THE GLEANER:

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CHEMISTRY OF AUTUMN.

In the 'Chemistry of Summer,' we illustrate the power of the earth to absorb heat; and in resuming our survey of the seasons, we shall commence by showing how it returns the excess of this acquisition to the radiant skies.

The process by which the return is made is called radiation, the heat being emitted in rays as if from a centre, but curious to observe that there is little analogy in this respect between solar and artificial heat. A fire, for instance, warms pretty nearly alike, all surfaces of the same mechanical texture, while the heat of the sun is modified by the colour of the object. A dark surface absorbs and radiates more rapidly than a light one. Thus a white dress is cooler than a black one; and men, acting upon perhaps unconscious experience, prefer the former in summer and the latter in winter.

Why then, have the natives of higher latitudes dark or black skins, since they must absorb more heat than lighter skins? That such is the fact the chemist demonstrates by experiment. He places the backs of both his hands in the sunshine on an intensely hot day, the one bare and the other covered with a black cloth; the former having the bulb of a thermometer resting on it, and the other having the bulb underneath the cloth. In such circumstances the exposed Thermometer indicates 85 degrees and the covered one ninety one degrees. In another trial the former indicates ninety eight degrees, and the latter 106 degrees. This is just what might have been expected from analogy, but the curious thing is, that the hand which has less heat is scorched and blistered, and that which has greater heat receives no injury! Thus the fact is obvious—although science cannot explain the cause—that the skin is protected from injury by the very colour which increases its absorption of heat.

The radiation of heat from the earth explains a beautiful and interesting phenomenon of the summer and autumnal months. At sunset, if the sky be clouded, the glowing earth parts with a portion of its heat to the air, the directly incumbent portion of which thus becomes much warmer than the solid body on which it rests. The consequence is, that the watery vapour, always present in the atmosphere is chilled when it approaches the earth, and condenses into those drops which sparkle like gems on leaves and flowers. If the the dew fell like rain, it would fall on all parts of the garden alike. but we find the grass plot completely saturated, while the gravel-walk which passes through it is nearly dry: and in like manner the leaves of the hollyhock are dripping diamonds, while those of the laurel are free of moisture. The cause of this difference is the difference in the radiating power of these several objects, some of which give out their heat with energy, and becoming cold induce a copious deposition of water from the air, while others, being bad radiators, remain so warm, that the aqueous vapour continues to float about them unchanged.

Extending our view farther, we find bare rocks and barren soils in the condition of the gravel walk, and the more fertile parts of the earth in that of the grassplot. The compact structure of the rock or hard soil unfits it both for absorbing and radiating heat energetically, while the reverse is the case in more productive spots, where the soil is of a loose or porous character. This affords a beautiful example of the economy of nature in bestowing dew only on places where it can answer a beneficial purpose. But dew in excessive abundance would be hurtful, and accordingly, it is only when the sky is clear, and the air moderately tranquil, that the phenomenon occurs in perfection. The clouds which protect the earth from the rigour of noon, act as screens to arrest a too profuse radiation at night, and sending back their own heat, they keep up by the interchange an equal temperature. On this principle a gardener hangs a thin mat over tender plants, to protect them from cold. A cambric handkerchief would answer the same purpose; for all that is wanted is to prevent the radiation of heat. A handkerchief of this kind was extended tightly, in the manner of a roof on the tops of four little sticks stuck in a grass plot, and forming a square. One night the grass thus sheltered was only three degrees colder than the air, while the grass outside the square was eleven degrees colder.

At this season we may frequently observe at sunrise a white mist, several feet high, covering a field of grass or corn; and if we walk through it, we may feel the humidity on the lower part of our person, while our head is bright and dry in the beams of the early sun. This 'earth cloud' is the aqueous vapour drawn suddenly during the night from the lower part of the atmosphere, by the rapid radiation of heat from the earth. The cloud prevented further radiation, and has therefore remained itself 'en statu quo,' but presently the sun will reconvert it into invisible vapour, and diffuse it throughout the atmosphere.

