ANIMAL CHEMISTRY.—By PROFESSOR LIEBIG.

We shall occasional'y give selections from this most interesting work. We think it would be very desirable that agriculturists should make themselves acquainted with animal economy, and that it is a subject well deserving their study. We are not acquainted with any work better calculated to enlighten them on this subject than that of Liebig. The following extract is from PART I.:—

"Two animals, which in equal times take up by means of the lungs and skin unequal quantities of oxygen, consume quantities of the same nourishment which are unequal in the same ratio.

The consumption of oxygen in equal times may be expressed by the number of respirations; it is clear that, in the same individual, the quantity of nourishment required must vary with the *force* and *number* of the respirations.

A child, in whom the organs of respiration are naturally very active, requires food oftener than an adult, and bears hunger less easily. A bird, deprived of food, dies on the third day, while a serpent, with its sluggish respiration, can live without food three months and longer.

The number of respirations is smaller in a state of rest than during exercise or work. The quantity of food necessary in both conditions must vary in the same ratio.

An excess of food is incompatible with deficiency in respired oxygen, that is, with deficient exercise: just as violent exercise, which implies an increased supply of food, is incompatible with weak digestive organs. In either case the health suffers.

But *the quantity of oxygen inspired* is also affected by the temperature and density of the atmosphere.

The capacity of the chest in an animal is a constant quantity. At every respiration a quantity of air enters, the volume of which may be considered as uniform; but its weight, and consequently that of the oxygen it contains, is not constant. Air is expanded by heat, and contracted by cold, and therefore equal volumes of hot and cold air contain unequal weight of oxygen. In summer, moreover, atmospherical air contains aqueous vapour, while in winter it is dry; the space occupied by vapour in the warm air is filled up by air itself in winter; that is, it contains, for the same volume, more oxygen in winter than in summer.

In summer and in winter, at the pole and at the equator, we respire an equal volume of air; the cold air is warmed during respiration, and acquires the temperature of the body. To introduce into the lungs a given *volume of oxygen, less expenditure of force* is necessary in winter than in summer; and for the same expenditure of force, more oxygen is inspired in winter.

It is obvious, that in an equal number of respirations we consume more oxygen at the level of the sea than on a mountain.—The quantity both of oxygen inspired and of carbonic acid expired, must therefore vary with the height of the barometer.

The oxygen taken into the system is given out again in the same forms, whether in summer or in winter; hence we expire more carbon in cold weather, and when the barometer is high, than we do in warm weather; and we must consume more or less carbon in our food in the same proportion; in Sweden more than in Sicily; and in our more temperate climate a full eighth more in winter than in summer.

Even when we consume equal weights of food in cold and warm countries, infinite wisdom has so arranged, that the articles of food in different climates are most unequal in the proportion of carbon they contain. The fruits on which the natives of the south prefer to feed do not in the fresh state contain more than 12 per cent. of carbon, while the bacon and train oil used by the inhabitants of the arctic regions contain from 66 to 80 per cent. of carbon.

It is no difficult matter, in warm climates, to study moderation in eating, and men can bear hunger for a long time under the equator; but cold and hunger united very soon exhaust the body.

The mutual action between the elements of the food and the oxygen conveyed by the circulation of the blood to every part of the body is THE SOURCE OF ANIMAL HEAT.

All living creatures, whose existence depends on the absorption of oxygen, possess within themselves a source of heat independent of surrounding objects.

This truth applies to all animals, and extends, besides, to the *germination of seeds*, to the flowering of plants, and to the maturation of fruits.

It is only in those parts of the body to which arterial blood, and with it the oxygen absorbed in respiration, is conveyed, that heat is produced. Hair, wool, or feathers, do not possess an elevated temperature.

This high temperature of the animal body, or, as it may be called, disengagement of heat, is uniformly and under all circumstances *the result of the combination of* a combustible substance with oxygen.

In whatever way carbon may combine with oxygen, the act of combination cannot take place without the disengagement of heat. It is a matter of indifference whether the combination take place rapidly or slowly, at a high or at a low temperature; the amount of heat liberated is a constant quantity.

