## THE BALLOON AS AN AID TO METEOROLOGICAL RESEARCH.

A PAPER READ BY PROF. JOHN WISE BEFORE THE FRANKLIN INSTITUTE.

In the science of meteorology there is no instrumentality competent to do so much good, and which has as yet received so little attention as the balloon. The phenomena of the atmosphere, in their relations to climate and sanitary effects—to agriculture, to physiology—to our mental forces and temperaments, are more fertile in scientific developments than an observer from the earth would suppose. Meteorological investigations are as occult, tame, and spiritless, without the aid of an air-ship, as would be hydrographical investigations without the water ship. The deep-sea soundings, so pregnant with interest in their revelations of infusorial life at the bottom of the ocean, find their counterpart in the deep air soundings in the opposite direction, in the myriads of vegetable life floating upon the currents of the atmosphere. It is not an uncommon thing to see the air currents above the clouds teeming with thistle seed, each one with its silken parachute sailing along in the grand procession. And so, too, is it with the pollen of other plants, moving along in little nebulous cloud patches.

The upper air is not so barren of scientific interest as its apparent vicinity, when viewed from the earth, would indicate. It is a marvel that so fruitful a subject, and one so easily to be explored, is so much neglected. The science of light seems almost reversed in looking down through the atmosphere to the earth from an insulated position of two or three miles of altitude. The earth looks concave, and the horizon is loomed up above the level of the observer. Sometimes a city five or ten miles off may be seen hanging in the heavens upside down, and illuminated by three suns. When this phenomenon presents itself above the cloud region it is more distinctly defined than when it occurs near the surface of the earth.

The phenomena of the clouds are full of interest. Some are dense, and some are attenuated. Some are warm, and some are cold. Some are light and some are dark. Some are charged with ozone. Passing through an ozone cloud causes hoarseness; it acts upon the mucous membranes, and is first perceptible by smell, and the twinging sensation it produces upon the cuticle of the hands and face. When the balloon comes near a cloud, electrical excitement takes place; it also occurs when the balloon is passing from one current of air into another. The finer part of the light sand ballast, used by the aeronaut, is drawn in a stream from the car up and against the body of the balloon. Also, the fine-cut index paper, used by aeronauts, is, in such cases, drawn up against the balloon, hanging there for a while with a tremulous motion, and then falling off. I have heard it making a crepitating noise when thus thrown out by handfuls. The stillness is so profound above the clouds that a noise, not perceptible on the earth, is quite discernible there.

It is remarkable how suddenly, at times, the currents of air strike the balloon, causing it to swing slightly to and fro, as well as to rotate on its vertical axis. These sharp crossing currents are always attended with marked electrical evolutions. The gas in a balloon, that is perfectly transparent when it leaves the earth, is changed into a cloud when it gets into a region of clouds. And it assumes this character of cloud in a perfectly clear atmosphere, when the balloon reaches the region of frost. I have had my hair thickly covered with hoar frost on a Fourth of July, and cloud issuing from the neck of the balloon, at an elevation of 19,000 feet.

The atmosphere is always clear and transparent after a rain storm; it is only then that an observer aloft has a great scope of view of mundane objects. On such occasions, the view in ascending from the seashore is very imposing. It is well known that from the land, or the surface of the sea, a ship is not visible when twenty miles off. The earth's convexity being about eight inches to the mile, and this obstruction of convexity, increasing as the squares of the distances, limits the sight of a ship within moderate scope. Thus, in ascending from a place like Boston harbor, the scene becomes very interesting. As you gradually go up, so come up the ships behind the horizon. It looks like magic. Of a clear day you can see ships at sea a hundred miles off, when the sun is in the opposite direction. With cloud fields between the observer and the ships, they have the appearance of sailing above and over the clouds. So the meandering of a river is sometimes seen convoluting itself over and under the clouds in the distance. These unique sights are, of course, optical illusions, but, without a knowledge of the science of optics, would be deemed mysteries. They prove, however, how subject we are to be misled by our senses in cases where science is not available to correct their errors.

The most marked difference between an earth view and a sky view occurs in the storm cloud. The nimbus, or thunder cloud, when viewed from the earth level, looks like an agitated and confused mass of leaden-colored vapor. When viewed from a little above its level, and from a few miles distance, it looks symmetrical. Bulged out above and below, and contracted in its middle, it trails along over the earth like a huge smoking, fuming engine, dragging its lower part slightly behind, like the trail of a court lady's garment. The electrical cannonading as it passes along, gives it quite a grand and imposing effect. It is quite practicable to sail above, behind, or in the midst of these imposing meteors. Sailing behind one, and between its upper and lower cloud, I saw a beautiful prismatic-colored grotto, and, apparently from within this grotto, came terrific peals of thunder. This grotto was, no doubt, produced by the refractive power of the gas in the balloon, as the sun was shining in between the upper and lower cloud, and through the balloon, and the grotto appeared on the opposi[illegible] of it; that is, the grotto was on the east side, and the sun [illegible] the west side of the balloon, and it was late in the afternoon. That such was its cause is inferred from the fact that prismatic circles of light had appeared in the upper cloud surface, when the sun's rays passed through the gas of the balloon when sailing above it. This phenomenon only occurred with a silken balloon: silk becomes transparent when varnished; cotton does not. A silken balloon is also more susceptible of electrical excitement, than one of cotton. A silken flag crepitates in passing from one current of air into another, a phenomenon not perceptible in a cotton one.

