A synopsis of the classification of the British palaeozoic rocks

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Sub-kingdom Articulata Cuv.

Sub-kingdom ARTICULATA *Cuv.*

= *Annulosa* Mac Leay, = *Diploneura* Grant, = *Homogangliata* Owen.

The most striking external characteristic of the multitudinous forms included in this sub-kingdom, is the division of the more or less indurated integument into a succession of transverse ring-like segments. All animals with jointed bodies belong to it, but a few members of the group (e. g. the *Cirripedia*) scarcely shew this character, and they have accordingly been separated from what we now know certainly to be their true allies, even by such observers as Cuvier and Lamarck. One unvarying characteristic of the entire group is, however, to be found in the disposition of the nervous system, which distinguishes them completely from the preceding group of so-called radiated animals, and from the next higher group, or mollusca. From this consideration it is that Grant and Owen have named the division. One pair of principal ganglia (representing the brain of vertebrate animals in function and position) is *dorsally* placed *over* the œsophagus at the anterior end, supplying nerves to all the higher senses—taste, smell, hearing, sight, the antennæ, &c.; from these, two cords surround the œsophagus, and form two parallel lines along the ventral aspect of the body, and on these are symmetrically placed numerous, nearly equal, ganglia, usually one pair for each segment of the body; generally speaking, the lower the type the greater the number of segments in the body and of ganglionic centres, while the higher the type (whether we speak of adult conformation, or the progress of metamorphosis) the greater becomes the nervous centralisation, the ganglia coalescing as it were from behind, as the joints of the body diminish in number; as the ganglia decrease in number they increase in size, and the intelligence and physical perfection of the creature increase in a corresponding ratio.

The sub-kingdom Articulata includes the five following classes:—1, *Annellida* (or *Annulata*); 2, *Myriapoda*; 3, *Insecta*; 4, *Arachnida*; 5, *Crustacea*.

1st Class, ANNULATA.

The animals of this class have long vermiform bodies, composed of a great number of only moderately indurated annular segments, only differing from each other in size, except the first, which contains the jaws, and generally eyes, and often antennæ for touch, and the last, which is perforated by the anus; each of the other rings usually is furnished with setæ for locomotion, but never provided with articulated legs; the blood is red, not (as some writers suppose) from red globules, as in the *Vertebrata*, but uniformly tinged. They have a mouth at the anterior end, followed by a short œsophagus, leading to a stomach, and often a gizzard, from which a straight intestine extends directly to the anus, which is dorsally placed in the last segment; numerous cæca (or biliary ducts?) enter the stomach on each side. A tortuous pulsating dorsal vessel sends the blood from the tail to the head, where it enters a large ventral vessel, which returns the blood again to the dorsal one by numerous anastomosing branches at the posterior end. Over the great ventral vessel, and chain of ganglia, is another longitudinal vessel, the "supra-ganglionic," into which the blood is driven from the anterior part of the dorsal vessel by a series of vertical, moniliform, muscular hearts, the current rushing towards the tail, where it enters the great dorsal vessel by anastomosing branches, and helps to propel its contents towards the head. Most of them are hermaphrodites. The eyes, when present, are formed of a simple expansion of the optic nerve, covered by a transparent cornea, without any of the usual lenses or humours.

The class *Annulata* is divisible into three orders: 1st, *Abranchia;* 2nd, *Dorsibranchiata;* 3rd, *Tubicola.*

1st Ord. ABRANCHIA.

This group is distinguished by the absence of external branchiæ, respiration being effected partly by the surface of the skin, and partly by internal vascular sacculi opening by external spiracles. It contains, as tribes, first, the *Annulata Suctoria* or leeches; second, the *Annulata Terricola* or earth-worms; and third, the little-known *Nemertina*, a marine group of very long, slender, smooth worms, without antenna, feet, or other appendages to the skin, and very indistinctly annulated. To this group has been provisionally referred the Silurian genus, *Nemertites.*

Genus. NEMERTITES (*Mac Leay*).

Gen. Char.—Body very long, linear, slender, of nearly uniform thickness throughout, without distinct articulations.

Only one species of this supposed genus of *Nemertina* has occurred, and it is very doubtful whether it and the so-called *Gordiæ* of the American Taconic slates may not belong more properly to the vegetable kingdom. (See the genus *Palæochorda*, McCoy, Pl. 1. A.)

NEMERTITES OLIVANTII (*Murch.*)

Ref.—Murchison Sil. Syst. t. 27. f. 4.

This body occurs usually in long loop-like folds, about half an inch apart, and three or four inches long. The diameter of the smooth subcompressed body is rather more than half a line; the length many inches, but unknown.

Position and Locality.—Not uncommon in the fine olive slates of Llampeter, Pembrokeshire.

2nd Ord. DORSIBRANCHIATA (*Cuv.*)

This group is almost equivalent to the *Annellida Errantia* of authors; it is composed of centipede-like worms, having the body entirely naked, and possessed of great powers of locomotion; the head is distinct and provided with eyes, jaws, antennæ, &c. The group is characterized by the almost uniform distribution of the gills in tufts over the remainder of the segments, which are very numerous and equal among themselves; one pair of gills on the outer edge of most of the rings; at the base of each branchial tuft is a retractile bunch of stiff bristles for locomotion, enclosed at the base in a thick, fleshy, lobe-like foot, and often a short, slender, fleshy, articulated process above and another below, called "cirri."

The two Cambrian genera, *Nereites* and *Myrianites*, apparently the first created beings of their class, belong to this, the most highly organized, group of all the *Annulata.*

Genus. NEREITES (*Mac Leay*).

Gen. Char.—Body very long, of nearly equal width throughout, of upwards of one hundred nearly equal and similar segments; each segment with a thick, short, ovate, lobe-like foot, surmounted by a slender cirrus exceeding the foot and the segment in length (or the distance between one cirrus and the next).

NEREITES CAMBRENSIS (*Murch.*)

Ref.—Murchison, Sil. Syst. t. 27. f. 1.

Sp. Ch.—Length unknown (upwards of two feet), usually seen in irregular obtusely angular contortions; width three lines (or rather more, as the cirri have a gentle backward curve); width of the body half a line; *cirri* thick, gradually tapering, two lines long; *feet* forming thick, ovate, fleshy lobes, one and half lines long; distance between the cirri (equal to length of segments) one and half lines.

The thick fleshy feet are not *sufficiently* distinct beneath the cirri in the above quoted figure, and these latter do not taper quite enough. A single indistinct specimen, a little wider than the above and having the feet *slightly* longer and more pointed, has occurred in the Scotch slates in the valley of the Tweed, in company with a multitude of the *Crossopodia Scotica* (McCoy), and it may perhaps ultimately prove distinct; but as there are exactly the same number of feet and cirri in a given space, I have little hesitation in considering it as only a variety—if even so much, of the Llampeter species.

Position and Locality.—Not uncommon in the slates of Llampeter, and Var. *a.* very rare in the olive slate of Thorney Lee Quarry, on the Tweed (opposite Ashestiel).

NEREITES SEDGWICKII (*Murch.*)

Ref.—Murchison, Sil. Syst. t. 27. f. 2.

Sp. Ch.—Usually disposed in long straggling trails, and short irregular rounded loops; length unknown (upwards of a foot); width of specimen slightly more than two lines (but the ends of the cirri curved, which diminishes the apparent width); width of body slightly more than half a line; length of the segments (equal to the distance between the cirri) one line; length of cirri (supposing them straightened) one and half lines; feet narrow, slightly more than half the length of the cirri.

I have been so fortunate as to detect the feet of this species in one part of the specimen in the Cambridge Collection; they are much smaller and more delicate than in the *N. Cambrensis.* A semi-elliptical hollow space, rather difficult to account for, is frequently seen on each side between each pair of cirri; it strikes me it may be the trace of the sweeping action of the little bush-like, retractile packet of bristles, forming the locomotive organs of the allied recent worms.

Position and Locality.—Not uncommon in the olive slates of Llampeter.

Genus. MYRIANITES (*Mac Leay*).

Gen. Char.—Body longer and more slender than in *Nereites;* cirri of the feet short (scarcely as long as a segment of the body, or the distance between one cirrus and the next); feet indistinct.

MYRIANITES MACLEAYI (*Murch.*)

Ref.—Murchison, Sil. Syst. t. 27. f. 3.

Sp. Ch.—Upwards of a foot long, usually coiled in long curved transverse folds, about one-fourth of an inch between the parts, which are very frequently approximately parallel; width of the animal throughout slightly more than one line, of which the body occupies nearly one half (being half a line wide), the cirri of the feet forming the remainder; the space between the cirri on one side slightly exceeds their length, being equal to the width of the body (indicating segments as broad as long).

The above quoted figure represents the worm *slightly* too wide where the cirri are marked.

Position and Locality.—Not uncommon in the olive slates of Llampeter.

MYRIANITES TENUIS (*M^cCoy*). Pl. 1. D. fig. 13.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. VII.

Sp. Ch.—Usually coiled in numerous, small, very irregular, undulations; diameter of body about one-third of a line.

This little worm is easily distinguished from the *M. Macleayi* (Murch.) by its very slender proportions, agreeing more nearly in this respect with the *M. Murchisoni* of Prof. Emmon's "Taconic Slate." I think it was about a foot long, from following, as well as I could, the convolutions of three individuals. I have only in one part seen traces of the cirri, which have the same general proportions as in the *M. Macleayi* (Murch.)

