fested by the plant which was supplied with uric acid. Whether this is more than accidental is worthy of study.

From these experiments the writer concludes that the amids resulting from the disorganization of protein compounds, as well as ammonia salts and nitrates, are capable of direct passage into the plant, and there serve for the reorganization of albumen, &c.

Cameron, in the investigation alluded to, remarked that his results demonstrate that it is not necessary that urea should decompose into carbonate of ammonia in order to become available to vegetation, and the above facts warrant the generalization that all the amids existing in the urine of animals are ready for assimilation, without any further resolution by decay. So far as they are directly concerned, then, any "fermenting" of manures of which they are ingredients is useless.

Oct. 1865.

ART. VI.—*Results of observations on the Drift Phenomena of Labrador, and the Atlantic coast southward;* by A. S. PACKARD, Jr., M.D.

THE whole surface of Labrador has passed through a denudation of great extent by continental glaciers. In the southern part of the peninsula, bordering on the gulf of the St. Lawrence, the glaciers evidently moved southward down the slope from the water-shed in the interior. On the eastern or Atlantic coast, at both sides of the mouth of Hamilton Inlet, which is forty miles wide, there are glacial lunoid furrows, like those observed in Maine by Dr. DeLaski, which tend to prove by their direction that a glacier forty or fifty miles in breadth filled this great fiord, and moved in an easterly direction from the water-shed in the interior, thence debouching into the sea.

Owing to the powerful disrupting agency of the frost and ice, the rounded and denuded rocks of Labrador have as yet revealed but few glacial striæ. The distribution of the boulders is restricted to the higher levels of the plateau. To find them in any abundance, it is necessary to ascend 500 to 800 feet above the sea, at which point they occur in profusion. Below this point they have been rolled, rounded, and rearranged into ancient sea beaches. But on the smooth polished quartzites and syenites, the former of which are levelled into broad plains grooved and furrowed and afterward polished almost like glass, with shallow depressions, being glacial troughs filled with water and forming countless pools, and on the rounded syenitic hills which assume dome-like or high conical sugar-loaf forms, we see everywhere in Labrador, below a level of 2000 feet, the traces of ancient glacier action exhibited on a vast scale.

At the close of the Glacial epoch the moraine matter was reassorted into marine deposits, which in this country have been exposed to a general and sweeping denudation. Only small patches are found remaining in sheltered positions. These marine deposits consist of finely laminated clays resting upon coarser, more stony, and gravelly beds. The former were evidently estuary deposits, the latter thrown down in deeper water, where the strong Arctic current prevailed. The oldest beds are the coarser strata, which, as in Maine, occur at high-tide mark. The more recent beds occur from ten to twenty feet above the sea level.

The fossil Invertebrata, found abundantly in these beds, afford excellent material for comparison with the present marine fauna of Labrador, and throw new light on the distribution of marine life during the close of the Glacial epoch. The assemblage is thoroughly Arctic in character, but, when compared with lists of the glacial shells of the north of Europe, it is found to bear a very distinct *facies*. It is evident that on each side of the Atlantic, the same faunal distinctions obtained during this period as now. There was, however, a greater range in space of purely Arctic species, and, though the European marine fauna was much more closely allied to our own, owing to the great predominance of exclusively Arctic forms, it is yet evident that the Arctic glacial fauna was divided into a Scandinavian district, and a Labrador district, each the metropolis of a small number of species peculiar to itself and limited to its area.

The assemblages found at various points along the coast from Labrador to Maine are not the exact equivalents of the present faunæ. They differ in containing a very small percentage of extinct species, and in a different grouping of species still living.

Thus, in the Labrador beds are several species of *Fusus* (Sipho) which differ from recent Arctic forms, and also a species of *Bela;* certain forms, such as *Panopœa* and perhaps *Cyrtodaria*, which were abundant formerly, seem to be dying out at the present day. In Maine the change is still more marked. Thus, the most characteristic shell of the marine clays is *Leda truncata* (*Portlandica*), which has wholly disappeared from the seas south of the circumpolar regions, unless future deep-sea dredging reveals its presence in some of the abysses off our coast. An undescribed *Macoma* is also characteristic of the beds about Portland; and other important changes have occurred in the relative abundance of species, and the manner in which they are grouped as compared with the present assemblages in zoological districts farther north, and similar in physical surroundings to the glacial seas.

The Labrador district of the Arctic fauna, instead of being restricted as now to the eastern coast of North America from the Arctic archipelago to the banks of Newfoundland, and shading

off into the Acadian district at the present line of floating ice, during the Glacial epoch extended up the St. Lawrence river, and as far as Portland, on the coast of Maine, where it shaded into a more southern assemblage.

In Maine there are two distinct horizons of life. The lowest and oldest is found at the bottom of the boulder-clay at high-tide mark along the coast. The second horizon is composed of rewashed, finely laminated, less stony clays occupying the coast from 25 feet above the sea level to a height, 50 to 100 miles inland, of nearly 300 feet. The species found in this second horizon are rather *boreal* forms than purely Arctic. In the beds about Saco and Scarboro' we find *Leda tenuisulcata* intermingled with the Arctic *L. pernula*, as it is not at present on the coast, and *Pandora trilineata* replaces the Arctic *Pandorina arenosa*. At Berwick, *Astarte castanea*, a boreal form, is introduced; while south of this, at Point Shirley, Desor and Stimpson found *Nassa trivittata*, *Buccinum plicosum*, *Astarte castanea* and *Venus mercenaria*, species which now, as an assemblage, abound most on the shores of New England south of Cape Cod, and in New York bay. Again, at Nantucket, Desor found a still warmer fauna occupying, apparently, an extension of this second horizon. *Arca transversa*, *Crepidula fornicata*, with *Buccinum plicosum* and *Nassa obsoleta* were found to abound in this locality, where the warming influence of the Gulf Stream was strongly felt, while the waters of Maine were cooled down by the Arctic or Polar current.

In the beds of this horizon at Gardiner occur the teeth of the bison, walrus, and bones of other animals, and the *Mallotus villosus;* also in the same beds at Bangor the fossil whale, and in Burlington, Vt., in the Champlain clays, which evidently belong to this horizon, the *Beluga Vermontana* of Thompson.

Thus the two glacial faunæ that have successively gained a foothold in northeastern temperate America, seemed, as regards both their land and marine animals, and also plants, (for *Potentilla tridentata* which is found only in Maine, Labrador and Greenland, is also found fossil in the Ottowa clays, according to Dr. Dawson,) to be a purely Arctic American assemblage. According to the view of Dr. Hooker,[2] the most ancient glacial flora was derived from Scandinavia. On the contrary, as far as geological evidence at present tends, the cave mammals of Europe were associated with the musk ox, reindeer, white bear, and other Arctic animals which abound in Arctic America, while no features in the Post-tertiary fossils of America seem to be European. These faunal distinctions would seem to be even more strongly marked than now in the distribution of the Vertebrata during the closing part of the Glacial epoch.

[2] Outlines of the Distribution of Arctic plants, by J. D. Hooker, M.D. Trans. Linn. Soc. London, xxiii, part ii.