Storm clouds do not all discharge thunderbolts. When a certain field space of atmosphere contains a number of them—and I have seen seven at one time, small ones—they deposit rain in fitful showers, but discharge no thunderbolts. When two or more of them coalesce, then discharges of electricity follow. These detached nimbus clouds are prevalent in the month of April and May, and produce what we term "April showers."

During the heat of summer the thundergust proper prevails. Its constant attendant is heat. We all know this from common experience, the precedent suffocating heat before a thundergust. When these meteors are generated suddenly they give out snow hail, and rain. The snow melts partly into hail, and partly into rain. Hailstones contain in their center a nucleus of snow. In rising up from the earth the deposition from a cloud grows diffuse, more and more, until you enter the base of the cloud, where it is a dense mist; and as you rise in the cloud, this mist becomes thinner, until near the top when it ceases entirely; at this point the cloud becomes warm, and when emerging from its top still warmer, caused by radiation and reflection; and then follows a twinging sensation in the cuticle of the face and hands like the pricking from bunches of needles, also slight hoarseness, with more or less pain in the base of the brain, and in the ears, when the ascent is sudden.

It is impossible to hold a level position in the body of a thunder cloud. You are all the time going up or down. The vortex current carries you up through the central part of the cloud, diverging the balloon outward with the outspreading vapor, upon which it describes its outward and downward course, generally to be drawn in again near the base of the cloud, and from thence upward on the uprising stream, and so on, like an endless chain, until you leave it by an increase of levitating force from its top, or an increase of gravitating force at its base; in the one case by a copious discharge of ballast, in the other by a copious discharge of gas.

To explore one of these meteors is, at first, calculated to produce a degree of anxious solicitude, but when experienced for a while, and duly considered, the experience becomes interesting and sublime, and well calculated to inspire the meteorologist with a desire to renew the investigation of atmospheric phenomena.

There is no disk rotation in a storm cloud, but there is a vortical rotation in its center caused by the two forces of the inrushing and uprushing air, shown in the swinging and rotating motion it gives to the balloon. This inward motion of the air toward the vortex of the cloud extends beyond the outer margin of the meteor, and will gradually draw the balloon toward and into the vortex. This can be prevented by giving the balloon an upward or downward motion, as, in either case, the center of the storm will recede from the air ship, and thus we have the power of riding in the wake or in the midst of a thundergust.

It may be deemed a hazardous mode of investigation to sail up into the air three or four miles high, but when we take into comparison the number of air voyages made, and the accidents related to them, we shall find as favorable results as in sea voyages. I have accounts of thirteen balloons that exploded while high in the air with their occupants, two of them with myself, while above the clouds, and in none of these was any one harmed. The law of atmospheric resistance is as certain as the law of atmospheric buoyancy. I even controlled the collapsed descending balloon from falling into a piece of woodland by lightening the weight in the disposal of ballast, and thus drifted beyond the trees.

So far as I have investigated accidents with balloons, not a single case occurred from any intrinsic principle of danger connected with the art. Not so with the sea ship. These two elements, wind and water, coming in conflict, cause the destruction of the vessel. Water, nearly a thousand times denser than air, and the air moving against the ship with a velocity of a hundred miles per hour, and the immense mast leverage, must necessarily bring a tremendous force upon its framework. Not so with the air ship. It has but one element around it, and, once free in the air, it matters not, so far as its ability to stand the strain is concerned, whether the wind moves one mile or one hundred miles per hour. Even with the latter velocity, your vessel glides along so smoothly and gracefully as not to ruffle a cobweb suspended from its flagstaff. Did you not perceive objects on the earth receding and approaching, it would be impossible to discern that you were moving at all. I traveled forty miles in forty-eight minutes in the midst of a cloud stratum, without being aware that I had moved forty rods before landing.

When accidents have occurred with balloons, they were always attributable, either to defective construction or a want of ordinary skill in the persons operating them. It is a deplorable truth that many, if not most, persons who use balloons are not scientific. And yet, this class have generally the most marvelous stories of blood oozing from their finger ends, and the balloon turning topsy-turvy, and the miraculous escapes they have made, to relate.

