

tion of gases through stomata and lenticils is given in lecture V. It has long been known that under certain conditions some plants absorb oxygen: this is most markedly true of fungi; and Professor Vines states (p. 76) that it appears that the power of absorbing this gas is possessed by all plants, sustaining this conclusion by the experiments of Wolkoff and Mayer on seedlings, those of De Saussure, Oudemans, and others on germinating seeds, and of De Saussure on many flowers. It also appears, that, if roots are not supplied with oxygen, the plant soon becomes unhealthy, and ultimately dies. Portions of plants which contain chlorophyl abundantly, absorb oxygen in darkness, while this is given off during their exposure to sunlight. All green portions absorb carbonic acid in sunlight. Ammonia also is taken from the atmosphere, as has been shown by Ville; but free nitrogen is apparently not thence absorbed, the presence of this gas in the cell-sap being accounted for by its solubility in water.

Lecture VI. is on the movement of water in plants. A very clear account of this phenomenon is given, the circulation being regarded as passing mainly through the cell-walls of the lignified tissues. Transpiration, or the exhalation of watery vapor from the leaf surfaces, is treated of in the seventh lecture, and the food of plants in the eighth.

The next six chapters are devoted to the metabolism of plants,—the changes which materials undergo in the tissues under the influences of light, heat, chemical affinity, etc.; and these are perhaps the most valuable parts of the book. Here the discussion begins with the consideration of the formation of non-nitrogenous organic substances, principally starch; then that of nitrogenous substances, collectively termed 'amides,' and of the function of chlorophyl, which is concisely stated to "absorb certain rays of light, and thus enables the protoplasm with which it is intimately connected to avail itself of the radiant energy of the sun's rays for the construction of organic substance from carbonic acid and water." A summary of what is now known of the metabolic processes is admirably stated on pp. 325-328; and an instructive table, showing the income and expenditure of matter and energy, is given. The energy is entirely referable to the absorption of light by the chlorophyl, and to heat.

Lecture XV. is devoted to the phenomena of growth; and the following six chapters, to irritability, which is thus minutely described, and the forces inducing its manifestation fully discussed. In the last two chapters the subject of reproduction is treated; and here may be found a *résumé* of present knowledge of the development

of spores and seeds in the various divisions of the vegetable kingdom, the phenomena of hybridization, of parthenogenesis, and of variation. The closing sentence is, "Evolution is no longer a matter of chance, but is the inevitable outcome of a fundamental property of living matter."

At the close of each chapter of this most valuable book, copious references to the bibliography of the subjects treated are given; but, for some reason not apparent, these are only to the works cited, and, except in a few instances, not to pages. Had these been added, it would have greatly facilitated the work of students who desire to pursue the study further. A very extensive index, arranged not only by subjects, but also by authors quoted, is appended.

CHALLENGER REPORTS.

THE Challenger cephalopods were at first placed in the hands of Professor Huxley, whose numerous engagements finally obliged him to decline the work, with the exception of a special investigation into the genus *Spirula*. Mr. William Evans Hoyle, who was intrusted with the work by Mr. John Murray, has devoted the report now under consideration chiefly to systematic work, but expresses his intention of preparing a supplementary article on the anatomy of those specimens which are available for this purpose. He alludes to the fact, that, since the return of the Challenger, marine explorations have been so energetically prosecuted, that no less than five genera, new when obtained by the Challenger, have since been described from the collections of the U. S. steamers *Blake* and *Albatross*, etc. Mr. Hoyle has been favored with the assistance and friendly advice of Professor Steenstrup, and has compared with the specimens of the fine collection at Copenhagen all the critical Challenger species, thus insuring a double authenticity for the determinations of the report. The latter commences with an excellent synopsis of the species of recent cephalopods, with references to the places where they are figured and described. The Challenger collection contains seventy-two species of thirty genera. Of these, thirty-two species and four genera were new to science. For one of these, *Amphitritus*, possessing the unique feature of having the mantle fused with the siphon in the median line, so as to form two openings into the branchial cavity, a new family has seemed necessary. None of the giant squids were obtained; as, indeed, the means for capturing such animals in their native haunts have not yet been devised,

