country full of lakes, swamps, and rivers, a dead flat in some places, in others undulating, even hilly. This was the true Siberian tundra, brilliant with flowers, swarming with mosquitos, and full of birds. In sheltered places, dwarf willows and weeping birch were growing, and (we were only some fifty versts from the forests) here and there a few stunted larches. Winding through the tundra was the track of what had once been the bed of a river, nothing now but a small deep valley forming a chain of isolated lakes and pools. * * * On some of the northern slopes, large patches of snow were still lying."

"The history of animal and vegetable life on the tundra is a very curious one. For eight months out of the twelve every trace of vegetable life is completely hidden under a blanket, six feet thick, of snow, which effectually covers every plant and bush—trees there are none to hide. During six months of this time at least, animal life is only traceable by the footprints of a reindeer or a fox on the snow, or by the occasional appearance of a raven or a snowy owl, wandering above the limits of forest growth, where it has retired for the winter. * * * Then comes the south wind, and often rain, and the great event of the year takes place; the ice in the great rivers breaks up, and the blanket of snow melts away. The black earth absorbs the heat of the never-setting sun; quietly but swiftly vegetable life awakes from its long sleep, and for three months a hot summer produces a brilliant alpine flora, like an English flower garden run wild, and a profusion of alpine fruit, diversified only by storms from the north, which sometimes for a day or two bring cold and rain down from the Arctic ice.

That the tundra is the former bottom of the Arctic ocean seems to us to be proved by the shallowness of the Arctic sea north of Siberia as shown by Nordenskiöld's map, also by the presence of hills of shells found by Seebohm, at least 500 feet above the sea, belonging to species still living in the Arctic ocean, the fossils occurring near or in a bluish, sandy clay. Space is not left us to speak of Seebohm's discoveries regarding the migrations of birds in Siberia, and the new facts he discovered regarding their hybridity and nesting habits. The volume will supplement Nordenskiöld's narrative.

WINCHELL'S WORLD-LIFE.[1]—The mode of formation, growth and decay of the worlds that people the universe is the loftiest theme upon which the human mind can exercise itself, but from its very loftiness is one upon which, as Professor Winchell would himself be one of the first to admit, certain knowledge has not yet been attained. When rival theories dispute for precedence, or

[1] *World-Life or Comparative Geology.* By ALEXANDER WINCHELL, LL.D., Professor of Geology and Palæontology in the University of Michigan. Chicago, S. C. Griggs & Co., 1883.

when a generally accepted theory has been weakened by the presentation of an array of objections, he does much for science who shows that these objections, valid perhaps against the first crude form of a theory, do not really invalidate it, though they may render necessary some modification and addition. This is precisely what Professor Winchell performs, in this ably written volume, for the well-known nebular theory of Laplace, which has of late years been attacked by a series of objections, such as the existence of retrograde motions; the length of the periodic times of the planets, which have been stated to be in some cases longer, in others shorter than the nebular theory allows; the absence of an adequate cause for rotary motion; the want of coincidence in the planes of the planetary orbits, their ellipticity, and their distance from each other. To these objections are added others based upon the relations of the planetary masses and densities; the geologist's objection that his science shows that more time than the nebular theory allows has been occupied by the earth in arriving at its present condition; and various others based on the relations of comets, stars and nebulæ.

Without disputing that these objections are fatal to the idea of nebulous matter contracting into rings, and ultimately into worlds without the intervention of any disturbing force, Professor Winchell seeks to modify the theory by finding the resisting force which, though it permitted the phenomena of the solar system to accord as a whole with the requirements of Laplace's theory, yet induced numerous deviations and eccentricities. The hypothesis of a regularly distributed ethereal medium is evidently insufficient, but the existence of cosmical dust, unevenly distributed, since it is in numberless positions tending towards aggregation, is by our author believed to furnish a cause for the observed deviations from regularity.

The first chapter treats of this cosmical dust, or meteors, the zodiacal light, comets, the Saturnian rings, and nebulæ of various kinds. The universe is supposed to be everywhere pervaded with the crude material out of which worlds are formed, and the ideas of Newton, Humboldt, Williams, and Siemens are reviewed. Then follows the theory that swarms of small masses of dark matter, circling in numberless orbits, and in all directions about the principal bodies of the solar system, but especially about the sun, must be in frequent collision with the planetary bodies, and must thus accelerate their motions and shorten their periods. This idea of cosmical matter (not ether) as a resisting medium, accounting for the eccentricities of planetary orbits, the want of coincidence between the planes ofthe equators of the planets, and between the orbit and equator of the same planet, for acceleration, and for irregularities in the movement of comets, is claimed by Professor Winchell as not yet trite, if not entirely new. The work embraces numerous other novel suggestions which bridge over

