LIV. On the law of storms

H.W. Dove

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we have made during the continuation of our researches?"—I am not disposed to alter anything that I have published; I have even more confidence than before in my own views; for had their observations been in agreement with the results which I had obtained, I should have had great reason, after my examination of their papers, to fear that my own ideas were erroneous.

I cannot conclude this letter without again expressing my regret at having been obliged to write it; but if it be recollected that Messrs. Nobili and Antenori's memoirs were written and published *after my* original memoirs; that their last paper appeared even in the *Annales de Chimie et de Physique* after mine; and that it had consequently the appearance of advancing the science further than I had done; that both papers accuse me of error in experiment and theory, and also of dishonesty; that the last of these papers is dated in March, and though it is now December, has been followed by no correction or retraction on the part of the authors; and that I sent them several months ago (at the same time that I forwarded them to you and others,) copies of my original memoirs, and of my notes to a translation of their first memoir; and if it be considered that, after all, I have not to reproach myself with the errors of which I am accused, and that these gentlemen's memoirs are so framed as to compel me to reply to their objections;—I hope that no one will say that I have written too hastily what might have been avoided; or that I should have shown respect for the truth, and done justice to my own publications, or to this branch of science, if, being aware of such important errors, I had not called attention to them. I am, my dear Sir, yours very sincerely,

M. FARADAY.

LIV. *On the Law of Storms.* By H. W. DOVE.

To Richard Taylor, Esq.

Editor of the Philosophical Magazine and Journal.

DEAR SIR,

IN the year 1828, I published in Poggendorff's *Annalen*, vol. xiii. p. 596, a memoir "On Barometric Minima," in which I established the fact, that the storm which accompanies a great depression of the barometric column is a vast whirlwind, which in the northern hemisphere proceeds from S.W. to N.E. The example there more especially investigated is the storm of the 24th of December, 1821, the centre of

which travelled from Brest to Cap Lindenaes in Norway. The rotation in this whirlwind was in the direction S.E. N.W., consequently on the S.E. side of the storm, that is to say, in France, Holland, Germany, Italy, Denmark, and Prussia the weather-vane veered from S.E. to S.W. and W. through south; on the contrary, towards the Atlantic coast of North America the direction was N.E. At the same time I observed in this memoir (p. 599.), that the greater number of hurricanes in the southern hemisphere, which I had examined, are whirlwinds rotating in the opposite direction.

Three years later, Mr. Redfield of New York, arrived at the same result by independent observations, as appears from his memoir, entitled "Remarks on the prevailing Storms of the Atlantic Coast of the North American States." (Silliman's Amer. Journ. of Sc., 1831. Avril.) In a later memoir, however, on the gales and hurricanes of the western Atlantic (*ib.* vol. xxxi.), Mr. Redfield has added a new and weighty fact to those already accumulated by me. From the storms, the course of which the American philosopher has there discussed and delineated by a chart, it follows, that the hurricanes taking their rise within the tropics, so long as they are confined between these limits, retain unaltered their original direction from S.E. to N.W.; so soon, however, as they reach the temperate zones, they suddenly bend round almost at a right angle, and then travel from S.W. to N.E. Finally, Lieut.-Colonel Reid, in his valuable treatise "On the Law of Storms," published in 1838, confirms by new examples the results already obtained, and especially calls attention to the fact, that by this change in the direction of its course the whirlwind spreads itself out continually from the centre more and more.

So long ago as the year 1735, Hadley proposed to solve the problem of the trade-winds, upon the principle, that air moving from the equator to the poles gradually acquires a westerly, and on the contrary air moving from the poles to the equator an easterly direction. A simple modification, or rather extension of this theory, gives a key to all the complicated phenomena of the variable and apparently so irregular motions of the wind observed in our own and other extra-tropical latitudes. It is only necessary to take into consideration the two currents contending for and alternately obtaining the upper hand, in order to see that the origin of the current, which Hadley treated as fixed for a given place, is in fact variable; wherefrom it follows, that the direction of the vane ought to be not stationary, but changeable, according to a law which I have named the law of rotation. From the same

fruitful principle I am now prepared to explain theoretically the phenomena of storms.

