subordinate, depending on the agency of light, and though necessary to the perfection of vegetation, yet not essential to its existence. In this manner each process may be followed out separately, but in regard to its immediate effects and remoter consequences, without clashing with the other; and the apparently discordant and even contradictory phenomena which on a first view they seem to exhibit, may be reconciled, and considered, not less in theory than in fact, as conspiring together to form one harmonious and perfect whole."

It is evident from common observation that the sun's light is of the utmost importance to vegetable life and perfection. A plant may indeed grow in a feeble and sickly manner without light; but under such a privation, the parts which are usually green assume a sickly white colour, as is the case with vegetables which happen to grow in a cellar. "When deprived of light all plants nearly agree in the quality of their juices. The pungent vegetables grow insipid: the highest flavoured inodorous: and those of the most variegated colours are of an uniform whiteness. Vegetables which grow in an exposed situation, burn when dry; but a vegetable laid in a dark box contains nothing inflammable."* It cannot well be conceived that such effects of light upon vegetables as have been briefly described, should occur, if light, and the organs of vegetables, had not been wisely adapted to each other.

The moisture which floats in the atmosphere is likewise of essential use to vegetable life. The leaves of living plants appear to act upon this vapour in its elastic form, and to absorb it. Some vegetables increase in weight from this cause, when suspended in the atmosphere and unconnected with the soil, as the *house-leek* and the *aloe*. In very intense heats, and when the soil is dry, the life of plants seems to be preserved by the absorbent power of their leaves. With an increasing heat of the atmosphere, an increasing quantity of vapour will rise into it, if supplied from any quarter.—Hence it appears that aqueous vapour is most abundant in the atmosphere when it is most needed for the purposes of life, and that when other sources of moisture are cut off, vapour is then most abundant. When clouds are of the same nature with steam from the spout of a boiling tea-kettle, they are then of the most essential use to vegetable and animal life. They moderate the fervour of the sun in a manner agreeable, to a greater or less degree, in all climates, and are grateful no less to vegetables than to animals. It has been observed, that plants grow more during a week of cloudy weather than in a month of dry and hot, and that vegetables are far more refreshed by being watered in cloudy than in clear weather. In the latter case, probably the supply of fluid is too rapidly carried off by evaporation. Clouds also moderate the alterations of temperature, by checking the radiation from the earth. The coldest nights are those which occur under a cloudless winter sky.

Rain is another of the consequences of the properties of water with respect to heat; its uses are the results of the laws of evaporation and condensation. These uses with regard to plants are too obvious and too numerous to be described. It is evident that on its quantity and distribution depends in a great measure the prosperity of the vegetable kingdom; and, as will afterwards be described, different climates are fitted for different productions no less by the relations of dry weather and showers than by those of hot and cold. "These alterations of fair weather and showers appear to be much more favourable to vegetable and animal life than any uniform course of weather could have been. To produce this variety we have two antagonist forces, by the struggle of which such changes occur. Steam and air, two transparent and elastic fluids, expansible by heat, are in many respects and properties very like each other. Yet the same heat, similarly applied to the globe, produces at the surface currents of these fluids tending in opposite directions. And these currents mix and balance, conspire and interfere, so that our trees and fields have alternately water and sunshine; our fruits and grain are successively developed and matured."†

It has been calculated that the quantity of rain which falls in England is thirty-six inches a-year, taking the average of the whole country. Of this it is reckoned that thirteen inches flow off to the sea by the rivers, and that the remaining twenty-three inches are raised again from the ground by evaporation. The thirteen inches of water are of course supplied by evaporation from the sea, and are carried back to the land through the atmosphere. Vapour is perpetually rising from the ocean, and is condensed in the hills and high grounds, and through their pores and crevices descends, till it is collected, and conducted out to the surface. The condensation which takes place in the higher parts of a country may easily be recognised in the mists and rains which are the frequent occupants of these regions. The coldness of the atmosphere and other causes, as already mentioned, precipitate the moisture in clouds and showers, and in both of these states it is condensed and absorbed by the cool ground. Thus a perpetual and compound circulation of the waters is kept up, it ascending perpetually by a thousand currents through the air; and descending by the rills and rivers, it again returns into the great and magnificent reservoir of the ocean,

In every country of our globe these two portions of the aqueous circulation have their regular and nearly constant proportion. In Great Britain the relative quantities, as before stated, are twenty-three and thirteen. A due destribution of these circulating fluids in each country appears to be necessary to its organic health; to the habits of vegetables, to all animals and to man. Drought and sunshine in one part of Europe may be as necessary to the production of a wet season in another, as it is on the great scale of the continents of Africa and South America, where the plains during one-half of the year are burnt up to feed the springs of the mountains, which in their turn contribute to inundate the fertile valleys, and prepare them for a luxuriant vegetation. Indeed, the properties of water with regard to heat make one vast *watering-engine* of the atmosphere.

CLIMATE.

Climate is the condition of the atmosphere as respects temperature, moisture, and other qualities affecting animal and vegetable life. No two places at a distance from each other can be said to possess the same climate, because each is subject to particular influences not affecting the other to the same degree. The warmest region of the earth is within 23½ degrees of latitude on each side of the equator all round the globe, because the earth in daily turning exposes that part more immediately to the sun In proportion as we advance from the equator towards the poles, the climate becomes more temperate and cool, yet in a very variable manner. Of two countries at an equal distance from the equator one will have a hot and another a cool climate, one dry and another moist. Climate, indeed, depends very materially on relative situation, and also on the nature of the country. The climates of Europe and America are very different under the same latitude.

From what has been already stated in reference to the diffusion and radiation of heat in the atmosphere, and also of the density of air at different heights, it will be inferred that climate depends on exposure to the sun's rays, and also on elevation. That district will possess the most genial climate which, during both summer and winter, lies most fair towards the sun, which is of only a moderate elevation, and is sheltered from cold cutting winds.—The more direct that the sun's rays strike the land, the stronger will be the heat; thus a sloping hill, which catches the rays for the greatest length of time throughout the entire year, will enjoy a better climate, other circumstances being equal, than a flat ground. So well is this understood in the grape countries on the Rhine, that the right bank of that river, which faces the sun, is reckoned to be much more valuable than the left, and it produces the finest wines. With respect to elevation, it is important to recollect, that as we ascend, the air diminishes in quantity. A person breathing at the top of Mont Blanc, draws into his lungs only half the quantity of air he does at the level of the sea. Vegetation is similarly affected at that elevation. Independently of the blighting effects of cold on high grounds, it is obvious that in these situations vegetation cannot possibly proceed with the same energy as in low-lying districts, for the plants are not allowed the same quantity of air.

Although a climate possessing a due proportion of moisture with sunshine is that best adapted for vegetation, it is surprising how grain crops will ripen in peculiarly wet climates, provided there has been a dry seed-sowing time, and the soil be open to allow the superabundant moisture to escape from the over-deluged

* From a MS. communicated. † Whewell.