The Gleaner:

AND NORTHUMBERLAND SCHEDIASMA.

VOLUME V. *Nec aranearum sane texus ideo melior, quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes.* [No. 24.

MIRAMICHI, TUESDAY MORNING, FEBRUARY 18, 1834.

THE GLEANER.

Useful and Entertaining Knowledge.

THE WISDOM OF GOD, AS DISPLAYED IN THE FORMATION OF WATER.

REFLECTING men have often lamented that physical science had so seldom been brought to the aid of ethics, and that the rich, moral truths, written with the finger of God on the tablets of nature, have been so seldom proclaimed by those who have been honoured with the privileges of a perusal. This is the more surprizing, because it is a language always read by philosophy with delight, and always received by the world with particular favour. The works on natural theology have been read with avidity and circulated extensively. They belong to no sect, militate against no subdivision of faith, violate no man's religion, and come into collision with no man's prejudices. Yet the number of such productions is remarkably small. They are meagre too, while the subject is one of surpassing interest and illimitable extent. As it is among the first duties of him who perceives a defect or discovers a treasure, to correct the one and diffuse the other, I shall endeavour to occupy your time in the development of the properties of water, as illustrative of design in creation, and of wisdom and goodness in the Creator. In the selection of the subject I have chosen that which is strictly within the limits of my department, and the particular point of view is one of inciting interest, and highly favourable to a comprehensive survey.

One of the most abundant substances in the world, water is also one of the most useful, whether we view it in the agency of its elements, or in the milder actions of its compound state. Every where present, it is every where active, and the extent and variety of the phenomena presented by it are such as a life-time of observation could not note, nor a century of experience appreciate. This is itself a very striking fact, for if the very different and even opposite uses subserved by water, were fulfilled by as many various substances, either they would be scarce or inaccessible in many places, or being all widely diffused, would stand in the way of each other, and encumber the beings they were made to benefit. Capable of assuming all the *forms* of matter, acting the part of a solid, a liquid, or a gass; susceptible of decomposition into two potent constituents, water admits of a prodigious extent and variety of application. It is, although obedient to most of the laws by which other matter is governed, gifted with some singular exemptions, so obviously the effect of design as to have drawn forth a declaration to that effect from every one who has observed them. The most remarkable of these peculiarities is that which exempts water from obedience to a law otherwise universal, viz: that all liquids are expanded, though in different degrees by the increase of their temperature. To this rule water is partially submissive, and from 40 degrees of Fahrenheit's scale up to its boiling point it is constantly expanded by augmented temperature.* But below 40 degrees the rule is violated, and the addition of heat invariably causes a contradiction. Water, therefore, at or very near to 40 degrees is the heaviest water; for, whether we heat or cool it, beginning at that temperature, it is increased in bulk, or lessened in specific gravity. For this reason the refrigeration of the surface of water makes that surface heavier, and it sinks into the warmer liquid below it, until the whole of the fluid in the vessel is reduced to the temperature, of 40° F. Cooled below that point, the surface of water, contrary to the general law, becomes lighter as it loses heat, and remains at the top until its temperature falls to 32° when it is transformed into ice. This very curious exception to a law, otherwise uniform in its application to liquids, appears to have been necessary to the welfare and even the continued existence of animals. Were water subject to the usual law of expansion by heat at all temperatures, the consequences would be disastrous. Before any ice could be formed in any river or lake, all its waters would be reduced to the freezing point, a temperature at which few aquatic animals could long survive. Then the place where ice would begin to form, would depend on accident, or the presence of solid bodies, around which, as *nuclei*, it would collect. But the fishes being of the temperature of water, would form centres of aggregation, and become enveloped in ice, disabled from motion, and put to a cruel death.

The exception to the general law enables the heat of spring and summer, too readily restore warmth to the water; for when the surface becomes warmer, it sinks into the colder though lighter liquid beneath, until the whole mass is raised again to 46°, when the usual law becoming applicable, the warmer water remains at the top. If it were otherwise, the cold fluid at the bottom of a lake, could not be brought near to the surface, and it would continue cold until the following winter, acquiring a still lower temperature; until finally the streams and lakes would become solid masses, mighty glaciers, untenanted themselves, and rendering uninhabitable the adjacent country. The population if it could still exist would not congregate on the river-courses and lake country, but would fly as far as possible from the desolate streams, which now teeming with fishes, and covered with the white sails of commerce, afford to man delicious food and easily acquired wealth.