Position and Locality.—Not uncommon in a particular layer of the fine olive slate of Greiston, on the Tweed, near Inverleithen.

Explanation of Figure.—Pl. 1. D. fig. 13. From the slate of Greiston, on the Tweed, natural size.

Genus. CROSSOPODIA (*M^cCoy*).

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. VII.

Etym.—Κροσσὸς, *fimbria*; ποῦς, *pes.*

Gen. Char.—Body long, moderately slender, of excessively short, numerous, wide segments, from which arise very long, delicate, crowded cirri, forming a broad dense fringe on each side, completely concealing the feet (at least five or six times longer than a segment of the body, or interval between one cirrus and another).

These beautiful worms are easily distinguished from their Protozoic companions, the *Nereites* and *Myrianites*, by the excessive shortness of the joints of the body, as indicated by the very crowded cirri (only one of which comes from the dorsal aspect on each side of any given segment) and by the broad, close, fringe-like, development of these latter, concealing the lobes of the feet, so conspicuous in the two genera named.

CROSSOPODIA LATA (*M^cCoy*). Pl. 1. D. fig. 14.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. VII.

Sp. Ch.—Length unknown (upwards of one yard); width nine lines, width of body three lines, length of cirri three lines; articulation of body and number of cirri indistinct, but apparently three in a space of one line.

Prof. Sedgwick informs me, that the portion of this remarkable worm which he saw in the rock, and of which the specimen described is a part, measured upwards of a yard in length, without signs of tapering or alteration of character, thus agreeing in proportion with its living allies. Its great width easily distinguishes it from the older *C. Scotica* (M^cCoy), and it has no resemblance to any other fossil I know of. The piece described is about four inches long, and is gently flexuous.

Position and Locality.—Tilestone (Upper Ludlow) of Storm Hill, Llandeilo.

Explanation of Figure.—Pl. 1. D. fig. 14. Fragment, natural size, from the Tilestone Storm Hill, Llandeilo.

CROSSOPODIA SCOTICA (*M^cCoy*). Pl. 1. D. fig. 15.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. VII.

Sp. Ch.—Length unknown (upwards of two feet), width nearly two lines, width of body (and trail on the surface of the beds) one-third of a line; cirri very fine, close, delicate, about five in the space of one line.

This interesting worm is closely allied to the so-called *Nereites Loomisii* of Prof. Emmon's "Memoir on the Taconic System," t. 3. f. 3, from the taconic slates of Waterville, Maine. The American species certainly belongs to our new genus *Crossopodia*, but, if correctly drawn, has much thicker and fewer feet. The narrow deep *trail* of the middle part of the body on the upper surface of the planes of deposition of the slate, and the narrow cord-like ridge formed by the casts in them on the under surface of the laminæ, might possibly be mistaken for a different worm resembling a *Gordius*, without due caution or the absolute demonstration of their nature, afforded by many of the specimens.

Position and Locality.—Absolutely swarms in some parts of the greenish slates of Thorney Lee Quarry, on the Tweed, opposite Ashestiel, near Inverleithen.

Explanation of Figures.—Pl. 1. D. fig. 15. From the slates of Thorney Lee Quarry, on the Tweed; natural size; the narrow markings being the trails left by the worms, the broader portions containing the body and fringe-like cirri perfect.

3rd Ord. TUBICOLA.

As their name implies, all of this order inhabit tubes, and are more or less sedentary, though not absolutely fixed organically to their dwelling. Their tube is either simply membraneous, formed of dried exudations from the surface of the body, or formed of agglutinated grains of sand, &c., or still more commonly composed entirely of calcareous matter; it is usually long, open at one end and closed at the other. The inhabiting worms are without eyes or antennæ, and have the gills attached to the sides of the head (whence their name *Cephalobranchiata*), forming two large feather-like pulsating tufts, having a contractile power sufficiently strong to drive back the blood received from the heart when it becomes aerated. The organs of locomotion are reduced on most of the segments to small processes, to assist in protruding or retracting the creature in its tube; and the cirri immediately about the head are altered into long tentacles, one on each side of the mouth, one of which in *Serpula* is much larger than the other, and bears on its extremity a circular, or conical, calcareous operculum for closing the mouth of the tube (which has sometimes been mistaken for *Patella*).

The tube affords characters for recognizing in the fossil state the two tribes, *Serpulinæ* and *Amphitritæ*, into which the order has been divided in the recent state.

1st Tribe. SERPULINÆ.

Tube strong, calcareous, dull (not polished), contorted irregularly, and attached to foreign bodies. Marine.

Genus. SPIRORBIS (*Lam.*)

Gen. Char.—Tube discoidally coiled, of few whorls, and attached by one side of its whole length.

SPIRORBIS TENUIS (*Sow.*)

Ref.—Sow. Sil. Syst. t. 8. f. 1. and t. 11. f. 8. (*S. Lewisi* on plate).

Sp. Ch.—Discoid, dextral, of one and half or nearly two whorls, partially exposed in a wide, deep, umbilicus; whorls with a broad or high back, sides sloping to the umbilicus, slightly concave, bounded by an obtusely rounded angle on both the umbilical and outer edges; diameter rather less than one line, width of last whorl rather less than one-third the diameter; surface with strong transverse, and obscure spiral lines.

Not uncommon, adhering to the inside of the last chamber of cephalopod shells, so that specimens often seem sinistral. I have only seen the surface very imperfectly preserved.

Position and Locality.—Lower Ludlow rock of Green Quarry, Leintwardine.

2nd Tribe. AMPHITRITÆ.

Tube fragile, straight or gently curved, unattached, formed either of naked membrane alone, membrane with grains of sand, &c. agglutinated, or solidified by a small proportion of calcareous matter, forming a dense thin, smooth, glossy tube. Marine.

Genus. SERPULITES (*Murch.*)

Gen. Char.—Tube smooth, arched, slightly calcareous, glossy; having two small longitudinal tubes at opposite points of the circumference (the convex and concave faces of the curve), stronger than the rest of the shell, and prolonged at the posterior end.

SERPULITES DISPAR (*Salt.* in App.) Pl. 1. D. fig. 11, 12.

Sp. Ch.—Upwards of four inches long and two lines wide in the greater part of its length, slightly curved, rather rapidly tapering towards the small end; extremities unknown; two lateral tubules very strong, calcareous, one-third of a line in diameter, intervening portion of tube very delicate, nearly membraneous.

The small diameter, and the exceeding delicacy of the sides of the tube compared with the strength and hardness of the two lateral tubules, easily distinguish this species from the *S. longissimus* (Murch.) Not unfrequently the delicate membraneous portion disappears, leaving a very puzzling appearance in the two disconnected wire-like lateral tubules.

Position and Locality.—Abundant in the Upper Ludlow rock of Scalthwaite Rigg, N. end of Benson Knot, Kendal, Westmoreland; in the calcareous flags of Dinas Bran, Llangollen; N. end of Tenter Fell, Kendal. Single lateral tubules apparently of this fossil occur in the black shale at three miles N. of Builth, Radnorshire; in the fine greyish sandstone of Tan y Craig, Builth; in the sandstone of the Hollies, Church Stretton, Shropshire.

Explanation of Figures.—Pl. 1. D. fig. 11. Natural size from Benson Knot.—Fig. 12. Ditto.

SERPULITES LONGISSIMUS (*Murch.*)

Ref.—Murch. Sil. Syst. t. 5. f. 1.

Sp. Ch.—Subcompressed tube upwards of a foot long, gradually tapering at the rate of only two lines in five inches, forming part of a curve about one foot in diameter at the large end, but curving more rapidly towards the apex; surface with obtuse transverse undulations; shell thin, glossy, opaline; average diameter four lines, of thickened convex and concave margins nearly one line.

Position and Locality.—Common in the Upper Ludlow rock of Aymestry, Herefordshire.

Genus. TRACHYDERMA (*Phill.*)

Gen. Char.—Tube submembraneous, tough, flexible; surface with short irregular transverse wrinkles or plaits.

This genus has been proposed (Mem. Geol. Surv.) by Prof. Phillips for some large, cylindrical, variously-curved coriaceous tubes of the Upper Silurian rocks, with an irregular, sharp, transverse plication of the surface; this latter character is so variable, and obviously unimportant, that by extending the genus so as to include all the simple submembraneous naked tubes of the Silurian rocks it would be more useful and intelligible, being distinguished from *Serpulites* by the latter having two strong lateral tubules, which I have shewn (Synopsis of the Carboniferous Fossils of Ireland, p. 170) to be highly characteristic of that genus, although it seems not to have occurred to the Survey observers as a distinctive character.

TRACHYDERMA SQUAMOSA (*Phill.*)

Ref.—Phill. Mem. Geol. Surv. Vol. II. t. 4. f. 3.

A very obscure fragment, apparently of this species, has occurred in the Upper Ludlow rock of Benson Knot, Kendal, Westmoreland.

TRACHYDERMA ? LÆVIS (*M^cCoy*). Pl. 1. D. fig. 10.

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. VII.

Sp. Ch.—Tube slightly curved, thin, coriaceous, slightly tapering, subcompressed, slightly more than one line in diameter at the broad end, and slightly less than one line at the imperfect smaller end of a specimen one inch seven lines long; surface nearly smooth.

The specimen is a brown, tough, flexible tube, irregularly and gently compressed (parallel to the plane of stratification of the rock) assuming an oval section; and being filled with the bright-coloured matrix shews clearly the thinness of the tube, which, from the same cause, has a few irregular indentations of the surface, which otherwise seems smooth.

