to the animal, perhaps more beautifully displayed than from any other point of view. For the vegetable having received force from without, holds it in trust, as it were, for the animal kingdom; and in the use of vegetable food it is known that the animal does not raise the compounds contained therein to any higher state of combination than that in which it receives them—except in the case of hemato-fibrine, and perhaps a few other instances. To build up its nitrogenized tissues it receives albumen, fibrine, and caseine; for its adipose tissue it takes in fat, though it can also form this last from starch or sugar; its gelatinous and cartilaginous tissues are supplied from the albuminous bodies by a process of diminishing complexity, and so on.

But this is not of much importance, after all, for the result would be the same, namely, that on the one hand animals receive compounds of great complexity and of loose chemical construction; and on the other hand their excreta consist of chemical forms of great comparative, and some of great actual simplicity, between the elements of which there exists great strength of affinity, thereby furnishing the conditions (Law III.) for the evolution of vast quantities of force, which being directed into the proper channels by means of the various forms of cells, through which it acts, performs all the functions of the body.

But here, if this be granted, another difficulty will arise in most minds, which at first sight might seem almost insurmountable, for, it will be asked, is it possible that such an immense amount of power of various kinds, put forth by animals, can be derived from the decomposition of what seems to be the comparatively small quantities of food they digest? To illustrate this forcibly, I was once for five days and four nights exposed to a temperature of from zero or below that point to a few degrees above the freezing point: during this time I was supplied with no food, no artificial heat, and travelled every day on foot through deep snow from morning till night. Now, I ask, could the muscular force employed, the heat evolved, and the vis nervosa put forth (without speaking of other forms of force liberated in less amount), have been derived from the decomposition of the tissues lost during that time? I make no doubt that the reply must be in the affirmative.

The answer to this difficulty resolves itself into two distinct parts. 1. The consideration of the quantitative relations of the forces in question; and 2. The economic powers of animals compared to those of a machine of merely human contrivance.

1. In the first place it must be acknowledged that we know little, if anything, of the relations of quantity borne to each other, by the chemical force on the one hand, and the various forms of vital on the other. But if we could get the resultant of any vital force when it merges itself into one of the physical forces, this being better understood, could more easily be compared, and this, fortunately, we can do in the case of the muscular force which as motion we can measure; —and I think it may safely be granted that far more than half the force given off by the body takes this form, thus enabling us to make a fair rough approximation to the result we are seeking. For if the relationship which exists between motion and heat be recollected—that the motor force capable of raising 772 pounds one foot, is only equal to the heat required to raise one pound of