Water offers, in freezing, another unusual exception to a general law. Most liquids in passing to the solid state are lessened in volume, or become heavier, so that solids usually, though not always, sink in their corresponding liquids. Thus lead, which is solid, sinks in melted lead. But water is expanded by congelation, and therefore ice floats and covers the lakes and rivers during winter with a solid crust, affording a bridge for migratory animals, and presenting to the escape of heat from the water below, a usual though imperfect barrier. But the expansion of water in freezing is of still greater use. As winter approaches, the earth becomes wet with frequent rains, and 'when,' says the Indian proverb, 'the pools are full the ice and snow will come.' Even the hardest and most compact soils are thus moistened. But the frost follows the water into the ground, converts every drop near the surface into ice, the expansion of which, forces asunder the adherent particles of earth, and renders the soil loose and spongy for the better reception and nutrition of grass, seeds, and the roots of trees and shrubs. But for this singular property, how may cold and sterile wastes would frown, where now there is verdure and luxuriancy? In this manner, too, the more friable rocks are dilapidated, and afford materials for the creation or enrichment of soils, with much greater rapidity than under the less active forces of the other elements of decay.

No other liquid freezes at or about the temperature of the formation of ice, which takes place at 32° of Fahrenheit's thermometer Mercury and Ether are frozen at a temperature at least 71° lower, and alcohol has never yet been converted into a solid by any degree of cold however great. But had the freezing point of water been materially different, what disastrous events would have mastered the world! If it were to freeze at a *higher* temperature, we should have the lakes and rivers in icy chains during the spring time and autumn: and our fields, instead of drinking in the genial showers of April, would often be covered with unfertilizing snow, when the plants and the flowers were looking up to the clouds for refreshment and food. The grass would be withdrawn from the reach of the ox and the horse, and the seeds would lie on the ground inaccessible to the birds, in the very season of maternal anxiety and care. Instead of the loose and friable soil, we should encounter, during the greater part of the year, a hard and unyielding crust, unfit for the reception of seeds or the stimulation of vegetable growth. If the freezing point were, on the other hand, considerably *lower*, still more terrible consequences would follow. Instead of reposing under the dry, light, and shielding snow of winter, the earth would often be deluged with water too cold for its living things: and they would perish. Think of getting wet in a shower at the temperature of 20° or 10°! But this water would penetrate the earth and carry down its coldness beyond the reach of the summer sun, and chill the soil into barrenness and desolation. A thousand ills would spring from *any* material alteration of the freezing point of water; but happily that temperature was selected for it, by Him, who, foreseeing all things, has not forgotten the lightest matter in his multitudinous universe.

The *specific gravity* of water is the very best which could be given to it. If lighter it would not be sufficiently buoyant, for animals or ships, and if much heavier, the fishes could not remain beneath its surface. Any animal would sink in alcohol, or ether, or oil, and on a sea of mercury it would be impossible to ballast a ship with any thing but gold or platinum. Its gravity, therefore, is nicely proportioned to the weight of fishes and other animals, to the timber of which ships are built, and to the means of ballasting them.

Comparad with that of other liquids, the capacity of water for heat is not a little remarkable. In passing through a given range of temperature, water absorbs nearly *thirty* times as much heat as the same weight of mercury, and about twice as much as alcohol, oil, or ether. The lakes, rivers, and oceans become, therefore, during summer, vast magazines of heat, cooling the air by their great capacity for carolic *heat*, and storing it up to be given out again when the temperature of the air declines. So that the waters resist sudden and great changer of temperature, both by imbibing and giving out, according to circumstances, a very large quantity of caloric; and as so large a portion of the terrestrial surface is occupied by water, the earth is not only made more inhabitable, but more healthful and agreeable. It is to the exorbitant capacity of water that we owe the land and sea breezes, by which tropical islands and coasts are so refreshingly fanned. For, as the land being of less capacity than water, is more quickly warmed by the sun, as sea breeze is created during the day, whilst, as during the night, the land for the same reason cools faster, a land breeze is produced. This vast capacity preserves the waters from freezing to a much later period of winter, and tends to temper the march of spring, and to prevent sudden thaws and violent inundations. If the capacity of water for heat were low, the fluids of the deepest lakes would soon be reduced to the temperature necessary to form ice, and the lakes and rivers would be withdrawn for a much longer period of each year from the uses of commerce. But as the water holds so vast a quantity of heat, it maintains a long conflict with winter, and in some insular situations, tempers its severity for the whole season. Even when ice *is* formed, the process is useful in lessening the severity of cold; for the ice being of much less capacity than water, yields up, in passing to a solid state, a very large quantity of caloric, which renders more difficult the solidification of the rest, and gives warmth to the surrounding air. For a like reason, the ice, as it melts into water in the spring, absorbs so great a quantity of caloric as to temper the onset of heat, and make the thaw gradual. Otherwise the liquefaction would be sudden, and floods of great extent and irresistible force would desolate, in the spring, the countries adjacent to the streams.

