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P. Baddeley Esq.

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ON THE DUST-STORMS OF INDIA. BY P. BADDELEY, ESQ.

To the Editors of the Philosophical Magazine and Journal.

GENTLEMEN,

Lahore, April 18, 1850.

I have only an hour or two to spare before the Indian mail leaves this, to give you a few notes regarding dust-storms, which are very prevalent in this part of India during the dry months of April, May and June, that is, before the setting in of the rainy season.

My observations on this subject have extended as far back as the hot weather of 1847, when I first came to Lahore, and the result is as follows :—Dust-storms are caused by spiral columns of the electric fluid passing from the atmosphere to the earth ; they have an onward motion—a revolving motion, like revolving storms at sea—and a peculiar spiral motion from above downwards, like a corkscrew. It seems probable that in an extensive dust-storm there are many of these columns moving on together in the same direction ; and during the continuance of the storm, many sudden gusts take place at intervals, during which time the electric tension is at its maximum. These storms hereabouts mostly commence from the north-west or west, and in the course of an hour, more or less, they have nearly completed the circle, and have passed onwards.

Precisely the same phenomena, in kind, are observable in all cases of dust-storms : from the one of a few inches in diameter to those that extend for fifty miles and upwards, the phenomena are identical.

It is a curious fact, that some of the smaller dust-storms occasionally seen in extensive and arid plains, both in the country and in Affghanistan above the Bolon Pass, called in familiar language “Devils,” are either stationary for a long time, that is, upwards of an hour, or nearly so ; and during the whole of this time the dust and minute bodies on the ground are kept whirling about into the air. In other cases these small dust-storms are seen slowly advancing, and when numerous, usually proceed in the same direction. Birds, kites and vultures, are often seen soaring high up just above these spots, apparently following the direction of the column, as if enjoying it. My idea is, that the phenomena connected with dust-storms are identical with those present in waterspouts and white squalls at sea, and revolving storms and tornadoes of all kinds ; and that they originate from the same cause, viz. moving columns of electricity.

In 1847, at Lahore, being desirous of ascertaining the nature of dust-storms, I projected into the air an insulated copper wire on a bamboo on the top of my house, and brought the wire into my room, and connected it with a gold-leaf electrometer and a detached wire communicating with the earth. A day or two after, during the passage of a small dust-storm, I had the pleasure of observing the electric fluid passing in vivid sparks from one wire to another, and of course strongly affecting the electrometer. The thing was now explained ; and since then I have by the same means observed at least sixty dust-storms of various sizes, all presenting the same phenomena in kind,

I have commonly observed that, towards the close of a storm of this kind, a fall of rain suddenly takes place, and instantly the stream

of electricity ceases, or is much diminished; and when it continues, it seems only on occasions, when the storm is severe and continues for some time after. The barometer steadily rises throughout. In this part of the world, the fluctuation of the barometric column is very slight, seldom more than two or three-tenths of an inch at a time.

The average height at Lahore is 1·180, corrected for temperature, indicating, I suppose, above 1150 feet above the level of the sea, taking 30 inches as the standard.

A large dust-storm is usually preceded by certain peculiarities in the dew-point, and the manner in which the particles of dew are deposited on the bulb of a thermometer. My mode of taking the dew-point is, to plunge a common thermometer in a little ice, let it run down 20° or 30°, take it out, wipe it dry, hold it up to the light, and observe the bright spot, and continue to wipe off the dew so long as it is deposited and dulls the bulb: at the instant it clears off mark the temperature. This I have compared frequently with Daniell's hygrometer, cooled by means of chloroform, and find them both correspond with the greatest accuracy.

This is a digression; but I have no time to arrange, and must therefore put down my remarks as they occur to me.

The dew-point varies very much, but is usually many degrees below the temperature of air, 20° to 50° or more.

It also varies according to the time of year. During November last the mean temperature of dew-point was about 47°, that of the air about 71°.

In January 1850, dew-point 43°; in the air, 61°; and the mean temperature of self-registering thermometer 45°·4.

In February 1850, mean of dew-point 48°, and air 64°·5.

April 1850, mean temperature of dew-point so far is about 60°, and the air 84°.

The sparks or the stream of electricity, as it is seen passing from one wire to the other, is in some cases, and during high tension, doubled or trebled; and is never straight, but invariably more or less crooked.

Various kinds of sparks are seen at times; one end of the wire has a star; and from the wire, when held just beyond striking distance, a brush is seen curved, which, when viewed through a lens, seems composed of a stream or curved brush of bright globules, like a shower of mercury.

The manner in which the electricity acts upon the dust and light bodies it meets with in its passage, is simple enough. I suppose the particles similarly electrified and mutually repulsive, and then, together with the whirling motion communicated to them, are whisked into the air. The same takes place when the electricity moves over water. The surface of the water becomes exposed to the electric agency; and its particles, rendered mutually repulsive, are in the same way whirled into the air.

