change is small) takes its place; but as soon as the muscle is called upon to give out its proper form of energy, its evolution ceases.*

And on these same principles we shall be able to explain the fact that irritable men of sanguineous temperament, (that is, as I understand it, men the elements of whose tissues are in a less stable condition than obtains in other people) have more of this free electricity than others.†

Part III.

To pass now to the third and last division of the subject, namely, the nature of the influence of the physical forces, principally light and heat, upon the living plant or animal in the ordinary state of nature.

And first of heat.

All organized beings are dependent in a greater or less degree upon the temperature of the medium by which they are surrounded; but plants and cold-blooded animals are so to a much greater extent than warm-blooded, from the fact that in them the vital forces are not derived wholly from the chemical changes going on within them, but are in part, and sometimes in great part, obtained directly from this very temperature, and the light that usually accompanies it.

It would seem that in plants, though light by its action on carbonic acid and ammonia supplies them with a great part of their food: heat is the force which, by its passage through the living tissue being changed to vital force, has to perform in great part the assimilative and nutritive functions. I say in great part, for in the union of the elements that had been set free by the agency of light, some force must be evolved, though this from the feebleness of union in the bodies formed must be small in amount (Law I) I am free to confess that I am not very clear on this point in my own mind. And here a question (alluded to above) arises of great interest and importance. In those bodies as starch, sugar, lignine, cellulose, etc., etc., which constitute the great mass of plants, and in which hydrogen and oxygen are in the proportion to form water, and where they are derived from water, are they in any degree separated? that is, has the affinity exercised by them in water been weakened when they are combined with carbon to form these new bodies.‡ I have no doubt that this must be answered in the affirmative, and if so the result is obvious, we must have a force to effect this decomposition beyond the force that is evolved in the formation of the new body (Law IV). If then to supply any of these needs plants are dependent upon heat, as, to fulfil their other wants they are on light, it is clear that a certain amount of heat will be re-

* Carpenter's "Human Physiology" p. 425.

† Carpenter's "Human Physiology" p. 429.

‡ A carefully conducted experiment, such as I do not know has ever been performed would readily settle this question—for if the H and O are separated, as I suppose, a given quantity of dry wood would yield more heat in its combustion than would as much charcoal as there was carbon in the wood in its combustion; but if the affinity between them is not at all lessened it would yield less, for we should have to subtract from the amount of heat evolved by the carbon, the strength of the affinity existing between the H O and the C in the wood. Is it not the union of the oxygen and hydrogen in wood, forming water, without the participation of carbon in the combustion, that constitutes the main part of the process in the formation of charcoal by suppressed combustion?