Position and Locality.—In the very fine beds of Caradoc sandstone of Acton Scott, Church Stretton, Shropshire.

Explanation of Figures.—Pl. 1. D. fig. 10. Specimen from the fine Caradoc sandstone of Acton Scott, natural size and section.

2nd Class. CRUSTACEA.

The animals of this class have a hard-jointed integument, composed of a thick, internal, spongy chorium or vascular cutis, a coloured pigmental layer, and a cuticular secreted external layer; these three layers are at first all equally flexible and continuous; subsequently transverse wrinkles appear, which gradually become segments by the cuticle acquiring calcareous matter, principally carbonate of lime, with a little phosphate of lime and magnesia, (and, according to some, a little 'chitine,' as in insects); these solidified bands become segments by separating posteriorly from the lower layer or chorium, which remains flexible, and permits the various motions. Each segment is believed (for they can seldom be all demonstrated) to consist of six pieces, two *tergal pieces* above (separated by a median longitudinal suture), two similar *sternal pieces* below, an *epimerian piece* on the upper half of each side, and an *episternal piece* forming the lower half of each side. In the lower crustacea the segments are very numerous, distinct, and nearly alike, but they gradually coalesce in the higher types, coinciding with the condensation of the nervous centres. No segment ever bears more than one pair of appendages, a fact which is used to demonstrate the true number of the segments which may be anchylosed into the apparently undivided head or thorax of many groups. In the majority of crustacea the first seven joints belong to the head, and bear the organs of sense and parts of the mouth, the next seven to the thorax (according to M. Edwards), bearing the organs of locomotion, the last thoracic joint being always defined by the male sexual openings, and the last seven to the abdomen, containing the principal viscera, and having the anus in the last joint. The first ring bears the eyes when they are present, the second and third rings bear the two pair of antennæ, which are absent only in the lowest types, the fourth bears the mandibles, the fifth and sixth the jaws, the appendages of the succeeding rings varying in shape and use according to the group.—*Digestion:* the complex mouth is always on the under side of the head, composed of the *labrum* or upper lip, a *labium* or under lip, *jaw-feet*, *mandibles*, *maxillæ*, *palpi*, &c., which it is unnecessary to describe, followed by a short vertical œsophagus leading to a large globular stomach directly over the mouth (often containing sharp tubercles for triturating the food), from which, as in all the Annulata, a straight intestine leads to the anus; there is a well-developed liver. *Circulation*, by a well-developed heart placed behind the stomach, of mixed blood, which imbibes the chyle from the intestine. *Respiration*, in the higher groups by gills, which are modifications of the flabelliform appendage of certain legs; in the lowest, apparently by the whole surface of the body, without special organs. *Nervous system*, on the plan mentioned when first speaking of the subkingdom *Articulata* (p. 127). *Hearing:* the higher groups hear well, the ear being situated in the base of the second pair of antennæ. *Sight:* a few parasitic groups are blind in their perfect state, but nearly all the rest have perfect eyes either simple, or what I have termed semicompound. The simple eyes are small, two or three in number, of a single set of lenses, each eye covered by a round, smooth cornea; the semicompound eyes are an agglomeration of simple eyes, each with its set of lenses and separate twig of optic nerve, the *group of eyes* covered by *one simple*, smooth, external cornea (true compound eyes, having a separate facet of the outer cornea for each eye beneath). *Reproduction:* sexes always distinct and in different individuals.

The class *Crustacea* is naturally divisible into the five following orders, commencing with the lowest in organization: 1st, *Cirripedia*, or Barnacles; 2nd, *Suctoria*, or the little parasitic Crustacea with tubular mouths; 3rd, *Entomostraca;* 4th, *Edriophthalma;* 5th, *Podophthalma*, or most highly organized, and having pedunculated eyes (Crabs, Lobsters, &c.)

3rd Ord. ENTOMOSTRACA.

= *Aspidostraca*, Burm.

The little crustacea which compose this order are very variable in their characters; they include a vast number of the most minute crustacea known; all those enclosed in a bivalve shell-like carapace (an extension of one of the cephalic rings) belong to it. They have no gills, but breathe by flat, membraneous, vascular vesicles attached to the thoracic extremities, and representing the flabelliform appendage and palpi thereof, modified for the purpose, or by the surface of the body only. The eyes, whether simple or compound, are covered by a smooth cornea. This order, which is of more importance to the geologist than all the rest of the class, is divisible into three tribes, named according to the structure of the feet: 1st, *Phyllopoda;* 2nd, *Pœcilopoda;* 3rd, *Lophyropoda.*

1st Tribe. PHYLLOPODA.

= *Branchiopoda*, Edw.

These have the feet extremely numerous, and, as their name implies, all leaf-shaped; they form extremely numerous, thin membraneous lobes, subservient to respiration.

The tribe is divisible into the five following families:—

1st, *Lymnadiadæ.*—In which the carapace covers the entire body in the form of a vertical bivalve shell, opening along the ventral margin; head adhering to the carapace; twenty to thirty pairs of feet, two eyes, either separated or united in one median mass (*Lymnadia*, &c.)

2nd, *Apodiadæ.*—Carapace horizontally semioval, not covering the abdominal segments, which are distinct; sixty pairs of feet (*Apus*).

3rd, *Trilobitadæ.*—Head and abdomen covered by separate dorsal shields; thorax of naked segments generally trilobed by two longitudinal depressions. Eyes two, large, semicompound, or absent.

4th, *Branchipodiadæ.*—No carapace, all the body rings distinct, naked (*Branchipus*, &c.)

5th, *Daphniadæ* (or *Cladocera*).—Body enclosed in a vertical oval shell, the anterior portion forming a beak-shaped hood for the head, which bears the single semicompound eye in front, and is separated below from the rest of the carapace, which is bivalve; only four pair of foliaceous feet; first pair of antennæ small, second pair very large, branched and bristled for swimming.

Family. LYMNADIADÆ (*MCoy*).

Body entirely enclosed in a vertical, bivalve, calcareo-corneous, oblong carapace, opening along the ventral margin; head adhering to the carapace; twenty to thirty pair of membraneous respiratory feet; two eyes, either united in one central mass or separate, one soldered to each valve.

The type of this family is the recent genus *Lymnadia;* and I think it may include all the so-called *Cythereæ* of the Palæozoic rocks, which, as Burmeister suggests, are much more probably Phyllopodous, and for which I have proposed the name *Cytheropsis*, also the two following genera.

Genus. BEYRICHIA (*MCoy*).

Gen. Char.—Bivalve, rotundato-quadrate or longitudinally oblong, ends unequal; anterior, posterior, and dorsal margins convex, and surrounded by a sharply-defined, narrow, tumid border or rim; ventral margin simple, straight, or concave; sides tumid, strongly divided into lobes by very deep, nearly vertical furrows, extending from the ventral more or less towards the dorsal margin.

Several species of this genus have been figured and described by Klöden, as varieties of his "*Battus tuberculatus*." I long ago perceived that the tubercles and furrows being unsymmetrical, the creature could not be a Trilobite, and soon recognized its bivalve structure; shortly before I published this genus (Synopsis Silurian Fossils, &c.) Dr Beyrich announced a similar observation incidentally in his memoir "Ueber Einige böhmish Trilobiten," but without naming or defining the genus, which I dedicated to him. The thickened margin separates it from those carboniferous so-called *Cypridinæ* of Koninck, some of which shew vertical furrows from the ventral margin, which latter character separates them, however, from the other crustacean bivalves which resemble them in form. An interruption may usually be detected in the sulcus which separates the thickened margin from the rest of the shell, at about one-third the length from the anterior end; this probably indicates the position of the connecting ligament of the hinge. (See our figures of *B. complicata*, Pl. 1. E. fig. 3, and 3 *a*). I only know the genus in the Silurian rocks.

BEYRICHIA KLÖDENI (*MCoy*). Pl. 1. E. fig. 2.

Ref. and Syn.—*Beyrichia Klödeni* (MCoy), Synop. Sil. Fos. Irel. p. 58. *B. tuberculata* and *B. gibba*. Mem. Geol. Surv. Vol. II. Pl. 8. fig. 14, 15.—(not *B. tuberculatus* of Klöden).

Sp. Ch.—Valves truncato-orbicular, ventral margin slightly concave; thickened margin very large and strong; surface tumid, having a lengthened oval, nearly vertical, tubercle reaching from the ventral two-thirds of the way to the dorsal margin, and nearest to the narrow end, surrounded by a very deep and wide sulcus confluent with the ventral margin, and helping to define the unequal ended, deeply sinuate, uniform contour of each valve. Length about one line and half.

This species does not exactly accord with any of those figured by Klöden, as varieties of his *Battus tuberculatus* (nearly all of which I have identified myself in the Gothland limestone). I therefore think that Mr Salter, in the Survey Reports, and the editors of the Ray edition of Burmeister's work on Trilobites, are not justified in replacing my name as above, by that of "*tuberculata* (Klöd. Sp.)" Any one attentively reading the elaborate description, or looking at the figures given by that author in his rare work, the *Versteinerungen der Mark Brandenburg*, will readily perceive, as I have above mentioned, that his *Battus tuberculatus* includes many species—the peculiarities of which *he* recognized as varieties; and I may further state, that of all his figures (none of which agree exactly with the present species) continental geologists generally apply his specific name to his fig. 22 only, which best deserves the name, and is the most common in the Gothland beds, though not yet recognized in Britain.