There are many phenomena connected with the *ebullition* of water equally worthy of the notice of the philosophical theologian. Among these is the *temperature* of boiling water. If that temperature had been much *lower* than it is, we should have been unable to use water as a culinary agent. Its power of destroying the hardness and cohesion of animal and vegetable substances would be annulled, and we should be deprived of many agreeable and even necessary articles of food. The Augustine monks, who live on the top of the great St. Bernard, complain of the scarcity of fuel, as being particularly inconvenient to them, because the water used in cooking food, boils there at so low a temperature as to require a very prolonged application of heat, and a consequent profuse expenditure of fuel. Travellers acquainted with the subject ought long since to have rectified this evil, by telling them to put salt into the water for all such processes as are compatible with its presence, and in other cases to apply pressure. Were the temperature of boiling water much *higher* than it now is we should be deprived of the advantage at present derived from many convenient materials used in the construction of culinary instruments, whose safety depends on the limitation of heat by the escape of vapour. But the particular temperature at which water boils is far removed from that of the ebullition of any other liquid. Ether boils at 98° F., alcohol at 173°. 5. spirits of turpentine at 316°, and mercury and oil at from 649° to 650°.

The vapour of water requires, for its production and continuance, a remarkable quantity of heat. A pound of steam, although of the same temperature as boiling water, holds enough of caloric to make a pound of water red hot, if it were possible to keep the water liquid at such a heat. This is proved by forcing the steam into ten pounds of water, which will be raised to 100 degrees, but if ten pounds are raised to 100, one pound would be raised to 1000 degrees, and that is a temperature visibly red in the day-time. There is no other liquid whose vapour is endowed with any thing like the same degree of power of absorbing heat, hence this may be enumerated among the many peculiarities of water.

Water does not give off vapour alone at the boiling point. Even ice yields a portion of steam, and at all ordinary temperature's evaporation is in action. Less when the water is cold, it augments as the temperature is increased, until at 212 degrees it is as rapid as possible. The extraordinary absorption of heat by vapour necessarily renders evaporation a cooling process, and as the quantity of vapour is proportional nearly to the heat, so is the refrigeration. To this property of water we are indebted for the possibility of living in tropical regions, and for much of the coolness of the summers of more temperate zones. We are naturally surprised at observing that the breeze which cools our bodies produces no effect of that kind on the thermometer; but our wonder ceases, when we consider that the moisture on the skin is vaporized, and that the vapour absorbs a great quantity of heat, while the thermometer being dry, is only of the temperature of the air, whether still or in motion. A few drops of water, placed on its bulb, will enable the breeze to lower its mercurial column, and prove that evaporation is a cooling process. In climates in which ice is not formed, the inhabitants cool wine and other liquids by wetting the vessels which contain them, and placing them in a rapid current of air. The power of quenching flame and extinguishing fire, so remarkable in water, depends mainly on the refrigating action of the steam. If steam were formed only at high temperatures, we should never be able to throw enough of water on a conflagration to arrest its progress. On the other hand if the boiling point were as low, as that of ether, we should be frozen ever in summer, as may be demonstrated by the familiar experiment of solidifying water by the evaportion of other from its surface.

As the formation of vapour cools the plains and the valleys,

* The reader is of course aware that in the scale of Farenheit's thermometer 32 degrees above zero, indicates the temperature at which water under the common pressure of the atmosphere freezes and is hence called the freezing point; whilst 212 degrees above zero or 180 above freezing point, is the temperature at which water boils under the customary atmospheric pressure.