These were built up almost exclusively of small globigerine shells, and still more minute calcareous debris cemented together. Two or three such tubes were found by me in each of these soundings; but I failed to extract the animals from them in a sufficiently perfect condition to admit of identification. I am nevertheless able to state positively that the tubes contained some species of Annelid, and think it is highly probable that certain borings, to be seen on foraminiferous shells in the same deposits, may have been effected by it. But whether this be the case or not, it is quite clear that an Annelid lives at the depths indicated, and there builds up its tenement."

At 682 fathoms Dr. Wallich met with a Serpula, and a cluster of apparently living polyzoa, and also a minute living Spirorbis. From a depth of 445 fathoms he fished up a couple of living "amphipod Crustaceans," and a "filamentous Annelid," and when we consider how these creatures could accommodate themselves to such localities, we have to take into account the "extraordinary fact that the *Ophiocomæ*, the *Serpula*, *the Spirorbis* of the deep soundings,—one and all belong to well-known littoral species." From these facts Dr Wallich observes: "We are irresistibly led to the inference that their acclimatizat. must have kept pace, during a vast sequence of generations, with the changes going on in the portion of the sea bed inhabited by them, and hence that, under sufficiently favourable circumstances, species may accommodate themselves to conditions differing so widely from those under which they were originally created, that their subjection to them, under circumstances less favourable, inevitably results in their extinction."

From what is known of deep sea life, we should be cautious in pronouncing judgment upon the far deeper portions of the ocean bed than our investigations have yet reached. There may be, probably is, a limit to the descending zones of life, but where it lies, seems rather for experiment than for deductive reasoning to tell. The more immediate question for solution is, how the creatures that have been discovered manage to live, under circumstances differing so widely from those in which we are accustomed to trace the mutual relations and dependance of animal and vegetable forms. Vegetable structures have not been found alive at greater depths than 2400 feet, while animals are now known to exist at 15,000 feet below the surface level. If any sort of plant lives much below the above-mentioned depth, it must perform its functions without the stimulus of light; and if animals exist far below the regions of vegetable life, they must be released from that dependance upon the latter, which we have been accustomed to regard as an universal law. Such are the interesting problems which the marine zoologist has to solve.

The pressure of great depths only opposes itself to life under peculiar forms. At a depth of a mile it amounts to 2640 lbs. on every square inch, or 160 times as much as we have to sustain on the surface of the globe A close vessel would need immense strength to resist anything of the kind, but if the pressure from within can equal that from without, its physical force would not necessarily destroy any organism exposed to its effects. Dr. Wallich judiciously indicates the difference between certain well-known experiments and the conditions under which deep sea creatures live. Thus, "in the case of pieces of wood and meat, and corked bottles containing air, which have been sent down to great depths, in order to demonstrate the effects of pressure, it is evident that precisely those conditions are present which are never to be met with in creatures constituted to live under it. In short, they prove too much; for they prove clearly that, in defiance of all obstacles, a state of equilibrium is rapidly engendered between the interior and the exterior of the wood, the mutton, and the bottles, and that whensoever this takes place no further change is experienced. If suddenly submerged, that is to say, before the pressure has time to overcome the resistance of the cellular and fibrous tissues of the two first, and of the earth employed in the last, diminution of bulk and consequent compression of the structure must inevitably result; but, on the other hand, if the submergence be gradual, the diminution in bulk is by no means a necessary consequence, and the change brought about is a simple displacement of a lighter medium by a heavier, according to a well known law of fluids." This is no doubt right in principle, but scarcely correct in detail, as all portions of an organism may not be thus permeable, and those which the heavier fluid cannot penetrate, must be subject to the pressure which it exerts on all sides. It will, however, be admitted without difficulty, that marine animals like the starfishes or the annelids of Dr. Wallich's dredgings would not be injured by the weight of water, if gradually submerged; and having disposed of one difficulty of deep sea life, let us turn to another, in which the function of respiration is concerned.