I have not seen the granulation of the surface figured in the Mem. of the Geol. Survey. The *B. gibba* figured by Mr Salter in that work is a very trifling variety of this species. His *B. plicata* of the Ray edition of Burmeister seems to be the same differently observed, and is, I think, only an elevated variety (? the female).

Position and Locality.—Gaer Fawr (in the fine sandy beds), Montgomeryshire; Cowan Head, and Underbarrow, Kendal, Westmoreland; in the Ludlow schists of Llanfair, Welchpool.

A remarkable variety of the above, or perhaps a new species, much elevated, and the middle lobe forming a very long vertical ridge extending nearly to the dorsal sulcus, and not defined by a sulcus at the upper end, occurs in the schist at Dermydd Fawr, near Craig Bronbanog, N.W. of Corwen.

Explanation of Figures.—Pl. 1. E. fig. 2. Left valve magnified eight diameters, and natural size.

BEYRICHIA COMPLICATA (*Salt.*) Pl. 1. E. fig. 3.

Ref.—Mem. Geol. Surv. t. 8. f. 16.

Sp. Ch.—Rotundato-quadrate, ends unequal, about one-third longer than deep, thickened border strongly defined; sides flattened, divided by three very deep and wide sulci, extending obliquely from the ventral towards the dorsal margin, two of these almost reaching the dorsal margin and dividing the surface into three unequal lobes; that near the middle of the shell narrowest, that of the small end pyriform and larger, that at the large end largest, the latter again divided by the third sulcus (which is much shorter than the others) into a small branch-like lobe from its inner side; the ventral ends of all these lobes occasionally swell into tubercles. Length about one line.

The figure of the Survey is incorrect in regard to the proportion of size between the lobe of the larger end and the branch which originates from it.

Position and Locality.—Very abundant in the calcareous flags of Pont y Meibion, two miles S. of Llansantfraid on the Ceiriog; Milltit Cerrig, Llangynnog; Cwm of the Cymerig, Bala, Merionethshire; Hill N. of Moel Uchlas; Pen y Park, Llanfyllin; Mathyrafal, S. of Meifod, Montgomeryshire; Tre Gil, S. of Llandeilo.

Explanation of Figures.—Pl. 1. E. fig. 3. Left valve magnified eight diameters, and natural size, from the schists of Pont y Meibion.—Fig. 3 *a*. Right valve magnified eight diameters, and natural size.

BEYRICHIA STRANGULATA (*Salt.* in App.) Pl. 1. E. fig. 1.

Sp. Ch.—Oblong, ends nearly equal, depth varying from half to two-thirds the length; dorsal margin slightly flattened, ventral margin straight, ends rounded; thickened margin tumid and separated from the sides by a very deep sulcus; sides moderately convex, with a small, oval, nearly vertical depression, a little nearer the narrow end than the other, and having a small tubercle on its margin nearest the narrow end. Length about one line.

The sulcus which defines the thickened margin is so very deep in this species, that in many specimens portions break easily off from the sides, and appear at first sight to have been deficient: this has obviously misled Mr Salter in his view of the species, which, however, as above defined, is a very good one; he informs me that his *Cytherina lævigata* (Quart. Geol. Journ. Vol. I. p. 445), is the same species. Sometimes the depression is less elongated than usual, being elliptical, and not reaching the margin.

Position and Locality.—In great abundance in the calcareous schists at Coniston Water-Head, Lancashire.

Explanation of Figures.—Pl. 1. E. fig. 1. Left valve of deep variety, magnified eight diameters, and natural size from Coniston.—Fig. 1 *a*. Right valve of long variety, magnified eight diameters, Coniston.—Fig. 1 *b*. Left valve of intermediate variety, and natural size; the thickened margin imperfect in parts, the dotted line indicating its completion. From Coniston.

Genus. CERATIOCARIS (*M^cCoy*).

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. IV. p. 412.

Etym.—Κεράτιον, *a pea-pod*, and Καρὶς, *a shrimp*.

Gen. Char.—Carapace bivalve, the dorsal line simply angulated (? undivided), with a slight furrow beneath it on each side; sides semielliptical, much elongated from before backwards, evenly convex; ventral margin gently convex, posterior end abruptly truncated obliquely; on each side near the anterior end, considerably below the hinge-line, is an ocular (?) spot, sometimes raised and distinct, in some species flat; surface marked with fine, obliquely longitudinal, imbricated striæ.

In the pod-like form some of the species resemble such shells as *Solenocurtus* and *Solenimya*, except in the truncation of the posterior end; others resemble the Crustacean genus *Dithyrocaris*, with which I think their affinity lies, though they differ in form, and want the peculiar ridges of that group. I conceive they were phyllopodous crustaceans allied to *Lymnadia:* the peculiar texture and kind of lineation of the surface resembles what we find in crustacea allied to *Apus*, &c. rather than in Mollusca; the general pod-like form, large size, and posterior truncation, separate the typical forms from any of the large species of *Cypridina*, and the two ocular spots separate them from all others. I suspect, from some of the specimens, that the two sides met along the dorsal line at an angle of about 45°, with probably little power of motion. The ocular spots even when flat may generally be recognized with care from the difference in their mineralization; they are often dark-coloured, as if retaining some of their pigment, and have a slightly granular aspect, corresponding in fact very closely, both in position on the shell and in apparent structure, with the double-eyed *Cypridinæ* of the Indian Ocean. In one species there is a short sulcus, extending on each side from the medial line behind the eye obliquely backwards and outwards, reminding us of the, perhaps, somewhat similar nuchal furrow of *Apus*. I only know the genus in the upper Silurian rocks.

CERATIOCARIS ELLIPTICUS (*MCoy*). Pl. 1. E. fig. 8.

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. IV. p. 413.

Sp. Ch.—Each side longitudinally elliptical, evenly convex, about twice and a half longer than wide; greatest width of the side and curvature of the margin about one-third from the anterior end, which is elliptically pointed; posterior end obtusely rounded, the oblique truncation nearly effaced; ventral margin convex; ocular spot elevated like a small tubercle, twice its diameter from the dorsal line, and about one-fourth the length from the anterior end. I believe the striæ of the surface have the direction usual in the genus, but they are very delicate. Length, one inch three lines, greatest width of the side six lines.

The elliptical form, prominence of the eye-spot, and its distance from the anterior end, mark the species well.

Position and Locality.—Rare in the Upper Ludlow rock of Benson Knot, Kendal, Westmoreland.

Explanation of Figures.—Pl. 1. E. fig. 8. Natural size, from Benson Knot.

CERATIOCARIS INORNATUS. Pl. 1. E. fig. 4.

Sp. Ch.—Valves twice and half as long as wide, moderately convex along the middle, abruptly contracted to a small mucronate point in front; dorsal line straight till near the anterior point, to which it slightly inclines; ventral margin most convex about the anterior third, which is the deepest part of each valve, from thence nearly straight to the posterior end, which is slightly narrowed, and truncated obliquely from the dorsal margin, the lateral angle being nearly of 90°; surface with short irregular impressed 'crustacean' striæ, imperfectly parallel with the ventral margin; ocular spot large; flattened, its own diameter from the dorsal line, and about three diameters from the anterior end. Length, one inch eleven lines, greatest depth eight lines.

In a note of Mr Salter's this was named *Dithyrocaris inornatus*, and I have accordingly used his specific name on the explanation of the plate; on revision, however, he has cancelled this, and requested me to describe it as of the genus to which I referred it. What Mr Salter took for a longitudinal lateral ridge, as in *Dithyrocaris*, may be seen from other specimens to be an accidental crumpling. The ocular spot escaped his notice, but is very distinct.

Position and Locality.—Not very uncommon in Upper Ludlow rock, at Benson Knot, Kendal, Westmoreland.

Explanation of Figure.—Pl. 1. E. fig. 4. Natural size of one side, from Benson Knot.

CERATIOCARIS SOLENOIDES*(*M'Coy*). Pl. 1. E. fig. 5.

Ref.—M'Coy, Ann. Nat. Hist. 2nd Series, Vol. IV. p. 413.

Sp. Ch.—Sides meeting along the back at an acute angle, each being nearly four times longer than wide, the ventral margin nearly straight and parallel with the dorsal line; anterior end narrowed and truncated obliquely forwards and outwards from the dorsal line; posterior end scarcely narrowed, truncated obliquely backwards and outwards; evenly convex, the edge slightly thickened; ocular spot a little depressed, close to about the middle of the truncated anterior margin; from the internal (dorsal) anterior angle a small furrow extends a little way obliquely backwards and outwards; oblique, longitudinal striæ very close and fine; eye two-thirds of a line in diameter. Width of each side from dorsal to opposite margin five and half lines; length one inch eight lines.

The ocular spot is generally dark-coloured. This much resembles a little *Solen* in form. It is the *Cultellus rectus* of Mr Salter's list in Prof. Sedgwick's printed papers, but has, however, clearly no relation to that Molluscan genus, as the above characters shew.

Position and Locality.—Common in the Upper Ludlow rock of Benson Knot, Kendal, Westmoreland.

Explanation of Figures.—Pl. 1. E. fig. 5. Natural size, shewing the ocular spot and oblique nuchal furrow, from Upper Ludlow, Benson Knot.—Fig. 5 *a*. Shorter specimen, shewing the two valves in contact; same locality.

CERATIOCARIS? UMBONATUS (*Salt. Sp.*) Pl. 1. E. fig. 6.

Syn.—*Cythere? umbonata* (Salt. in App.)