The red appearance of the sky at sunrise predicts foul weather, and the same phenomena at sunset fine weather, the rationale of which is explained by science, although not so clearly as to tempt us to enter into the subject. The husbandman however, knows the fact by experience, and corroborates it by observations drawn from other circumstances. In the morning if the cattle low more than usual, stretch forth their necks and snuff the air with extended nostrils, it is a sign of coming rain; but if the chickweed remain open, and the trefoil and birdweed raise their heads boldly, there is no unusual 'hydration in the atmosphere. As for the ordinary hydration, or presence of the watery vapour we have mentioned, that is indispensable to the life of both plants and animals.

If the air we breathe thus require to be mixed with water, so the water in which aquatic plants or animals live require to be mixed with air. Expel the air from rain water by boiling, and after suffering it to cool in a well corked bottle, pour it gently out upon a finger glass. If you introduce a small fish into this *pure* water, it will show signs of distress by gasping at the surface, and would soon die if kept immersed; but if, before introducing the fish, you pour the water for a few minutes from one vessel into another, you fit it, by the admixture of air for the support of animal life. The reason is, that the respiratory organs of fishes, withdraw oxygen, not from the water but from the air which it contains. If we place a fish even in properly aerated water, and then secure the mouth of the vessel with an air tight cover, the creature will die when the oxygen of the air is consumed. Fishes require a constant supply of aerated water, just as land animals require a constant supply of hydrated air.

But there is a still more curious analogy between fishes and land animals; for in confined places, the former like the latter, may be poisoned by their own breath. They exhale carbonic acid: and unless there are growing plants at hand, stimulated by solar light, to decompose this mephitic vapour—respiring the carbon and emitting the oxygen—the consequence is langour, sickness and death. This is why it is necessary for the life of fishes in glass globes either to change the water frequently, or introduce some aquatic plants to decompose the results of their respiration. But plants do more than this; they protect the fish from the heat of the sun Light coloured or silver fish, more especially, are liable to be scorched by the solar heat, and one which became discoloured after the removal of shade from his habitation was examined by a naturalist, and pronounced to be fairly sunburnt.

Although living plants emit oxygen, they are supposed when they die and decay in stagnant water, to be the source of the air bubbles we see at this season bursting upon the surface. The vapour contained in such bubbles is composed not of oxygen, but of carbon and hydrogen, and resembles the common coal gas. It is identical with the fire damp of mines, and receives from the chemist the name of carburetted hydrogen. This is the *ignus fatuus* (kindled by some unknown agency) which we now observe in the evenings dancing over the surface of marshy soils, and which popular superstition has personified in Jack-o'-Lantern and Will-o'-the-wisp.

There is another phenomenon of the season which chemistry has to a certain extent explained. The artificial conversion of water into vapour, the chemist finds, is always attended by the development of electricity, sometimes with the concomitants, of light, heat, and sound. He supposes, therefore, that the thunder storm is the consequence of the natural process of this conversion constantly going on in every aqueous portion of the globe. Electricity he discovers, so far resembles heat, that it desires to communicate its redundance to objects that are deficient; and like heat, it is opposed, facilitated or arrested in this effort by various substances, according as they are good or bad conductors. Anhydrous air, to use the words of Mr Criffiths, 'is a non-conductor, earthy substances are bad conductors, and purer metals are the the best conductors of imponderable electricity.' Now when the atmosphere approaches the anhydrous state, or is greatly desiccated, as at this season, it is a very imperfect conductor, and the clouds therefore, or aqueous volumes floating in to upper regions remain for a time highly charged, notwithstanding their efforts at deliverance, with accumulations of electricity. When these become excessive, the struggle is at an end. The imprisoned lightening bursts forth, and rushes down to the earth and waters, rending the unwilling air, the violent collapses of which, instantaneously succeeding the passage of she extraneous body, produces the roar we term thunder. The time taken by light to travel is so short (one hundred and ninety two thousand miles in a second) as to be inappreciable by the senses; but sound moves at the rate of only about 380 yards in a second. The apparent interval, therefore, between the two—although they are really simultaneous—enables us easily to guess at the distance of the electricity; for we have only to multiply the 380 yards by the number of seconds which elapse between the lightning and the thunder.