Some valuable experiments on board the French ship "Bonité" give us an insight into the quantity of gaseous matter existing in the water at different depths, which appears, within the limits investigated, to increase as the surface is left behind. From these investigations, and on other grounds, Dr. Wallich concludes that "since the tendency of fluids to absorb gaseous bodies is constant under all circumstances, although, as already stated, the quantity they are capable of appropriating increases with the pressure, it follows that the deeper the stratum of water, the greater must be the amount of gaseous matter held in solution by it." But the ocean is not a closed vessel, in which the liquid and the gas are squeezed together without possibility of escape, and if water at a mile down contains more air than the strata above it, the effect must be produced by the operation of a powerful attraction increasing with the compression and depth, so that every layer of water drags the air from the layer above it, and is in turn robbed by the stratum beneath itself. This may be so, but we do not think it is proved to be the case, in an increasing ratio throughout all depths. The "Bonité" experiments were not conducted at great depths, the greatest being only 2243 Paris feet. They seem however to show that, while the quantity of nitrogen is diminished as the pressure is augmented, that of carbonic acid and oxygen is considerably increased, and might accumulate to a deleterious extent if it were not rendered innocuous by the constant formation of carbonate of lime.

Within considerable limits of downward range, we may conclude from the preceding facts, that deep sea creatures are provided with the means of breathing in water, in the same way as their similarly organized inhabitants of the ocean nearer the surface level; but how do they feed? The starfish may devour the humble creature that inhabits the foraminiferous shell, but what is the latter to do when dinner-time comes? Dr. Wallich admits the difficulty of furnishing an answer without appealing to a process of nutrition for which he says there is no acknowledged precedent. It is the custom of scientific men, upon insufficient evidence, and in the face of well-known facts, to assume that no animal can assimilate inorganic matter that has not previously been brought within the vital circle by vegetable forms. Dr. Wallich conjectures that if the Protozoa can separate from the water the carbonate of lime to form their shells, they may also be able to make a similar direct use of other inorganic materials to serve as food. It is certainly, as he says, in vain that we attempt to establish a definite line of demarcation between the two kingdoms of nature, and although some philosophers still "stand upon the ancient ways," the majority are disposed to surrender the notion that the lowest living forms can be distinctly divided into animals and plants. Further researches may show more clearly the gradations by which animal and vegetable characteristics are blended together; but if respiration enables the animal to assimilate the oxygen of the air, and, through the introduction of salts of iron, into the stomach, that metal finds its way into the blood, the first link of the chain of connection is found in the highest forms of animated being.

The geological importance of Dr. Wallich's researches is very great, as strata cannot now be considered to have been formed in shallow seas, *merely* on account of their containing the remains of animals that we are accustomed to associate with moderate depths, nor are the biological aspects of the new truths less singular and instructive. From *à priori* reasoning it might have been imagined that if, through long ages, a littoral species of an animal so highly organized as a starfish had become acclimated to totally different conditions of depth, pressure, darkness, and aeration, it would also have undergone constitutional changes that would have been reflected in its structure, but no such alteration seems to have taken place in the subjects of Dr. Wallich's investigation. We inquire whether the deep sea ophiocomæ which belong to a littoral species were themselves in earlier life the occupants of shallower waters, and made a voluntary or involuntary migration to the depths below; or whether they were the born children of the abyss, the lineal descendants of some pilgrim fathers of their race whose wanderings date back to the period when changes of level and in the distribution of land and water necessitated an alteration of their abode. The *Ophiocoma granulata* appears to be a creature of determined adhesion to a particular type. It ranges from the confines of the Arctic circle to the British shores, able to make itself at home from ten fathoms to 1260, and in either of these extreme conditions, or in any of their intermediaries, to rear a family for the perpetuation of its name.

No similar adaptability seems to belong to any member of the vegetable world. Dr. Wallich met with no proper Algæ below two hundred fathoms, and his deep sea dredging only yielded Diatoms whose frustules "indicated a molecular condition of the