Mr Salter has applied this latter name to a bivalve fossil, the generic position of which seems to me very doubtful. The valves are obliquely oval, with a slightly-defined margin; anterior and posterior ends elliptically rounded; dorsal margin slightly more convex than the ventral; sides diagonally gibbous, forming an obtuse umbo at about the anterior third, near the hinge line, a little in front of which a small, depressed, eye-like spot is visible with a lens; texture very minutely granulose under a high power; average length two lines, width one and a half line (one specimen four lines long).

In some specimens the umbo, or most prominent part of each valve, is nearer the centre. The size and eye-spots separate it from *Cythere*, and although the form is very different from the typical species of the present genus, still the *C. ellipticus* seems to form a transition in this respect.

Position and Locality.—Common in the schists of Gelli Grin, Bala; Dermydd fawr, Craig Bronbanog, N.W. of Corwen; Conway Falls; Llanfurog.

Explanation of Figure.—Pl. 1. E. fig. 6. Natural size, and magnified six diameters, from the schists of Dermydd fawr.

3rd Family. TRILOBITADÆ.

= *Palæadæ* Dalman.

Body covered (with a few exceptions) by a longitudinally trilobed crust, the head and abdominal segment anchylosed into distinct cephalic and caudal shields, the thoracic segments alone remaining distinct and moveable.

The *cephalic shield* is approximately semicircular; when most fully developed it presents the following parts: an external thickened "*limb*" or "*margin*," often prolonged backwards at the lateral angles into "*wings;*" the shield is usually divided into two pieces by a suture peculiar to trilobites termed the "*eye line*" or "*facial suture*," being continuous from one side to the other near the front margin, descending with a slight outward curve to the eye over which it makes an abrupt outward curve to define a small semicircular lobe, improperly called the "eye-lid," its direction from the lower end of the eye varies according to the Genus and forms a very valuable character; in some cases the eye-lines do not join in front of the glabella, but cut the anterior margin separately, thus dividing the shield into three pieces, and in *Calymene*, to this latter disposition is added a peculiar marginal transverse "rostral suture," dividing the head into four pieces. These sutures exist in no recent *Crustacea*, being only now known in true insects. By some recent continental Palæontologists all outside and anterior to the eye-line is called the "*cheeks*," and all within or posterior to it is called the "*glabella;*" by a greater number of writers however (and in the following descriptions) the latter term is used only for the elevated middle portion of the head, and the triangular depressed space on each side form the cheeks, through the middle of which the "*eye-line*" runs; the *glabella* is divided by not more than three lateral sulci into never more than four lobes; at the base of the glabella a strong furrow going across is called the "*neck furrow*," behind which is the "*neck segment*," or spira; these sulci indicate the attachment of the buccal muscles. The *eyes* are reniform, prominent, situated in a gap in the eye-line, beneath and external to the eye-lid; they have all the "*semi-compound eyes*," the outer thin layer of the cornea being entire and smooth, the inner thick layer facetted and perforated; Burmeister notes that the larger the eye of living crustacea, the thinner the cornea, hence why the large-eyed *Phacops* having a thin easily-lost outer cornea, seems to have a facetted eye. I have drawn attention to a deep puncture on each side of the antennary lobe, in the furrow separating the glabella from the cheeks near the front margin, which I have called the "*antennary puncta*," and which I conceive gave passage to small antennæ like those of *Branchipus*, of which organs they hold the normal position. Attached to the under side of the anterior edge of the head is an ovate crustaceous piece varying in shape according to the genus, its anterior part is dilated into two horn-like processes following the curve of the anterior margin of the shield, the surface of this organ is marked with fine irregular impressed striæ like the rest of the under surface of the crust of Trilobites; it is believed to be immovable, and corresponds to the enlargement in front of the mouth in some of the recent *Phyllopoda*, and is, as in them, named the "*Hypostoma*." The *Thorax* is formed of a variable number of segments (constant for each genus), forming the movable portion of the crust between the cephalic and caudal shields; it is in general strongly trilobed longitudinally, the middle and most convex portion termed the "axis," and the lateral, lobes or pleuræ; each segment has the axis divided in many genera into a raised, posterior exposed portion, and a depressed anterior articular portion, which is concealed under the preceding segment when the animal is extended, becoming visible as it rolls up, or on the fracture of the edge of the preceding ring; the *pleuræ* are straight, or bent down at the end; in the latter case the end often 'sharpened at its anterior edge for contraction,' or provided with a triangular '*facet;*' one of its sides parallel with the anterior edge, its base at the distal extremity, and its apex reaching about one-third towards the axis, its thickened posterior margin joining the anterior margin of the segment at an obtuse angle, at the point where the end of the pleura begins to bend down, has, from its form, been called the "*knee*" by Pander, Portlock, &c.; the same point has by others been termed the "*fulcrum*." In most cases a deep groove extends transversely from the axis along the middle of each pleura as far as the 'knee,' and then its extremity is often bent backwards at an obtuse angle, I propose to term this the "*pleural groove*," and Dr Burmeister suggests, with great probability, that the membraneous gill-feet were attached to the corresponding ridge on the under side; caudal shield or "*pygidium*" semi-elliptical of one solid piece, axis and side lobes generally with transverse false segmental furrows, rarely corresponding in number on the axis and sides, and not admitting of independent motion.

Dr Burmeister comparing trilobites with *Branchipus*, suggests that the narrow body was lodged exclusively in the narrow prominent middle lobe or axis extending from the front of the glabella to the end of the pygidium, and that the lateral lobes were merely to protect the delicate respiratory feet hanging beneath them; these being mere lateral extensions of the true or axal rings renders it impossible they could have acted as oars, as has been suggested. In such cases, as *Paradoxides*, where the thoracic segments are very numerous, and the abdominal shield disproportionally small, a doubt occurs as to whether some of the abdominal segments may not be erroneously counted as thoracic; but as this could only be determined by observing the position of the female genital openings, which mark the last thoracic ring, Palæontologists are content to call all the free movable segments thoracic, and refer to the abdomen only those which are anchylosed into a caudal shield or pygidium. The lateral portions of the body are covered with a thin, tough, membrane on the under side, marked with oblique dichotomous impressed striæ.

The homologies of the cephalic shield of Trilobites have been less attended to than almost any part of their structure. The apparently anomalous nature of the facial suture has been spoken of by Burmeister, who saw no clue to its nature; the nature of the parts outside the eye-line, or 'wings,' as they were called, has also been alluded to by authors as inexplicable; while those who, comparing the Trilobites with *Branchipus*, supposed the body of the animal to occupy the axal lobe only, have expressed their astonishment at the eyes being placed on the lateral lobes, or 'cheeks.' When we bear in mind that the carapace of a crab, for instance, is a great backward prolongation of one of the rings of the head, and is quite distinct from the posterior cephalic and the thoracic segments which it covers, and which exist in a membraneous state beneath it, we are prepared to admit, that though the segmental furrows on the glabella of many Trilobites indicate cephalic rings, they by no means prove the cephalic shield to be formed of the anchylosis of such rings, which may only exist below, *impressing* the shield like the various regions on the back of a crab. To determine of what rings the shield is composed, I started with the main characteristic of the first ring of all crustacea, which is, to bear the eyes when they are present; the second and third rings bear the antennæ; and the remainder of the cephalic rings bear the parts of the mouth. The eyes of Trilobites, when they exist, are always connected with the piece anterior and external to the eye-line; this piece is usually continuous from side to side at the front margin, and I think is probably the first or ophthalmic ring; its lateral portions produced backwards, and bearing its peculiar appendages, the eyes, with it: every ring being theoretically divisible into six pieces, affords an explanation of the suture which sometimes separates the two parts in front, and even of the rostral shield of *Calymene* (if it belongs to this ring). On this view the facial suture becomes at once intelligible as the line of separation between the first and second cephalic rings, analogous to the divisional line between one thoracic ring and another. The piece within and behind the eye-line should on this supposition be the second or antennary ring; and as remarkably supporting this, I must refer to p. 42 of my "Synopsis of the Silurian Fossils of Ireland," where I announced the discovery of the remains of antennæ, as a deep pore on each side of the front of the glabella, in the furrow which surrounds it, and in which, when clear of matrix, I have observed them in *Trinucleus*, *Acidaspis*, *Calymene*, *Ampyx*, *Griffithides*, &c. We would thus have the cephalic shield of Trilobites composed of an extension of the first two cephalic rings. The protuberance called the glabella probably contains the stomach, which is always in crustacea large and placed over the mouth; the segmental furrows on the sides, indicating the rings beneath, which bear the parts of the mouth.

The arrangements hitherto proposed of this group fall far short of what could be desired for a satisfactory or natural classification. I have satisfied myself that the number of the segments, so far from being of family importance, as hitherto supposed by some authorities, cannot indicate more than subgeneric differences among Trilobites, being an instance of a law well known to every experienced zoologist, that those characters of most vital importance in any class or order are often found suddenly to lose their importance in some subordinate section of the group. Thus in the whole class *Crustacea* the number of segments is of great importance, and scarcely varies in the largest groups, while in the *Entomostraca* alone (to which the Trilobites belong) we have every variety, from the smallest to greatly the largest number of segments known in the class. The consideration therefore of the characters of all the recent and fossil Crustacea, taken as a whole, warns us against laying the stress, which has hitherto been done, on the number of segments as a general character for the formation of the great groups. Such a use of this character separates the most nearly allied forms into distinct families, and allies those agreeing in no other points. The two chief systematic arrangements which have been proposed are those of Dr Burmeister, taking as the principle of division the presence or absence of such contractile power as enables the animal to roll itself into a ball; and that of Hawle and Corda, who rest their great divisions on the margin of the pygidium being toothed or entire. The latter character seems to me of no more than specific importance, and the former, though of imperfect application and not ascertainable in many cases, is included in the following mode of arrangement, which, after a careful study of the British and Foreign types, I venture to propose, founded on a consideration, in the first instance, of the structure of the *pleuræ*, or lateral portions of the thoracic segments, which I find to afford definite characters easily ascertainable in all moderately well-preserved specimens. I propose to divide the Trilobites into the five following subfamilies;—1st, *Agnostinæ*; 2nd, *Harpedinæ*; 3rd, *Ogyginæ*; 4th, *Paradoxinæ*; 5th, *Asaphinæ*.

