logical society of France, he has named it Titanophasma Fayoli. The interest attaching to this remarkable creature, which has not before been figured, and to another somewhat smaller species published by him five years since under the name of Protophasma Dumasii, is twofold. First: scarcely any group of Orthoptera is so specialized as the Phasmida, or walking-sticks; and one would naturally look upon these bizarre creatures as the last term in a long series of forms in a special line of development. They had never been found fossil, excepting in one or two fragments in amber, when suddenly the upper coal-measures of Commentry revealed a considerable number of forms, of which M. Brongniart has only described two. He points out, that they differ from modern types in certain features, such as the relative length of the parts of the thorax and legs; but their connection with living Phasmida is unmistakable. Second: the hind wings are of a type very different from those of living Phasmida, and accord closely, as pointed out in my paper on *The early types of insects*, with those of a whole group of detached wings found in carboniferous beds in Europe and America (Dictyoneura, Paolia, Haplophlebium). These have always been looked upon as Neuroptera. It can hardly be doubted that these wings belong to this early type of walking-sticks, — a probability, we may add, strengthened by unpublished material in our possession. Here we have clear evidence of the presence, in early times, of synthetic types of marked character. As M. Brongniart informs me that he has now over five hundred and fifty specimens of arthropod remains from Commentry alone, and as our own Mazon-Creek beds have doubtless yielded as many, we may look for many new revelations concerning the early insect fauna of our globe. I am already acquainted with half a dozen or more species of Dictyoneura and allied genera from our American coal-fields, notably from Pennsylvania. The figures we give are from M. Brongniart's sketches, reduced lineally one-half. The body is that of the original specimen of Titanophasma described in the *Comptes rendus* of Dec. 11. The wing, his latest discovery, and not yet described, has merely been mentioned by M. Brongniart, in the bulletin of the entomological society of France: it was found detached in the same beds, and is conjectured by him, not without reason, to belong to the same or a closely allied species. Of Protophasma, specimens have been found with the wings attached to the body. Samuel H. Scudder.

ANATOMY AND HISTOLOGY OF POLYOPHTHALMUS.

This interesting genus, which was first discovered by Dujardin in 1839, and more fully described by Quatrefages in 1850, is the subject of a fine monograph by E. Meyer in the *Archiv für mikroskopische anatomie*, xxi. 769. The transparent worm is 15–18 mm. long; has twenty-eight bristle-bearing segments, followed by eight smooth, very small ones, none of which are marked externally. The bristles form two rows on each side. Most remarkable are the eyes; of which there are three on the head, and several pairs on the body. In P. pictus, the species investigated by Meyer, there are twelve such pairs, on as many segments. The external cuticula is of nearly uniform thickness, except over the sensory organs, where it is thinned out; but the hypodermis varies considerably, and is composed of narrow cylinder cells and relatively large unicellular glands, which last have granular contents, an oval nucleus, and a cross-shaped opening through the cuticula for the duct. The external coat of annular muscles is very imperfectly developed. The remaining muscles resemble those of other annelids. The bristles arise from the bottom of four pockets in each segment; the pockets (*bursae*) are invaginations of both the hypodermis and cuticula; but the hypoderm cells are cubical, and not cylindrical as over the rest of the body. The brain is kept in place by a set of threads of muscular and connective tissue, which run from various points of the body-wall to the cerebral envelopes. A detailed description of the nervous system is given. The ventral cord is nearly uniform, and has no distinct ganglionic swellings. It lies close against the skin, which directly underneath it is reduced to a thick cuticula with a matrix of flat cells, which pass suddenly on either side into the layer of hypodermal cylinder cells. There are two pairs of peripheral nerves in every segment. The sensory organs are numerous and interesting. The organs of touch are the cephalic and anal papillae. The former is a small elevation of the integument of the forehead, covered with a delicate cuticula and thin hypodermis, and receiving a number of nerve filaments. The nine anal papillae are similar in structure, but project more. There are also the so-called lateral organs, a pair in each bristle-bearing segment, which are probably homologous with the *seitenorgane* discovered by Eisig in the Capitellidae. They lie between the two bristle pockets of each segment, and have the form of hemispherical projections, probably covered in life with free sensory hairs arising from the modified hypodermal cells, which rest upon a peripheral ganglion, from which they are separated by a thin membrane; the membrane is pierced by the cells to establish their connection with the ganglion. There are beaker-shaped organs, having evident resemblance with those of fishes and the Capitellidae, but present only in a single cephalic pair. There is also a pair of ciliated pits of horse-shoe shape on the oral segment. These pits are in structure quite complicated; and their bottom has hair-bearing sensory cells, which are greatly elongated, have rod-like nuclei, and rest upon a ganglionic layer, to which runs a large special nerve. There is an evident histological similarity between the ciliated pits, the beaker-shaped organs, and the lateral organs. The lateral eyes are of two sizes, those upon the eighth to the fifteenth segments, both inclusive, being nearly twice as large as the four other pairs: they all lie close against the integument, the overlying cuticula and hypodermis being both very much thinned. The