The comparative slowness with which sound moves, produces a curious effect; for when the lightning is long, irregular, and ragged, betraying its distant origin, we hear the thunder first, it may be from the top of a tree near which we are standing, then far beyond this, then from a still more remote point, and ultimately from the cloud whence the lightning first issued. Thus the thunder is a loud rumbling noise, instead of the single terrible crack which indicates the proquinty of the electricity. As to the bright and mute flashes we see sometimes in the evening at this time of the year, it is supposed that they are so distant that the sound of the thunder has been lost in its passage.

The identity of lightning and electricity was only slowly understood; but at length the question was definitively settled by Franklin by means of a common kite. It being early known that the electric fluid was attracted by points, it was determined to ascertain whether lightning —so similar in other respects—acknowledged the same influence. A pointed wire, therefore, was attached to the stick of a kite, which, on being carried up into the open air during a thunder storm, attracted electricity from the clouds; and this, on the machine reaching the ground, was discharged with vivid sparks and sharp reports, and a merely probable analogy thus converted into a distinct proof of identity. This gave rise to the invention of the metallic rod, placed for the protection of dwellings, in deep connection with the humid earth; and so presenting a harmless path for the flash of natural electric fire. Electricity, however, is not like heat, conducted progressively by metals, but instantaneously: an extraordinary example of which we see in the most wonderful discovery of this wonderful age—the electric telegraph.

A thunder storm is frequently attended by heavy showers of rain or hail; but these secrets of the clouds have hitherto defied the researches of chemistry. All we know with certainty is, that rain drops as we mentioned in our former article, are hollow spheres; and that hail stones are exquisitely-shaped crystals, forming a short six-sided prism, with a six-sided pyramid at both ends, but one of them truncated, or cut off, as if to enable the figure to stand. For this form to be observable, it is of course necessary for the hail to be received on a soft yielding surface.

But the most interesting spectacle presented by this season is the corn waving before the breeze, and offering for the necessities of man a food, the nourishment of which has been abstracted in so extraordinary a manner from air, earth and water. This food science can analyse, but by no synthetical process imitate. In vain it compounds the elements oxygen, hydrogen, nitrogen and carbon, in the exact proportions of the grain: no inorganic substance will support human life. The chemist cannot make food, even with all its materials at his command: his art is confined to ascertaining the nature and properties of that which has been subjected to the mysterious laws of vitality, whether in the animal or vegetable creation. And yet science, weak as it may seem in this respect, is able to stimulate and assist nature in her processes for man's own benefit. Grain-bearing vegetables are all in this sense artificial: wheat, barley, oats, maize, rye, rice, millet, beans and peas having never been discovered in a wild or natural state of growth.

In this hot weather the appetite for food is not so keen as in cold weather; and chemistry, through her high-priest Liebeg, informs us of the reason. The source of heat within the human body is the combination—the combustion so to speak—of the carbon of the food with the oxygen of the atmosphere. 'The animal body is a heated mass, which bears the same relation to surrounding objects as any other heated mass;' receiving heat when these are hotter, and losing heat when these are colder than itself. The blood, notwithstanding, of an inhabitant of the arctic circle, has a temperature as high as that of a native of the south, and this shows that 'the heat given off to the surrounding medium is restored within the body with great rapidity'—a compensation which must take place more rapidly in winter than in summer. 'Now in different climates the quantity of oxygen introduced into the system by respiration varies according to the temperature of the external air: the quantity of inspired oxygen increases with the loss of heat by external cooling, and the quantity of carbon or hydrogen necessary to combine with this oxygen must be increased in the same ratio. If we were to go naked like certain savage tribes, or if in hunting or fishing, we were exposed to the same degree of cold as the Samoyedes, we should be able with ease to consume ten pounds of flesh, and perhaps a dozen of tallow candles into the bargain daily, as warmly-clad travellers have related with astonishment of these people. We should then also be able to take the same quantity of brandy or train oil without bad effects, because the carbon and hydrogen of these substances would only suffice to keep up the equilibrium between the external temperature and that of our bodies.

The quantity of food is affected likewise by the number of our respirations. In oppressively hot weather, this number is limited by our inability to take exercise, and consequently we do not imbibe enough of oxygen to consume our usual quantity of carbon. If we enable ourselves for a time to keep up this quantity, or in other words, to eat our usual quantity of food, by the means use of stimulating condiments, our health soon fails.