1st Subfamily. AGNOSTINÆ.

Minute, blind, head and tail covered by nearly equal and similar rotundato-quadrate shields; only two thoracic segments.

This subfamily includes both the families *Phalacromides* and *Battoides* of Hawle and Corda which only differ in the margin of the tail of the latter being denticulated, and that of the former being smooth,—points in my mind scarcely of generic importance.

From the absence of eyes and the very slight powers of locomotion argued by so small a number of feet bearing rings, I strongly suspect that the genera of the present family were parasitic, and may hold the same position among the Trilobites that the *Suctoria* do among the crustacea generally, that group being distinguished from its allies by the want of eyes, few body rings, little or no powers of locomotion, abnormally and variously shaped bodies, and being parasitic (generally) on fish. *Bophyrus*, the analogous group among the *Isopoda* is usually parasitic on the gills of *Crustacea* under their carapace, and such I strongly suspect were the habits and mode of life of the *Agnostinæ*, living in all probability attached to the gill feet on the under side of Trilobites, the largest known species of which accompany the little Agnosti.

Genus. TRINODUS (*M^cCoy*).

Syn.— = *Arthrorachis* Hawle and Corda.

Gen. Char.—Cephalic and pygidial shields nearly equal, semielliptical (or from the projection of the middle of the articular margin, obscurely pentagonal); *glabella* semicylindrical, strongly defined, having a very minute lobe at each side of the base; *cheeks* convex, horse-shoe shaped, entirely surrounding the glabella; *external margin* narrow, defined, convex, not extended at the angles; *pygidium* having an elongate tubercle down the middle of the axal lobe, which is strongly defined, semicylindrical, and divided on each side of the mesial tubercle by two fine transverse sulci; lateral lobes horse-shoe shaped, convex, entirely surrounding the axal lobe, surrounded by a distinct external margin: surface smooth.

I originally defined this genus in 1846 in my "Synopsis of the Silurian Fossils of Ireland," and pointed out its distinctions from *Agnostus* (absence of the characteristic transverse divisional sulcus of the glabella, &c.) Subsequently (1847) Hawle and Corda figured and described the group under the title *Arthrorachis*, and likewise distinguished it from *Agnostus*, or *Battus*, without knowledge of what I had done. By some curious mistake however, Mr Salter has stated in the "Mem. of the Geol. Survey," (Vol. II. Pt. 1. p. 351) that I have only described the tail in my generic character, and also overlooking the independent establishment of the same genus by the Bohemian Palæontologists, has reunited it to *Agnostus*.

TRINODUS AGNOSTIFORMIS (*M^cCoy*). Pl. 1. E. fig. 10.

Trinodus agnostiformis (M^cCoy), Syn. Sil. Foss. Irel. t. 4. f. 3. *Agnostus trinodus β convexus* (Salt.) Mem. Geol. Surv. Vol. II. p. 350.

Sp. Ch.—Cephalic shield semioval, about one-fifth longer than wide; *glabella* sharply defined, very convex, narrow, semicylindrical, front rounded; cheek-piece horse-shoe shaped, convex, width equal at the sides and round the front, slightly exceeding that of the glabella (? the front divided by a faint longitudinal mesial furrow); outer margin about half the width of the cheeks, convex. Length of head two lines, length of glabella one and half lines, width of glabella rather more than half a line.

I have some doubt whether the longitudinal furrow in the middle of the front of the cheek-piece be correctly observed, as I have only one specimen of the species at hand for examination, and if constant it must have escaped me at first. The tail has been figured in the above volume of the "Memoirs of the Geol. Survey," but the segmental furrows seem to have been overlooked.

Position and Locality.—One specimen, Limestone of Rhiwlas, Bala, Merionethshire.

Explanation of Figure.—Pl. 1. E. fig. 10. Head natural size, and magnified six diameters; the dotted line indicates the portion of the margin which is wanting. From Rhiwlas.

TRINODUS TARDUS? (*Bar. Sp.*) Pl. 1. E. fig. 9.

Syn.—Battus tardus Barrande. *Arthrorachis tarda* Hawle and Corda. *Agnostus trinodus* Salt. Mem. Geol. Surv. Vol. II. t. 8. fig. 11. (omit the ref. to M^cCoy).

Sp. Ch.—Cephalic shield truncato-orbicular, about one-fifth wider than long; *glabella* not quite two thirds the length of the head, very broad, ovate, nearly as wide as long, convex, defined by a very deep furrow; cheek-piece of equal width all round, about one-third less wide than the glabella, convex, a wide hollow separates the cheek from the narrow external margin, the hollow and margin taken together about equalling the cheeks in width. Length of head two lines.

We have only the head of this species which seems to agree exactly with the Bohemian form noticed; the tail apparently of the same species is figured from a Wexford specimen by Mr Salter in the "Memoirs of the Geol. Survey" as the original variety of my *T. agnostiformis;* this reference however (as any one may see by referring to my original description and figure,) belongs rather to his *A. trinodus β convexus.* The segmental furrows of the pygidium are not indicated in Mr Salter's notice.

Position and Locality.—One specimen in the Limestone of Rhiwlas, N. of Bala Lake, Merionethshire.

Explanation of Figures.—Pl. 1. E. fig. 9. Head, natural size, and magnified six diameters: the dotted line indicates the completion of the broken margin.

Genus. DIPLORHINA (*Hawle and Corda*).

Gen. Char.—Cephalic shield rotundato-quadrate; glabella subcylindrical, rounded in front, divided near the middle by a strong transverse sulcus, and having a small rotundato-trigonal lobe on each side of the base; *cheeks* horse-shoe shaped, entirely surrounding the glabella; outer margin narrow; *thorax* of two rings, axis about four times wider than the pleuræ, which are obtuse, and divided by a diagonal pleural furrow; *pygidium* very obscurely rotundato-pentagonal, longer than wide, axis convex, mitre-shaped, middle of the sides concave, pointed posteriorly, bordered behind and at the sides by uniformly continuous side lobes; outer margin rather wide, smooth.

DIPLORHINA TRIPLICATA (*Hawle and Corda*)? Pl. 1. E. fig. 11.

Syn. and Ref.—Agnostus pisiformis Murch. Sil. Syst. t. 25. f. 6 *a* (not of Brong.)

Sp. Ch.—Head rotundato-quadrate, length and width almost equal; cheek-piece slightly narrower than the glabella, and a little wider near the middle of the glabella than in front, moderately convex, divided in front by three radiating sulci, one medial and one on each side about half way between that and the medial transverse sulci of the glabella; glabella subcylindrical, rounded in front, slightly concave at the middle of the sides, divided slightly in front of the middle by a strong transverse sulcus, the anterior portion evenly convex, posterior portion more prominent, obtusely carinate along the middle; a small obtusely trigonal segmental lobe on each side of the base of the glabella. Surface minutely shagreened. Length and width each about one and a half lines.

As Hawle and Corda have not figured their species, I subjoin, in a note*, that part of their description applying to the head.

Position and Locality.—Rare in the black shale of Pen Cerrig, three miles N. of Builth.

Explanation of Figure.—Pl. 1. E. fig. 11. Head, natural size, and magnified six diameters.

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* "Kopf flach gewölbt, vorne gerundet, fast parallelopipedisch; breit gerandet, Rand flach, Randfurche seicht. Wangenstück hufeisenförmig und überall gleich breit, Vor den Vorderlappen der Glabella mit drei kurzen, nach vorne gerichteten Falten geziert. Dorsalfurchen tief. Vorderlappen trapezoidisch, mit der breiten Basis an den etwas nach Vorn ausgeschweiften Mittellappen der Glabella stossend; letzterer ist nahe am Vordern Ausschnitt mit einem kurzen scharfkieligen Buckel geziert, zur Seite und nach hinten ausgeschweift ausgeschnitten. Basilarlappen klein, dreieckig." Prod. Monog. der böhm. Tril. p. 47.

2nd Subfamily. HARPEDINÆ.

Ovate, head large; eyes small; glabella with segmental furrows; body very long and rapidly tapering, of numerous rings; pygidium very small; pleuræ wide, straight and flat till near the end which is obtuse and abruptly bent downwards, each having a straight mesial furrow not reaching the margin; no facets.

The principal genera of this subfamily are:—1st, *Amphion;* 2nd, *Harpes* (subg.? *Harpidella;*) 3rd, *Conocephalus.*

Genus. HARPIDELLA (*M^cCoy*).

