference of intensity, this difference is far greater than that which could originate from the resistance of the longer conductor.

When the sky is cloudy and the weather stormy, there are frequently observed in the electric conductor currents which are sufficiently intense to affect the telegraphic indicators, which are, however, far from having extreme sensitiveness.

When they were placing the conducting wires of the Northern Telegraph line from Vienna, the workmen frequently complained of a kind of spasms which they felt in handling the wires. These spasms ceased as soon as they took the precaution not to touch the wires with naked hands. These spasms were most frequent and intense in Styria, the highest region of the line. Thus, near Kranichfeld, a workman received a shock sufficiently violent to overturn him and paralyse his right arm.