The carbon of the food, which is converted into carbonic acid within the body, must give out exactly as much heat as if it had been directly burnt in the air or in oxygen gas; the only difference is, that the amount of heat produced is diffused over unequal times. In oxygen, the combustion is more rapid, and the heat more intense; in air it is slower, the temperature is not so high, but it continues longer.

It is obvious, that the amount of heat liberated must increase or diminish with the quantity of oxygen introduced in equal times by respiration. Those animals which respire frequently, and consequently consume much oxygen, possess a higher temperature than others, which, with a body of equal size to be heated, take into the system less oxygen. The temperature of a child (102° C) is higher than that of an adult (95 5°).—That of birds (104° to 105 4°) is higher than that of quadrupeds (98 5° to 100 4°) or than that of fishes or amphibia, whose proper temperature is from 2.7° to 3.6° *higher than that of the medium in which* they life. All animals, strictly speaking, are warm-blooded; but in those only which possess lungs is the temperature of the body quite independent of the surrounding medium.

The most trustworthy observations prove that in all climates, in the temperate zones as well as at the equator or the poles, the temperature of the body in man, and in what are commonly called warm-blooded animals, is invariably the same; yet how different are the circumstances under which they live!

The animal body is a heated mass, which bears the same relation to surrounding objects as any other heated mass. It receives heat when the surrounding objects are hotter, it loses heat when they are colder than *itself.*

We know that the rapidity of cooling increases with the difference between the temperature of the heated body and that of the surrounding medium; that is, the colder the surrounding medium the shorter the time required for the cooling of the heated body.

How unequal, then, must be the loss of heat in a man at Palermo, where the external temperature is nearly equal to that of the body, and in the polar regions, where the external temperature is from 70° to 90° lower.

Yet, notwithstanding this extremely unequal loss of heat, experience has shown that the blood of the inhabitant of the arctic circle has a temperature as high as that of the native of the south, who lives in so different a medium.

This fact, when its true significance is perceived, proves that the heat given off to the surrounding medium is restored within the body with great rapidity. This compensation takes place more rapidly in winter than in summer, at the pole than at the equator.

Now, in different climates the quantity of oxygen introduced into the system by respiration, as has been already shown, 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 may be increased in the same ratio.

It is evident that the supply of the heat lost by cooling is effected by the mutual action of the elements of the food and the inspired oxygen, which combine together.—To make use of a familiar, but not on that account a less just illustration, the animal body acts, in this respect, as a furnace, which we supply with fuel. It signifies nothing what intermediate forms food may assume, what changes it may undergo in the body, the last change is uniformly the conversion of its carbon into carbonic acid, and of its hydrogen into water; the unassimilated nitrogen of the food, along with the unburned or unoxidized carbon, is expelled in the urine or in the solid excrements. In order to keep up in the furnace a constant temperature, we must vary the supply of fuel according to the external temperature, that is, according to the supply of oxygen.

In the animal body the food is the fuel; with a proper supply of oxygen we obtain the heat given out during its oxidation or combustion. In winter, when we take exercise in a cold atmosphere, and when consequently the amount of inspired oxygen increases, the necessity for food containing carbon and hydrogen increases in the same ratio; and by gratifying the appetite thus excited, we obtain the most efficient protection against the most piercing cold. A starving man is soon frozen to death; and every one knows that the animals of prey in the arctic regions far exceed in voracity those of the torrid zone.

In cold and temperate climates, the air, which incessantly strives to consume the body, urges man to laborious efforts in order to furnish the means of resistance to its action, while, in hot climates, the necessity of labour to provide food is far less urgent.

Our clothing is merely an equivalent for a certain amount of food. The more warmly we are clothed the less urgent becomes the appetite for food, because the loss of heat by cooling, and consequently the amount of heat to be supplied by the food, is diminished.

If we were to go naked, like certain savage tribes, or if in hunting or fishing we