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Gen. Char.—Cephalic shield subtrigonal, surrounded by a thick narrow flattened border, sides nearly vertical, compressed; *cheeks* entirely surrounding the glabella in front, forming there a narrow tumid border, widening backwards as they descend into tumid, broad, triangular, nearly vertical wings, having large prominent eyes near the middle of their posterior margin, from which on each side an obscure impressed line extends upwards and inwards to about the first third of the glabella, (perhaps indicating the eye-line); *glabella* very convex, semielliptical, obtusely rounded and wide in front, surrounded by a strong defining sulcus; two segmental furrows on each side, the first very strong, curving, from about the middle of the side of the glabella, inwards and backwards into the neck furrow, so as to include a large tumid ovate lobe on each side; a little above this the very short and faintly marked anterior segmental furrow curved in the same direction; *surface* granulated.

The head alone of this genus is known; it differs from *Harpes* (Gold.) in its small size, narrow, unpunctured rim, absence of the ocular tubercles on the anterior part of the cheeks, great size and basal position of the eyes, and furrow from them to the glabella, &c. The true place of the genus cannot be determined till the thorax and pygidium are known.

HARPIDELLA MEGALOPS (*M^cCoy*).

Ref. and Syn.—*Harpes? megalops* (M^cCoy) Syn. Foss. Irel. t. 4. f. 5.

As this is the only species of the genus known, I can only add to the above description the measurements, and remark that from the abrupt bending down of the cheeks, from the nearly horizontal front and glabella to the nearly vertical wings, the eyes are rarely seen, except when most carefully cleared, and that when in the rock the whole animal generally seems, in consequence, much narrower than it ought, as shewn in the figures above quoted. The granulation in the English specimen is coarse and very irregular in size.

Length of head three and half lines, width of glabella one and half lines.

Position and Locality.—Not uncommon in the Wenlock limestone of Dudley.

3rd Subfamily. OGYGINÆ.

Body flat, broad, oval; thorax as long as the head, four to eight thoracic segments; pleuræ flat, sickle-shaped, horizontal, having a pleural furrow not reaching the margin, ends not produced into spines; no facets; pygidium nearly as large as the head; eyes small or absent.

The *Ogyginæ* include (so far as I know) all the flat-sided Trilobites not entering into the group of *Paradoxinæ;* unlike them, however, the body is very short and wide, and the pygidium instead of being diminutive is nearly as large as the head, giving a broad oval form to the body; the thoracic segments are only from four to eight in number, never facetted, and their extremities are never prolonged into spines.

The British genera are:—1st, *Trinucleus* (subgen. *Tretaspis*); 2nd, *Ampyx;* 3rd, *Ogygia* (subgen. *Barrandia*); 4th, *Bronteus;* 5th, *Lichas,* (subgen. *Acanthopyge, Trochurus*).

Genus. TRINUCLEUS (*Murch.*)

= *Cryptolithus* Green.

Gen. Char.—Cephalic shield semicircular, the limb broad and flat, with several rows of impressed cup-like puncta on both surfaces; spines of the external angles very long; *glabella* pyriform, without lateral furrows; *cheeks* spherical triangles without eyes or eye-lines; generally a small spine on the neck furrow; *thorax* of six joints, lateral lobes twice the width of the axis, flat, straight, with parallel sides, slightly deflected at their free ends, pleural groove broad, shallow, not reaching the margin; *pygidium* triangular with a deflected margin, axis with about seven segmental furrows, sides flat with about six segmental divisions each subdivided by a faint line towards the end.

I have (Synopsis of Sil. Foss. of Ireland) drawn attention to a particular (? antennary) pore in this and other genera of Trilobites near the front margin on each side of the glabella, in the furrow which separates the latter from the cheeks; in the same furrow I often observe in certain states of preservation two or three punctures on each side of the base, one of them in the neck furrow, indicating apparently the insertion of the oral muscles, and holding the place of the segmental furrows of other Trilobites.

The facial suture of this genus as figured by Burmeister, on the authority of Lovèn, was supposed to go round the edge of the punctated border, to turn in at the angles, and cut the posterior margin near the angles of the cheeks; this would be so singularly unusual a course, that I have taken every pains to investigate the point, and feel satisfied there is no suture in the position indicated; on the other hand, I think I have ascertained their true course, in several species, to be in a more normal position; as I have observed them, they run from the re-entering angles between the front of the glabella, and the cheeks close outside the furrow which separates the glabella from the cheeks nearly to the posterior margin where it turns outwards, (and may generally be well seen at this point) and runs parallel with, and a little above the posterior margin which it finally cuts near the outer angles of the cheeks. I have discovered a facial suture in precisely the same position in *Ampyx*, the proximity to the furrow of the side of the glabella having probably caused them to be overlooked in both genera.

TRINUCLEUS CARACTACI (*Murch.*)

Ref.—Murch. Sil. Syst. Pl. 23. f. 1. and Port. Geol. Rep. Pl. 1. B. fig. 3 and 5.

Sp. Ch.—Cephalic shield nearly semicircular, its width exceeding twice its length; margin wide, regularly rounded, three concentric rows of punctures in front of the glabella, five rows in front of the cheeks, more numerous and scattered towards the angles, which have a triangular extension backwards and outwards, nearly half as far as the pygidium before giving off the slender spines which extend obliquely outwards and backwards; *glabella* smooth, broad, ovate, moderately gibbous; neck furrow strong with a small spine on the middle; *cheeks* gibbous, smooth, triangular, their length and width about equal; *pygidium* nearly as long as the abdomen, three times wider than long, slightly and obtusely mucronate, lateral lobes with five to eight furrows, the three first most distinct, axis with about fourteen minute segments.

I agree with Col. Portlock in thinking this species has never more than three rows of pores in front of the glabella, I therefore believe it distinct from the Bohemian *T. ornatus* which has always five; but besides the greater width of the punctured border in the *T. ornatus* it is fully distinguished from our species by the few furrows on, and the extremely small size of, the pygidium, which in the *T. Caractaci* nearly equals the abdomen in length, but is only half that in the *T. ornatus*. (See the figure of Beyrich, *Untersuchungen über Trilobiten*, Pl. 4. fig. 1, and the description of the same under the name *T. Goldfussi* in Barrande's "Notice Préliminaire," &c. p. 31).

Position and Locality.—Alt yr Anker, Meifod, Montgomeryshire; Llechwedd, Llwyd, W. of Llanfechan, Montgomeryshire; Pwllheli, Caernarvonshire; Craig y beri, Llanarmonfach, Montgomeryshire; Tan y Bwlch y Groes, S. of Bala, Merionethshire; Hordely S.; Gelli Grin, Bala, Merionethshire; Llanwddyn in the Berwyn Mountains; Rhiwargor, near Llanwddyn; Chiney Longville, Shropshire.

T. elongatus (Port.) t. 1. B. fig. 7 only differs in the entire animal being longer and narrower, the length of the cephalic shield being considerably more than half the width.—One specimen of this variety has occurred in the schists of Pwllheli.

TRINUCLEUS GIBBIFRONS (*M^cCoy*). Pl. 1. E. fig. 14.

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. IV

Sp. Ch.—*Cephalic shield* nearly semicircular, length rather more than one-third of the width; *glabella* pyriform, rounded in front, gradually narrowing towards the base, compressed, exceedingly gibbous, its height above the cheeks nearly equalling its width; on each side of the neck-furrow (in casts) there is a deep puncture, and another similar a little in front of it; a small spine on the neck-furrow; *cheeks* spherical triangles, height and width about equal, moderately convex; border of moderate width, three rows of punctures in front of the glabella and four rows in front of the cheeks, more numerous at the sides, generally connected in front by radiating furrows, forming an imperfect fimbriation. Usual length of cephalic shield three lines. Surface very minutely granulated.

This very common species is figured without a name by Portlock (Geol. Rep. Pl. 1. B. fig. 13 and 14). The fine granulation of the lobes of the head, and the extreme prominence of the gradually narrowing, pyriform, compressed glabella separate this at once from either the *T. Caractaci* or *T. latus*, with which it seems to have been confounded; it is wider than the former, less so than the latter. From the two little punctures on each side of the base of the glabella this strongly approximates to the *T. scyllarus* (His.), as distinguished from *T. seticornis*, but, although with abundance of specimens, I cannot find any trace of ocular tubercles or eye-lines in the midst of the cheeks, as in *Tretaspis*, to which those species belong; these punctures indicate, no doubt, the insertion of the muscles of the jaws, but are not extended into transverse segmental furrows as in those last-named species; in the radiation of the border and number of rows of pores in front, it approaches slightly to the *T. radiatus* (Murch.), but is distinguished by the head being rounded, the cheeks wider, and the border not being more than half the depth as well as being by no means so distinctly radiated.

Position and Locality.—Common in the limestone of Goldengrove, Llandeilo; the schists of Tre Gil, S. of Llandeilo; and Alt yr Anker, Meifod, Montgomeryshire; also at Pen y Craig, above Llangynyw, Montgomeryshire; a variety with a shorter shield, the lobes of which are more spherical, perhaps from pressure, occurs in the black shale three miles N. of Builth, Radnorshire.

Explanation of Figures.—Plate 1. E. fig. 14. Natural size, Caradoc sandstone, Goldengrove.—Fig. 14 *a*. Ditto, magnified three diameters.

TRINUCLEUS LATUS (*Portk*). Pl. 1. E. fig. 15.

Ref.—Portk. Geol. Rep. Pl. 1. B. fig. 11 and 12.

