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XXXV. *Memoir upon a Process employed in the ci-devant Maçonnais of France, to avert Showers of Hail, and to dissipate Storms. By M. LESCHEVIN, chief Commissary for Gunpowder and Saltpetre at Dijon*.*

IT is more than five-and-twenty years since the consideration of the mischief produced by storms accompanied with hail, induced several philosophers and friends of humanity to ascertain the method of averting this destructive plague. The celebrated coadjutor of Buffon, M. Guenaut de Montbeillard, thinking that hail is only formed after violent claps of thunder, suggested, in 1776, the establishment of a great multiplicity of conductors, which, by drawing off the electric fluid, would prevent the explosion of thunderbolts, and the consequent formation of hail. His memoir, in the form of a letter to M. Guyton Morveau, was read by the latter to the academy of Dijon, and will be found at length in the *Journal de Physique*, tom. xxi. p. 146. M. Montbeillard, in support of his opinion upon the causes of hail, brings forward the observations of the first-rate natural philosophers, and suggests the most scientific and æconomical method of executing his projects.

This circumstance induced M. Guyton de Morveau, who never allows any opportunity to escape of being useful, to investigate the theory of the production of this meteor. He seconded the philanthropic views of his fellow-countryman by developing this theory in an excellent memoir, published in the *Journal de Physique* for January 1777, p. 60, by the title of, "Letter of M. de Morveau to M. de Montbeillard upon the influence of the electrical fluid in the formation of hail."

Some years afterwards, M. Buissart, of the academy of Arras, without knowing any thing of M. Montbeillard's work, read a memoir to that society on the various advantages that might be derived from a multiplicity of electrical conductors or thunder-rods. This memoir will also be found in the above journal, vol. xxi. p. 140.

* From M. Millin's *Magazin Encyclopedique* for 1806, tom. ii. p. 5.

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Although these various works had called the attention of the public administration and of the affluent landholders to this important subject ; and although, since the first publication of the ideas of Messrs. Montbeillard, Guyton de Morveau, and Buissart, innumerable disasters caused by hail in various parts of France had demonstrated the extreme utility of the measures proposed, or of any other more efficacious or simple which might be suggested ; yet not a single landowner, that we know of, has to this day put in practice any method to avert this plague.

In an interesting memoir, presented to the Academy of Dijon, an 11, by M. Denize, member of the learned Society of Maçon, and containing inquiries upon the means of dispersing storms and preventing hail, we find a curious account of the custom, established in several places, of firing off powder-boxes on the approach of storms, in order to prevent the production of hail. This account, however, was not accompanied with any detail upon the process, nor even with the name of those places where it is practised ; and the schemes proposed by M. Denize appeared to the academy to be accompanied with too much difficulty in their execution : his memoir, in which all the phenomena analogous to his subject are presented with much clearness, and explained according to the principles of sound philosophy, excited much interest, but did not meet with that degree of attention it seems to deserve.

I learned accidentally, some time ago, that the process indicated by M. Denize is in use in most of the communes of the ci-devant Maçonnais, and that a part of the mining powder which I send into this district of the department of Saone and Loire, is employed for the purpose of dissipating storms and preventing hail. The desire of ascertaining such an interesting fact induced me to profit by my connections with that department, in order to procure circumstantial details upon this process, and its analogy with the principles established in the memoir of M. Denize ; and the conclusions he draws induced me to revise his memoir, and to examine the various methods he suggests to check a hail storm in its birth.

M. Denize, after having examined the history of antiquity to ascertain if the antients knew any thing on the subject, concludes, if they did, that they have left us nothing instructive on the subject. Among the moderns he finds no other practice resorted to than that of ringing the church bells; and he observes, with great reason, that this method of averting a storm may be regarded as purely superstitious, and as affording no physical preventive whatever.

The author then proceeds to an examination of the process resorted to of exploding gunpowder; a process, as he says, only adopted within *these few years*, and the adoption of which he ascribes to two causes: "On the one hand, the suppression of the ringing of bells since the revolution; on the other hand, some observations which lead us to think that the commotions excited in the air by considerable discharges of artillery are sufficient to prevent hail; storms being far less frequent, or at least very moderate, in the track of camps or armies*."

The investigations I procured to be made taught me, that so far from the suppression of bell-ringing having had any influence in encouraging the gunpowder process, the latter has been in use for upwards of five-and-thirty years in one of the communes of the ci-devant Maçonnais, as I shall afterwards demonstrate. I shall add to the observations which appear to M. Denize to be the second cause of the adoption of the above method, a fact which convinced me of the influence exercised upon dense clouds by strong and reiterated explosions. I was led personally to make this remark at Grenoble, where there is a school of artillery established.

The sky was pure and serene, when about nine o'clock in the morning numerous clouds began to extend over all the valley in which Grenoble is situated, and covered the mountains by which it is bounded. The instant the discharges of the field-pieces commenced, between nine and ten o'clock, the clouds opened away before us, and the sky resumed its serenity. They did not again collect until the exercise of the guns was finished.

* For some curious remarks on this subject see *Philosophical Magazine*, vol. iv. p. 333.

Next follows in the above memoir the indication of the only preservative against hail, suggested by naturalists, being the establishment of a multiplicity of thunder-rods.

Before entering into the detail of the new methods he submits to the judgment of the learned, M. Denize proceeds to lay before them the results of his own observations upon the formation of hail. It will not be out of place to follow him in this branch of his subject.

I think we may thus state the principles upon which the author's opinion is founded :

The elements which enter into the composition of storms are, the atmospheric air, water, electricity, and caloric.

Water dilated by caloric is formed into vapours, and becomes specifically lighter than the atmospheric air; it ascends, and carries with it a quantity of electricity proportioned to the capacity it has just acquired.