difficulties that others have magnified. At pages 111–113, reasons are given why, in a contracting, rotary spheroid, "an annular mass of relatively considerable amount would separate, and a secular interval would intervene before the separation of another annular mass." This ring would be completed when the centrifugal force at the equator exceeded the centrifugal force plus the attractions of the separated ring. At page 121–3 the causes of the rotation of the mass derived from a ring, and those which influence its direction, are treated of. In treating of the general cosmogonic conditions of a cooling planet Professor Winchell appears to coincide with the theory which would make the center of the earth solid; he gives reasons why "sub-meridional trends" should be early established upon a cooling globe, so that all the *primitive* wrinklings of the crust should extend across its parallels; explains the craters of the moon by the tidal outflow of molten matter; and gives reasons for believing that planetary tides cause the development of much heat. The floor of the primitive ocean had, says our authority, an igneous origin, but it no longer exists on this earth, having been destroyed by sedimentation from above, and by fusion from below. Professor Winchell supports the older theory of a shrinking globe and a wrinkling crust, against the objections of LeConte, Dutton, Fisher, and others.

The present condition and cosmogonic history of the planets are next treated of, commencing with the earth. It is here suggested that "the tidal deformations of the earth's crust may be the source of the internal heat which manifests itself in fluidity," and farther on Professor Winchell considers the probable effect of tidal action upon other planets. Mars is said to have lost all water and atmosphere; Venus to have a planetary history not greatly divergent from that of the earth, and probably an atmosphere admitting light aud heat to about an equal extent with that of the earth; and Jupiter to be still lingering in the high thermal stages of planetary life. The next chapter treats of planetary decay, of the final disappearance of the continents beneath the ocean by the operation of erosion and the cessation of elevatory forces, and of ultimate planetary death from refrigeration and other causes. In the third part the systems outside of our own are dealt with. Eruptive action on an incrusted globe is spoken of as the most probable cause of variable and temporary stars. In the last part the speculations of the great philosophers, of Kepler, Descartes, Leibnitz, Swedenborg, Wright, Kant, Sir W. Herschel, Laplace, are brought together and compared. It is shown that the conceptions of unorganized homogeneous matter (chaos), and of a vortical movement existed from the dawn of Greek philosophy, but that the dynamical principles of the solar system were settled by Newton and the great mathematicians of the eighteenth century, while the etailed theory of world-formation is principally due to

Laplace and Kant. The book is written by an earnest thinker for the use of earnest thinkers, by whom, even if not in all points agreed with, it will be held in high esteem.

DOBSON'S MONOGRAPH OF THE INSECTIVORA.[1]—The well known and able author of a "Natural History of the Chiroptera" has in this monograph, two of the three parts of which are now issued, extended his labors to the more complicated group of the Insectivora. His classification is, ostensibly, founded upon Peters, Mivart, and Gill, and recognizes two sub-orders, one of which (Dermoptera) contains the flying lemur or Galeopithecus, while the other (Bestiæ), includes all other insectivores. The Bestiæ are ranged in two groups and five super-families, viz: Tupaioidea, Erinaceoidea, Soricoidea, Centetoidea, and Chrysochloridea. The Tupaiidæ and Macroscelidæ are ranged in the first super-family; the Talpidæ and Soricidæ in the third; the Centetidæ, Solenodontidæ and Mythomyidæ in the fourth. The other super-families contain but a single family each. The Erinaceidæ are selected to commence the study of the order, on account of the fact that they afford the largest species to be found in the first three super-families which form the first group, and are characterized by molars with broad W-shaped crowns. The Centetidæ, equally typical of the second group with V-shaped molar crowns, and also of large size, follow the true hedgehogs. Two species of Gymnura are recognized, viz: *rafflesii* and *suilla*, the latter differing mainly in the shortness of the tail, and in its smaller size. Of Erinaceus nineteen species are enumerated, nine of which are African, while all the others occur in Asia, and one only in the Palæarctic region in both Europe and Asia. The six genera of Centetidæ contain but eight species, all Madagascan, though *Centetes ecaudatus* is found also in the Comoro islands, and also in Bourbon and Mauritius, in which islands it has probably been introduced. The sub-family Oryzorictinæ contains only *Oryzorictes hova*, a species at present known by two specimens in the Paris Museum. Microgale with two species, and Geogale with one, are recent additions to the Centetidæ. Although *Solenodon cubanus* is enumerated as distinct from *S. paradoxus*, it is allowed to be so closely allied that additional material may prove it a local variety. Nothing is known of the habits of this genus in its wild state. *Mythomys velox* is still the sole and little known example of its family, which differs from Centetidæ and Solenodontidæ in the absence of clavicles, and has the crowns of the molar teeth intermediate between the V-shaped ones of these families and the W-shaped ones of Talpidæ. From its large, laterally flattened fish-like tail, it is evidently a good swimmer, as stated by Du Chaillu.

[1] *A Monograph of the Insectivora, Systematic and Anatomical.* By G. E. Dobson, M. A., F. R. S. Parts I and II. London, J. Van Voorst, 1882–83.