At sea the waterspout is thus formed. First of all is seen the cloud descending, and beneath may be observed the water in a cone, misty and agitated; soon the cloud is seen to approach and join the

latter, involving both extremities in one column, having a spiral motion, and on it moves or continues stationary. The power of electricity in raising bodies, when combined with this peculiar whirling motion, will account for fish, &c. being carried up in its vortex and afterwards discharged to a distance on the earth. The motion of the dust-storm may be described by spinning a tee-totum on a drop of ink; and the way in which bodies are projected may be in like manner described, by letting fall a drop of ink on the centre of a tee-totum while spinning. In this case the particles of ink are thrown off at tangents ever varying, as the centre moves; and perhaps it will be found, that when these kind of storms pass through forests, trees uprooted are distributed something in this manner.

The violent dust-storms are by some supposed to commence at the foot of the hills. I cannot tell if this be the case or not, but should think that they do not necessarily do so, as many often originate in extensive arid plains; and the rarefaction of air, from great and long-continued heat, may be in some way connected with the exciting cause.

Some of them come on with great rapidity, as if at the rate of from 40 to 80 miles an hour. They occur at all hours, oftentimes near sunset.

The sky is clear, and not a breath moving; presently a low bank of clouds is seen in the horizon, which you are surprised you did not observe before; a few seconds have passed, and the cloud has half filled the hemisphere: and now there is no time to lose—it is a dust-storm, and helter-skelter everyone rushes to get into the house in order to escape being caught in it.

The electric fluid continues to stream down the conducting wire unremittingly during the continuance of the storm, the sparks oftentimes upwards of an inch in length, and emitting a crackling sound; its intensity varying upon the force of the storm, and, as before said, more intense during the gusts.

Many dust-storms occur at Lahore and in the Punjaub, generally during the hot and dry months, as many as seven and nine in one month.

One that occurred last year in the month of August seemed to have come from the direction of Lica, on the Indus, to the west and by south of Lahore, and to have a north-easterly direction. An officer travelling, and at the distance of twenty miles or so from Lica, was suddenly caught in it; his tent was blown away, and he himself knocked down and nearly suffocated by the sand. He stated to me that he was informed by one resident at Lica, that so great was its force at the latter place, as to crack the walls of a substantial brick dwelling in which the above officer had lately resided, and to uproot some trees about.

The instant the insulated wire is involved in the electric current marked by the column of dust, down streams the electricity.

I have sometimes attempted to test the kind of electricity, and find that it is not invariably in the same state; sometimes appearing +, at other times —, and changing during the storm.

One day I caused the current to pass through a solution of cya-

nide of silver, so as to affect a small piece of copper, which was rapidly covered with a coating of silver, which upon drying peeled off. In this case the cyanide of silver was pure, without any salt; but in subsequent attempts to silver a wire in this way, I have not succeeded, only a very slight deposit taking place, which was not increased by long exposure to the influence.

But in all the cases I tried subsequent to the one first alluded to, the oxide of silver was dissolved in cyanide of potassium. In the course of time bright and minute crystals were formed, transparent and colourless, on a copper coin.

Yours truly,

P. BADDELEY,

Surgeon-Assistant, Lahore.

ON CERTAIN PHÆNOMENA OF FORCED DILATATION OF
LIQUIDS. BY M. MARCELLIN BERTHELOT.

If a somewhat strong capillary tube, closed at one end and drawn out at the other to a slender point, is filled with water at the temperature of 28° or 30° Cent.; if this tube is cooled down to 18° , so as to cause a certain quantity of air to enter it at the open point, and it is then closed, and again heated to 28° and gradually higher, after a certain time the air is completely dissolved. If cooled to 18° , the original temperature at which the tube contained at the same time gas and liquid, it is seen that the water continues to occupy the whole of the internal capacity, and maintains thus an invariable density between 28° to 18° . Its temperature may even be lowered still more. At this moment the least shock or collision, the least variation causes the instant reappearance, with a sort of ebullition, a slight noise, and a shock more or less perceptible, of the gas dissolved in the water. It dilates rapidly, and in less than a second has resumed its primitive volume at 18° . I have made the same observations with the following liquids, selected from all classes:—water, solutions of various salts and gases, solution of soda, various acids, alcohol, æther, acetone, Dutch liquid, essence of turpentine, oil of olives, creosote, sulphuret of carbon, chlorides of metalloids and metals, bromine. Mercury is the only liquid with which I have not succeeded, either in the presence of the air or *in vacuo*. A bubble of air remained several days in presence of the mercury without dissolving, at least completely, and that under pressures of 200 to 300 atmospheres, produced by preventing, for that length of time, the dilatation of the mercury due otherwise to an increased temperature of 8° or 10° .

In these phænomena there are two things very distinct. 1. An unstable supersaturation of the liquid by the gas, produced under the influence of the pressure. There are numerous examples of this order of facts. 2. A state of forced dilatation of the liquid: the latter, in fact, an instant before the vibration, fills the volume which the gas occupies an instant after conjointly with it, and this volume is the same which the dilated liquid filled on an elevation of temperature of 8 to 10 degrees and more. The variation of density thus produced is enormous; for water it is equal to $\frac{1}{42.6}$ of its volume at 18° ; for alcohol to $\frac{1}{9.3}$, for æther to $\frac{1}{2.9}$. Such an effect would be produced in an opposite direction only by a pressure of 50 atmospheres for