

quired for any given amount of growth and development exhibited by the plant; that is, a quantitative relation must exist between the force supplied and the vital force put forth which depends upon it; and this is seen to be the case in the most striking manner, for according to Bousingault "the same annual plant in arriving at its full development and going through all the processes of flowering and maturation of its seed, everywhere receives the same amount of solar light and heat, whether it be grown at the equator or at the temperate zone, its rate of growth being in a precisely direct ratio to the amount it receives in any given time."

Very much the same thing is seen in the case of the lower cold-blooded animals though what is the nature of the relation existing here between the physical and vital force, I do not pretend to say; it may be that the former merely furnishes a necessary condition for the evolution of the latter from other sources; it may be changed into it directly; or again the heat may alter its form and becoming chemical force may so pass into the vital; be this as it may, the relation exists and is well seen in the case of the *Crustacea*. For 1, the variety of their form and organization (which may be regarded as so many varied manifestations of the organising force) increase as we pass from the polar seas towards the equator the number of species thus augmenting greatly as we go southward. 2. The differences of form and organization are not only more numerous and more characteristic in the warm than in the cold regions of the globe; but they are also more important. 3. Not only are those *Crustacea* which are most elevated in the scale deficient in the polar regions, but their relative number decreases rapidly as we pass from the equator towards the pole. 4. The average size of the *Crustacea* of tropical regions is considerably greater than that of the tribes inhabiting frigid or temperate climates. 5. It is where the temperature is most elevated that the peculiarities of structure which characterize the several groups are most strongly manifested. And 6. There is a remarkable coincidence between the temperature of different regions and the prevalence of certain forms of *Crustacea*.\*

The rate of performance of their functions in cold-blooded animals depends much upon the temperature in which they live. Now as the respiratory process is an exponent of the rate of life of any animal, that is of the rate of chemical change taking place in the organism, it follows from the above that should this be stopped, the length of life of the animal will be in the inverse ratio of the temperature to which it is exposed; and so we find it, for when frogs were confined in a limited quantity of water and not allowed to come to the surface to breathe

|              |                  |                    |      |
|--------------|------------------|--------------------|------|
| They died in | 12 to 32 minutes | when the water was | 90°  |
| "            | " 35 90          | "                  | " 72 |
| "            | " 350 375        | "                  | " 50 |
| "            | " 367 498        | "                  | " 30 |

At the lowest temperature mentioned the prolongation of life was not due to torpidity, for all the functions of the animal were performed, but slowly. †

\* Milne Edwards "Histoire des Crustacés" tome iii pp. 555 et. seq. quoted by Carpenter in his article in Phil. Tran. 1850.

† Dr. F. W. Edwards "On the influence of physical agents on life."