Let ab be a series of material points parallel to the equator, which are set in motion by a certain impulse in the direction at from south to north. The rotation of the earth combined with this impulse will produce a motion of ab towards gh , if the space dbh is void of matter. But if this space is filled by quiescent matter, the particles at b will, as they move, come into contact with particles in the space dbh , which rotate with less velocity; their motion in the direction of east will therefore be retarded, and the point b will move not towards h but towards f . The particles at a are, on the contrary, in juxta-

position with particles, which at first have an equal velocity of rotation, and consequently move as they would in a vacuum, that is, towards g . If, then, ab represent a mass of air impelled from south to north, the storm will have a more southerly direction at the east side, a more westerly one on the west side, and will thus acquire a tendency to whirl in the direction S.E. N.W. This tendency to whirl would not take place, were there no resisting matter in the space dbh , and will therefore increase in proportion as this resistance prevents the course of the storm from deviating towards the west. Now within the north tropical regions the space dbh is filled with air, which flows from N.E. to S.W. Here, therefore, the resistance is at a maximum, and the air at b has its westerly tendency so far checked, that it retains its original direction towards d almost unaltered, whilst, on the other hand, the air at a has acquired a tendency to move towards d . The storm accordingly will whirl with the greatest intensity, but retains its initial direction and lateral magnitude. So soon, however, as it reaches the temperate zone, it finds itself in contact with air at dbh , which is in motion from S.W. to N.E. The resistance, which the particles at b experience, will therefore be considerably diminished, or even almost vanish, that is to say, the direction bd is transformed into the direction bh , and the storm bends round almost at a right

angle, and at the time grows wider and wider as it progresses.

The phænomena of storms south of the equator may easily be inferred from what has been said above of the opposite hemisphere. The rectilinear course within the tropics, the sudden curvature at the limits of the tropics and the temperate zones, the accompanying expansion of the whirls constituting the storm; in a word, all the essential phænomena of storms, must clearly be the same for one hemisphere as for the other, with the sole exception, that in the one (the northern) the rotation is after the order of the letters S. E. N. W., and in the other (the southern) after the order of the letters S. W. N. E.

I take this opportunity to make, in my own vindication, a few remarks upon the manner in which my labours in this field have been brought under the notice of the English public. In the Lond. and Edinb. Phil. Mag., vol. xi. p. 390, a paper by Mr. Dalton has appeared, in which I am directly charged with claiming for myself a theory which he had already many years before made known, and which had still earlier been promulgated by the celebrated Hadley. Upon a diligent perusal of Mr. Dalton's Meteorological Essays and Observations, and of Hadley's original Memoir (The Cause of the general Trade-wind, Phil. Trans. 1735, p. 58), I have not succeeded in finding a single trace of, or bare allusion to, the existence of the law of rotation, which it was the principal object of my paper to establish by observations, and explain upon theoretical principles. And if your readers or Mr. Dalton should do me the honour to look into my Meteorological Essays, Berlin, 1837-38, pp. 244-250, it will be seen, that so far from attempting to usurp the credit so justly due to Hadley for the fundamental idea, upon which my own theory is founded, and which he had himself so successfully applied to the particular problem of the trade-winds, I have been anxious to acknowledge the full extent of my obligations to him, and to bring his merits as a discoverer prominently forward.

In an article upon Lieut.-Colonel Reid's law of storms in the Edinburgh Review, I find my meteorological researches again alluded to, but upon a distinct ground. The anonymous Reviewer, in his patriotic anxiety to satisfy his readers of the purely British growth of this theory, allows that some remarkable passages upon the subject had previously appeared in the memoirs of the Berlin Professor, but that these are mere ingenious speculations, *for they are no more*. The term *passage*, for a memoir (on barometric minima) of seven-

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teen closely printed pages, strikes me as a little extraordinary, but perhaps this arises from my imperfect acquaintance with the nice distinctions of your language. I leave it to my English readers to determine, with what degree of justice results deduced from a greater number of contemporary observations, than (as I believe) had ever previously or have even since been brought together, can be represented as *no more than ingenious speculations*.

I am, dear Sir, yours with much esteem,
 Berlin, Sept. 30, 1840. H. W. DOVE.

LV. *On the Electricity of a Jet of Steam issuing from a Boiler.*
 By H. G. ARMSTRONG, Esq., in *Letters to Professor Faraday*.*

SIR,
 A FEW days ago, I was informed that a very extraordinary electrical phenomenon, connected with the efflux of steam from the safety-valve of a steam-engine boiler, had been observed at Seghill, about six miles from Newcastle. I therefore took an early opportunity of going over to that place, to investigate the truth of what I had heard, and by so doing I have ascertained the precise facts of the case, which appear to me to possess so much novelty and importance, that I deem it right to transmit the particulars to you, believing that in your hands they will prove most conducive to the advancement of science. Without further preface, I shall proceed to narrate what I saw and heard on the spot.

There is nothing remarkable in the construction of the boiler, which is supported upon brick-masonry in the usual way. The annexed sketch represents an end view of the

* Communicated by Professor Faraday.