I trust enough has been said and done to show that we can go up into the air, into the cloud, into the storm, by day or by night, to investigate the phenomena of the upper air without incurring the accusation of being reckless, especially when high officials of state use them to escape from a beleaguered city, and governments send them off with mail-route agents to distribute daily mails.

The Franklin Institute, a time-honored school of art and science, is worthy of the establishment of a section of meteorology for the purpose of exploring the wonders of the atmosphere with the aid of a balloon and meteorological instruments. An air ship can be constructed for such purpose at a trifling cost as compared to the advantages to be derived; and the cost of inflation is now vastly reduced in the facilities afforded by the coal gas; and with such men as Dr. Wahl, our efficient secretary, to make the investigations, and an experienced air navigator to take charge of the air ship, and if my experience is worth anything, it would be voluntarily given, much can be done toward the establishment of certain scientific data as related to meteorological phenomena in the course of a year.

Dr. Wahl allows me to say, that he has not only no hesitation in making such explorations, but that he would most earnestly and cheerfully engage in the pursuit. The barometer, hygrometer, and electrometer, in the corner of the house, may hang there a century, and not reveal as much to the explanation of meteorological science as they will in one day up in the clouds, in the hands of a well-trained person.

We owe such a course of investigation to the age we live in. The onward march of knowledge exacts it and demands it at the hands of the learned institutions, and there is none so well adapted to its prosecution as the Franklin Institute.

When it is considered that we do not know, to this day, from whence the source of electricity in cloud phenomena—whether in storms it is a primary or a resultant; whether there is one kind or two kinds developed in a thundergust; whether the thunderbolt makes its detonation forcing its passage through the air, or in its percussion upon more solid matter; whether the bolt darts from one cloud to another, or whether it invariably darts to the earth—we should use all reasonable means to find out. The European scientists shot arrows into the air to learn something of atmospheric electricity. Franklin, always practical, not being able to get up into the clouds himself, sent up his representative, the kite, and, in a moment, demonstrated a fact, which, for a thousand years, had been held in abeyance—the identity of cloud and machine electricity. The great philosopher, fearing the ridicule of the unlearned over a man flying a kite, went clandestinely out to Bush hill, under cover of his son, to try the mission of his aerial messenger, and it proved and settled the long-mooted question.

The air-ship is destined to settle the question of the relation of atmospheric with terrestrial electricity, and how this pervading agent—gravitation *per se*, or intrinsic motion, or vis-vitæ, or whatever we may term it—is to be appropriated to our common welfare; for in it we live, and move, and have our being.

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### Buhl Work and Reisner Work.

Buhl was a cabinet-maker in the days of Louis the Fourteenth, and was instrumental in bringing into use a kind of decorative furniture, or furniture decoration, which has been more or less in favor ever since. It was not usually, in his work, actual wood that formed the surface; more frequently it was brass, silver, or some other metal, inlaid in tortoise-shell, on a wood backing. The mode of procedure was curious. A layer, say, of brass, and a layer of tortoise-shell, each as thin as veneer, were glued on opposite surfaces of a piece of paper; another piece of paper was glued outside, a pattern or device was drawn on the outside paper, and all the lines of the device were cut through and through with a fine saw. A little moistening removed the papers, and separated the inlay. What followed? Two patterns could be produced out of the two veneers: a brass inlay in tortoise-shell, and a tortoise-shell inlay in brass. The inlays, thus fabricated, were applied as veneers to the surface of a cabinet or other article of furniture. Old cabinets, thus adorned by Buhl and his cotemporaries, are now eagerly bought up at high prices by art collectors.

Another cabinet-maker of the same period, Reisner, varied the form of his productions by employing two kinds of wood instead of brass and tortoise-shell: usually selecting tulip wood and some darker variety. This was called Reisner work; like real Buhl work, it now commands high prices. It is evident that, the principle once being clearly understood, its application may be almost infinitely varied, according to the choice of materials, whether tortoise-shell, ivory, mother-of-pearl, ebony, fancy woods, gold, silver, brass, copper, or whatnot. Cheap imitations of Buhl work are now produced by cutting out the veneer patterns with a stamping press, instead of by the slower aid of a saw. Other cheap imitations are made in the papier-maché workshops of Birmingham; fanciful patterns in brass, stamped out, are fastened down upon papier-maché, and the interstices of the device gradually filled up with successive coatings of black japan varnish. As to the devices that may be cut out with a fine saw, the fretwork of a pianoforte furnishes a very good example; although it is not often that the workman attempts anything of a pictorial character therein.

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OF the 20,000 horses captured by the Prussians at the surrender of Sedan and elsewhere the best have been picked out and supplied to the German artillery and cavalry. These include many capital Norman horses for the cavalry, and heavy animals for the artillery. The Barbary horses of the African troops, excellent as they are are deemed too small for the Prussian cavalry.

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IT is now said that the Mont Cenis tunnel will be completed in 1871. The Hoosac tunnel will require three years more for its completion. Both affairs are great bores.