Report of the scientific results of the exploring voyage of the Challenger. Vol. xvi.: Zoölogy. London, Government, 1886. 4°.

those observed or recorded by naturalists being without exception in an invalid condition or cast dead on the shores. With regard to the distribution of the species in depth, there are great difficulties in the way of deciding whether the specimens came from a given depth or not. Circumstances seem to indicate that Cirroteuthis, probably Bathyteuthis and Mastigoteuthis, and perhaps one or two species of Octopus, may be reckoned as abyssal forms. But no structural features appear to have been discovered by which a species may be definitely asserted to be a deep or a shallow water animal. This agrees well with the conclusions drawn by others from a study of the deep-sea mollusks of other classes. A full discussion of the geographical distribution of the class gives completeness to the report. In the discussion of genera and species, Mr. Hoyle has the courage of his opinions, and freely criticises where the circumstances seem to him to warrant it, but his tone is uniformly courteous. His report may be heartily commended.

The Stomatopoda are crustaceans related to the common Squilla of our southern and eastern coasts, and are restricted to shallow waters. Prof. W. K. Brooks remarks that when he examined the Challenger collection, consisting of only fifteen species, his first feeling was of disappointment, since the types seemed all familiar. But after a more thorough examination, this gave way to a lively interest, since it appeared that the material was such as to enable him to trace the ancestry and development of this small and compact order with great completeness. The Squillidae have a very long larval life, and are found at the surface of the sea, where the currents carry them vast distances; so that some of the species have a nearly world-wide distribution. The larvae are among the most elegant of the immature crustacea found in the tow-net, and naturally excite great interest among the naturalists who capture them. But the young stages do not thrive in confinement, the eggs seem dependent on the parent for suitable conditions up to the time of hatching, and so the connection of the isolated links in the chain of life of any given species has been a task of great difficulty. The very numerous larvae contained in the Challenger collection, and the indefatigable application of Professor Brooks to the problem, have enabled him to add materially to the knowledge of the group, and to smooth away many difficulties for subsequent students. According to the author, the Challenger collections "enable us to determine, with much greater certainty than before, the larval type which pertains to nearly every one of the genera of adult Stomatopoda, and also to give a pretty complete picture

of the developmental history of each larval type."

The collection of reef corals made was a large and important one, there being representatives of two hundred and ninety-three species, referable to sixty-nine genera, and by series large enough in many cases to afford an instructive idea of the very considerable range of variation within a species. Of the whole number, about one-fourth were new. Of the seventy-three new species, seventy-one were obtained in the Pacific, and two in the Atlantic, which illustrates fairly well our comparative knowledge of the two chief coral regions. Of the sixty-nine genera, eight are new, all from the Pacific. The report is confined to a description of the hard parts, the material for anatomical purposes being otherwise disposed of by the authorities. In the generic grouping, Professor Verrill's revised list of Dana's zoöphytes, contained in the 'Corals and Coral Islands,' has been followed, with certain amendments as to species. Much use has been made of Professor Moseley's field notes as to the habitat and environment of the corals. A detailed list of the species from each locality has been given, which it is hoped may serve as a basis for a knowledge of the distribution of the reef corals. In classification, Mr. Quelch has mainly followed Duncan for the Madreporaria; but in the Rugosa the occurrence of *Moseleya latistellata* has led the author to apply a new treatment, which he anticipates will lead to some discussion. This remarkable species is directly and closely related to the most typical Cyathophyllidae, while at the same time it presents undeniable astraeid characters. It must be looked upon as one of the most remarkable types of structure brought to light by the Challenger. It occurred at Wednesday Island, Torres Strait, in eight fathoms. The discussion of distribution, areal and bathymetric, is very interesting. The Atlantic reef coral fauna is sharply separated from that of the Pacific and Indian Oceans. The distribution in depth is greater than formerly supposed, two species reaching to seventy fathoms, though it is tolerably certain that the zone of most active growth does not extend much below twenty fathoms. The thermal limit of 68° F., which is doubtless the limit of active reef-building, does not, as formerly was believed, confine the existence of the reef-building species. *Manicina areolata* was obtained at the Cape in water of the temperature of 65°, and *Madrepora borealis* is said to inhabit the cold waters of the White Sea near Archangel, Russia. On this point we confess to some scepticism, until at least a second specimen is obtained; that in the Paris museum, still unique, dating from

1829. Certain corals have been observed living in brackish or even nearly fresh water, others in the mud about the mangrove roots, and one species seemed to suffer little from exposure at low tide to the sun and air. The statement of Edwards and Haime, that a species of coral common in the Red Sea is found in the Dead Sea, is another matter which will bear renewed examination. The report supplements in a satisfactory manner the valuable work of Professor Moseley, and will add materially to the reputation of its author.