If the air in which these vapours are suspended is of a temperature lower than theirs, they condense, by the disengagement of their caloric, into clouds more or less thick.

Under this new form, their dimensions being diminished, they contain a superabundant quantity of electricity, which they may get rid of by communication either with others or with the earth by means of conductors; but after a time they will be less electrified, if, by traversing some streams of air abounding in caloric, they resume their former state of dilatation.

It is from the contact of clouds variously electrified that storms are produced, the electric fluid darting successively from one cloud to another in order to obtain an equilibrium.

As the author explains the formation of drops of rain during storms, and afterwards drops of hail, in a manner peculiar to himself, that is to say, by referring their formation to the concussion occasioned in the atmosphere of the clouds by claps of thunder, I shall quote his own words on the subject :

“ As soon as the thunder begins to explode in the heart of the storm, the explosion shakes every part of the surrounding air, at the same time that it suddenly diminishes

its density. This concussion occasions violent vibrations in the smaller molecules of the air; consequently it detaches from them the heaviest humid particles, and forces them mutually to approach each other. They unite in virtue of their attraction, and they are immediately precipitated in drops of rain, the size of which is proportioned to the quantity of particles of water which have been united to them during their fall.

“ It is generally at this moment that the formation of hail takes place.”

The theory of the author for explaining the phænomena that successively take place during a storm, is precisely the same with the theory ascribed to the same phænomena by M. Guyton de Morveau in his above-mentioned memoir.

The following, according to M. Denize, are the characters according to which we may judge when it is time to put in practice the preservative processes :

“ From the moment that the thick and obscure clouds begin to accumulate, if we perceive that violent and impetuous winds tend to compress them the one against the other, and to condense them strongly, and as soon as we hear the thunder roaring in the middle of these clouds, and when they appear isolated in the air, and not communicating with the earth by means of any mists or undulations, it is then that the danger threatens, and we cannot too speedily establish the most powerful and energetic conductors between these clouds and the surface of the earth.”

I think we may class under three divisions the methods recommended by the author for dispersing storms : and it seems to me that, although he has followed no order in the indication of these methods, they may be reduced to the following three propositions :

1. Excite in the air strong commotions capable of shaking, if we may use the expression, the particles of water adhering to it, so as to produce an abundant rain.

We may attain this object by the sound of great bells, the reiterated noise of guns or drums, &c.; by the detonation of the fulminating powder, and by the explosion, in the middle

middle of the clouds, of rockets directed towards the place where the clouds are thickest.

2. Establish energetic conductors between the clouds and the earth, either by fires lighted from distance to distance, and kept burning by supplies of dry substances, or by the disengagement of humid vapours, or the combustion of resinous matters.

3. Draw off the electric fluid, which is in superabundance in the clouds, by a multiplicity of thunder-rods. As the storms in our country are accompanied by the east and south-east winds, it would be proper to establish in every canton, on those sides of their horizon, these conductors, which might be placed both on elevated places and on high trees: this consideration would lead to the multiplication of large trees in the above quarters, and immense advantages would consequently result in respect of the increase of fire-wood.

Such is the succinct analysis of this memoir, which evinces that its author is a philosopher familiarised in the explanation of the grand phænomena of nature: it belongs to learned men and enlightened ministers to decide how far the means proposed are practicable in the country, and compatible with the security of the inhabitants and the principles of a good government. To the hopes held out in this memoir, that one of our greatest earthly plagues may be successfully averted, the unhappy reflection is added of the dreadful accidents that may arise from the inconsiderate employment of most of the preservatives recommended by M. Denize. However that may be, it seemed to me to be interesting to lay the above analysis before my readers previous to giving the details of the process employed in the *cir-devant* Maçonnais for preventing storms.

It was at Vaurenard this process originated, 35 years ago. The marquis de Chevrier, a naval officer, retired upon his estate at Vaurenard, having often witnessed the ravages occasioned by hail, and recollecting to have seen the explosion of guns resorted to at sea in order to disperse stormy clouds, resolved to combat this plague by an analogous method.

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For this purpose he made use of boxes of gunpowder, which he caused to be fired off from the heights on the approach of a storm; and his attempts had the happiest effects: he continued until the period of his death, which happened at the commencement of the revolution, to preserve his lands from the ravages of the hail-storms, while the neighbouring villages frequently experienced their baneful effects. He consumed annually about 200 or 300 pounds of mining powder, which was furnished to him from the magazine at Maçon.

The inhabitants of the communes where the marquis de Chevrier's estates were situated, convinced, by the experience of a great number of years, of the excellence of this practice, continued to employ it. Their example was imitated by the surrounding communes; and the practice gaining ground, it is at this moment in use in the communes of Vaurenard, Iger, Azè, Romanèche, Julnat, Le Torrins, Touilly, Fleury, Saint Sorlin, Le Viviers, Les Boutteaux, and many others. The largeness of the powder-boxes, their charge, and the number of times they fire them off, vary according to circumstances and the position of the places. In the commune of Fleury they make use of a mortar which carries a pound of powder at a time; and it is generally upon the heights, and before the clouds have had time to accumulate, that they make the explosions, which they continue until the stormy clouds are entirely dissipated. According to the account given me by the keeper of the magazine at Maçon, the annual consumption of mining powder for this purpose is from 400 to 500 kilogrammes.

The extension of this process for these some years past, and the success with which it has been constantly accompanied, makes it desirable that it should be more generally known wherever hail-storms extend their ravages. It belongs to the learned societies to propagate, by premiums and experiments, a practice by no means so costly as to produce inconvenience, and which from its simplicity of execution is open to every country inhabitant.