oval lens lies close against the hypodermis, and can be strongly stained with haematoxylin. From the inner surface of the lens depend a cluster of prismatic cells, with nuclei in their bases, or ends away from the lens. These cells fill up the interior of the eye, and are enclosed in an envelope, which is fibrous, pigmented, and nucleated. The fibres probably are, in part at least, ramifications of the eye-nerve; the envelope is separated from the inner cells (so-called *glasskörper*) by a limiting membrane. These eyes conform, therefore, in their structure, with the known type of annelidan eyes. The three cephalic eyes are embedded in the brain. Their most remarkable peculiarity is the extension of the envelope of the eyes over the lenses, where it is much thickened. Each eye has three lenses (in P. pictus), but otherwise is similar in structure to the lateral eyes. Three pear-shaped vesicles lie beside the eyes: these Meyer believes to be probably otocysts. The digestive tract has five divisions: 1°, the mouth cavity, is a rather long cylindrical tube; 2°, the pharynx, extends in many windings and folds to the end of the fifth body-segment; it is quite muscular, and has numerous peculiar glands opening into it; these two parts appear to correspond to the fore-gut, while 3°, the oesophagus, seems rather a portion of the mid-gut, since it is lined with ciliated epithelium; 4°, the largest division or stomach proper, which has two ventrally placed glandular coeca at its anterior end; the coeca are lined with an epithelium composed of two distinct kinds of cylinder cells; the stomach has an external wall of fibrous and connective tissue, within which is a close network of large capillaries, which gradually becomes more and more irregular posteriorly; the epithelium over the capillaries is ciliated, but over each mesh there is a single cell, which extends down between the vessels, and itself forms a complete glandular bag, and represents a hitherto unknown type of cell-form; 5°, the end-gut, is very short. The vascular system is well developed, and is described in detail. A short account of the body cavity is given; the structure of the segmental organs was not elucidated. The sexual organs have been accurately described by Quatrefages and Claparède.

C. S. MINOT.

THE GLACIAL THEORY BEFORE THE PHILADELPHIA ACADEMY.

AT the meeting of the Academy of natural sciences of Philadelphia, Feb. 13, Prof. Angelo Heilprin, referring to the subject of glaciation, stated that in his opinion the vast ice-sheet which is generally supposed to have covered, during the great 'ice age,' a considerable portion of the northern region of the European and North American continents, could not have had its origin, as is maintained by most geologists, in a polar ice-cap; since it may be reasonably doubted whether any accumulation of snow and ice in the far north could ever have attained a magnitude (in height) sufficient to have propelled a glacier with an estimated thickness of several thousands of feet, to a distance of hundreds of miles, and up mountain-slopes to an elevation of five or six thousand feet.

The height of such snow-accumulation must necessarily depend upon two circumstances: 1°, the quantity of aqueous precipitation; and, 2°, the upper limit in the atmosphere to which clouds may attain. It is well known that as a rule clouds rise highest in the regions of highest temperatures, — the equatorial, — where the vapor absorption by the atmosphere is greatest; and, for a similar reason, higher in summer than in winter. The minimum rise will therefore take place in the polar regions, and necessarily during the polar winter. High (discharge) clouds in the extreme north are stated by arctic explorers to be a rarity, and hence precipitation in the form of snow must be restricted to a comparatively low atmospheric zone.

No great accumulation of snow can take place above this zone, which must consequently be of the height of the ice-cap. As a matter of fact, the officers of the late arctic expedition under Sir George Nares observed that the crests of the greater elevations were devoid of snow, and that in the winter-months there was altogether, even in the low lands, very little precipitation, heavy precipitation beginning only with the spring-months. The greatest snow-clad elevation in Greenland is Washington Land, supposed to be 6,000 feet, which gives origin to the great Humboldt glacier. Although this peak is completely buried in snow (of undetermined thickness), it may be safely doubted whether, unless with a warmer climate, snow of any great thickness could possibly accumulate on a summit of much greater height. If not, the elevation, in the opinion of the speaker, was entirely inadequate to account for the phenomenon of glacial propulsion southward to the extent required by geologists.

Prof. H. Carvill Lewis remarked, that, notwithstanding the difficulties in the way of a theoretical explanation, the fact of a great continuous glacier at the time of maximum glaciation seemed clearly indicated, at least in America, by the numerous observations recently made. He described the extent of the glacier in America, as indicated by its terminal moraine, and stated that the close similarity of its phenomena at distant portions of its southern edge indicated a continuous ice-sheet. The continuous motion of its upper portion is shown by the uniform direction of glacial striae upon elevated points. Thus the south-west direction of the striae upon the mountain-tops of northeastern Pennsylvania was identical with that upon the Overlook Mountain of the Catskills and that of the Laurentian of Canada. The striae at lower elevations conformed more or less to the valleys, and did not indicate the general movement of the ice. The thickness of the glacier increased northward, the rate of increase diminishing as its source is approached. This latter point has not heretofore been appreciated, although observed some time ago by Dr. Hayes in the case of the Greenland glacier.

Recent observations by the speaker in Pennsylvania had shown the glacier to be 800 feet thick at a point five miles north of its extreme southern edge, and 2,000 feet thick at a point eight miles from its edge, while it was only about 3,100 feet thick one hundred miles farther north-east, and about 5,000 feet thick three hundred miles back from its edge. The amount of erosion it caused upon rock surfaces was in some degree a measure of its thickness, being far greater in Canada, even upon the hard Laurentian granites of that region, than in Pennsylvania, where even soft rocks were but slightly eroded.

The present thickness of the glacier in central Greenland was considered, and the magnitude of certain icebergs detached from it given. A friend of the speaker had within a few months seen a floating iceberg near the coast of Newfoundland which stood 800 feet above the water by measurement, and may have been therefore nearly a mile in depth. Dr. Hayes saw an iceberg aground in water nearly half a mile deep.

That the great glacier flowed up steep inclines, was abundantly proven by recent observations of the speaker in Pennsylvania. He instanced the striae