This valuable contribution to comparative osteology ('Report on the human crania and other bones of the skeleton,' part ii., by Sir William Turner) is largely devoted to the discussion of the pelvis. The characteristics of the black races differ among themselves as well as from those of the European type, which, as by far the best known, is adopted as a standard of comparison. In most of the negroids the conjugate diameter is long compared with the transverse, and the height increases. In the negroes and Tasmanians these characters are less pronounced compared with Europeans. In nearly all the black races the average length of the sacrum is greater than its average breadth, contrary to what occurs with white races, and, in so much, more like a tail. The lumbar curve in the black races, as derived from the vertebrae alone, is concave forward; the clavicle may be longer in proportion to the humerus than with the whites; the scapular index is apparently higher, except with the Bushmen and Australians, while in the Tasmanian it may have been distinctly lower; the radius and tibia are longer in relation to the humerus and femur; the shaft of the upper limb is proportionally shorter than that of the lower limb. In general, racial characteristics appear in the skeleton as well as in the skull. Among existing races osteological characters may be found similar to those of the most ancient known remains; and the differences which exist between the bones of primitive people are no more, in kind or degree, than are to be seen in corresponding parts of men of the present day.

AGRICULTURE IN MICHIGAN.

THE Michigan board of agriculture is likewise the governing body of the Michigan agricultural college, and considerably more than half of its twenty-fourth report relates to the latter institution. The general report of the secretary is followed by the inaugural address of the new president, Hon. Edwin Willits, and the reports of the

Twenty-fourth annual report of the secretary of the state board of agriculture of the state of Michigan, 1884-85. Lansing, State, 1886. 8°.

president and professors upon the work of their several departments. This, in most cases, is of a twofold character, — instructional and experimental. Of the instructional work it is hardly necessary to speak, further than to say that it follows the modern methods of teaching the physical sciences, and that, as is well known, ample facilities are provided in the way of laboratories, apparatus, farm, garden, park, etc.

The experimental work of such an institution is necessarily subordinated to the work of instruction; and, while valuable experiments have been made, the college by no means takes the same high rank as an experiment-station that it does as a college. In this connection we note that President Willits, in his inaugural, speaks of the Hatch bill, now pending in congress, as a bill "to make all the agricultural colleges experiment-stations." If this is the intent of the bill, it were better left to slumber in committee of the whole. We certainly shall not look for great good from its passage, if the theory prevails that the professors of an agricultural college can successfully conduct an experiment-station in their leisure moments with an income of fifteen thousand dollars per annum.

AN ingenious gentleman of Evanston, Ill., has succeeded in applying the principle of the injector to a grain-elevator. The grain is run from the car to a revolving hopper, through an aperture in the bottom of which is forced a powerful blast of air, which carries the grain a certain distance up a horizontal tube. At intervals in this tube are bends, or horizontal curves, forming relays. These relays act as auxiliary hoppers, a fresh blast of air being admitted at each one, which carries the grain to the next higher relay. In this way the grain may be raised to any desired height. A modification of this device is arranged to raise grain from the hold of a ship or boat.

— A new method of manufacturing illuminating-gas from crude petroleum consists in conducting a stream of the petroleum to a moderately heated chamber, thereby producing vapor and liquid, and then separately conducting the vapor to decomposing-retorts heated to a certain temperature, and at the same time conducting the liquid portions to decomposing-retorts heated to a higher temperature, whereby the respective products are decomposed, and converted to permanent gas, without overheating either portion.

— An Austrian electrician named Marcus is supplying the German navy with a newly invented petroleum-engine for torpedo-boats. The engine is set in motion by electro-magnetism, and is more powerful than a steam-engine of the same size.