Sp. Ch.—*Cephalic shield* smooth, transversely elongate, from three to four times wider than long; anterior and posterior margins subparallel, the angles produced laterally (not deflected backwards); *glabella* convex, with nearly parallel sides, anterior and posterior ends almost equal, obtusely rounded; *cheeks* transversely semielliptical, about one-third wider than high, gently convex. Average length of cephalic shield four lines.

Confounded with the *T. fimbriatus* by Portlock, from which it differs in the margin, being punctured, not radiated, the posterior half of the glabella not being contracted nor furrowed at the sides, and the lobes of the shield being smooth and the cheeks destitute of the ocular tubercles, or eye-line.

Position and Locality.—Rare in the schists at Selottyn Road; Gelli Grin, Bala, Merionethshire; Maes Meillion, S. of Bala, Merionethshire; Llwyn y Ci, N.W. of Bala; Bryn Evan Yspatty; Rhiwlas, N. of Bala; Pen Cerrig Serth.

Explanation of Figure.—Plate 1. E. fig. 15. Specimen natural size from Tyrone, shewing antennary pores, and general transverse form.

TRINUCLEUS? RADIATUS (*Murch.*)

Ref.—Murch. Sil. Syst. Pl. 23. fig. 5.

Sp. Ch.—*Cephalic shield* rotundato-quadrate, little more than twice as wide as long; margin very wide, at least as deep as the cheeks at the sides of the front; anterior margin wide, concave; anterior lateral angles obtusely rounded, sides nearly straight, generally inclining slightly inwards towards the posterior lateral angles, from each of which a short slender spine extends outwards and backwards at an obtuse angle with the sides; about four rows of punctures in front, more numerous at the sides, connected in lines by strong radiating furrows; *glabella* ovate, gibbous, cheeks little wider than high, convex. Usual length of cephalic shield seven lines.

This species is easily recognised by the great width and square form of the radiated border to the head, but though I have seen many specimens none have shewn me the glabella or cheeks in perfect preservation; I am consequently uncertain whether they have the characters of a true *Trinucleus* or of a *Tretaspis*.

Position and Locality.—Common in the slates of Dinas Mowddy, Merionethshire; N. of Tremadoc, Merionethshire.

Genus. TRETASPIS (*M^cCoy*).

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Gen. Char.—General characters of *Trinucleus*, but having but five body-rings, the base of the glabella having two short segmental furrows on each side, and the cheeks being traversed diagonally by a nearly straight eye-line, extending on each side from the junction of the cheeks and glabella in front towards the lateral angles, cutting the posterior margin a little within the angles, and usually exhibiting a small ocular (?) tubercle in the middle. Type of the genus *T. seticornis* (His. Sp.), *T. Bucklandi* (Bar.)

In my Synopsis of the Silurian Fossils of Ireland, I pointed out the course of the eye-line in this genus, which separates it at once from *Trinucleus*, and renders it probable that the small tubercle in the middle of the cheeks in the *T. seticornis*, *T. fimbriatus*, &c. are true eyes.

The furrows at the base of the glabella also are distinctive from that genus. Mr Salter, (Mem. of the Geol. Survey, Vol. II. Pt. 1. p. 335), speaking of Hawle and Corda's work, says, "*Tetrapsellium* is distinguished from *Trinucleus* solely by a swelling in the axal furrow of the head; it is almost identical else with *T. seticornis*:" this might mislead the English reader with the idea that the present genus then was identical with *Tetrapsellium;* the fact is, however, in his strictures on the Bohemian authors Mr Salter overlooks the grand character of their genus, namely, its having but four body-rings ("Vier Leibringe," H. and C. Monog. p. 42. 8th line).

TRETASPIS FIMBRIATUS (*Murch. Sp.*) Pl. 1. E. fig. 16.

Syn. and Ref.—*Trinucleus fimbriatus* (Murch.) Sil. Syst. t. 23. f. 2.

Sp. Ch.—*Cephalic shield* very minutely granulated, more than twice as wide as long; *glabella* pyriform, moderately convex, one-third longer than wide, two short segmental furrows at each side of the base; *cheeks* moderately convex, with the straight diagonal eye-line and central ocular tubercle almost imperceptible; *margin* very narrow, radiatingly furrowed, except the lateral angles, which are directed outwards and downwards, and bear irregular punctures, as in the other species; thorax shorter than the glabella; axis two-thirds the width of the pleuripedes; *pygidium* three times as wide as long, with seven axal and six lateral segments. Most usual length of shield about two lines, of which the fimbriated margin is about half a line; width, exclusive of the spines, five lines.

Position and Locality.—Llandeilo flag, Pen Cerrig, three miles N. of Builth, Radnorshire; Bryn Melyn, near Bala, Merionethshire.

Explanation of Figures.—Pl. 1. E. fig. 16. Entire specimen, natural size, from Pen Cerrig.—Fig 16 *a*. Ditto, magnified three diameters.

TRETASPIS SETICORNIS (*His. Sp.*)

Syn. and Ref.—*Asaphus seticornis.* Hisinger Leth. Suec. Pl. 37. fig. 2.

Sp. Ch.—Cephalic shield closely granulated, nearly semicircular, about twice as wide as long; angles prolonged into slender spines directly backwards; margin broad, four rows of punctures in front, more numerous at the sides, usually a smooth furrow separates the outer two rows of punctures from the rest; *glabella* having the anterior half nearly spherical, posterior half abruptly contracted to a narrow neck, with a distinct neck-furrow and two short segmental furrows at each side, the ends forming three deep punctures in casts; *cheeks* spherical triangles, convex, as high as wide, traversed diagonally by the eye-line and having a small ocular tubercle in the middle; *pygidium* obtusely rounded, more than twice as wide as long, seven segments in the axal lobe, six on the lateral lobes. Length of head about five lines.

Position and Locality.—In the slates of Moel y Gunnedd uchaf, W. of Bala Lake, Merionethshire; Alt yr Anker, Meifod, Montgomeryshire; Cwm of the Cymmerig, Bala.

Genus. AMPYX (*Dal.*)

Gen. Char.—*Buckler* trigonal; *glabella* very large and prominent, narrow behind, and having a long slender process projecting upwards and forwards from its anterior end; *cheeks* flattened, posterior lateral angles prolonged backwards into long slender spines; (? no eyes nor eye-lines); *thorax* of five or six flattened segments, the sides straight, divided by a large diagonal pleural groove, which is narrow and close to the upper edge near the axis, gradually widening towards the obtuse ends; *pygidium* nearly as large as the buckler, subtrigonal, one strong anterior segmental furrow; axis faintly marked with numerous transverse furrows, sides smooth or ribbed, flat, with a narrow vertical margin.

From the examination of a vast number of specimens in various states of preservation, I think I have ascertained the course of the facial sutures in the *A. nasutus* (Dal.) and *A. nudus* (Murch. Sp.); they run almost parallel with the furrows which separate the glabella from the cheeks on each side, from the front nearly to the posterior margin, near which they turn outward and finally cut it at a short distance from the base of the glabella; there is a tumid spot about the middle of the eye-line which may be an eye, the proximity to the sides of the glabella rendering it difficult to detect

AMPYX LATUS (*M^cCoy*). Pl. 1. E. fig. 13.

Ref.—M'Coy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—Entire animal transversely oval, length one-fifth less than the width; *cephalic shield* smooth, front margin regularly curved, width three-fifths the length; *glabella* moderately tumid, pyriform, having a narrow vertically elongate (? ocular) swelling close to the middle third of each side, and two short, minute, segmental furrows at each side of the narrow base; *thoracic segments* five, pleuripedes of each side twice the width of the axal lobe; *pygidium* very obtusely and regularly rounded, four times wider than long, axis with about seventeen minute segmental furrows, sides with about eight. Length of entire animal three and a half lines.

This rare species is most allied to the *A. parvulus* (Forb.) and the *A. nasutus* (Dal.), from both which the perfect animal is easily known by its transversely oval form; the regular curvature, and great width of the cephalic shield, and of the pygidium, easily distinguish these parts when found separate; the latter agreeing nearly in form with that of the *A. parvulus*, from which it differs equally with the other in all the other characters of cephalic shield, &c.

Position and Locality.—Rare in the Black shale, three miles N. of Builth, Radnorshire.

Explanation of Figures.—Pl. 1. E. fig. 13. Natural size, black shale, three miles N. of Builth.—Fig. 13 *a*. Ditto, magnified three diameters.

AMPYX NUDUS (*Murch. Sp.*)

Ref. and Syn.—Mem. Geol. Surv. Dec. 2. t. 10. *Trinucleus nudus* Murch. Sil. Syst. p. 660. t. 23. f. 5.

Sp. Ch.—Entire animal longitudinally ovate, length about one-fourth more than the width; *cephalic shield* smooth, about two-fifths the length of the animal, about twice as wide as long; *glabella* very tumid, pyriform, with a short spine projecting from the convex front, narrowed posteriorly and with two short segmental furrows at each side of the base; *antennary pores* large, in the furrow between the cheeks and the glabella near the front margin; *cheeks* longer than wide; *thoracic segments* six, pleuripedes one-third wider than the axal lobe; *pygidium* triangular, slightly mucronate, twice as wide as long, the axis with sixteen segmental furrows, the sides with nine. Average length of cephalic shield, five lines.

At about half the length of the eye-line there is an elongate swelling which may indicate the position of an eye.

Position and Locality.—Very common in the shale at three miles N. of Builth, Radnorshire: Wellfield, Builth; Tre Gil, S. of Llandeilo.

Genus. OGYGIA (*Brong.*)

Gen. Char.—Body ovate, flattened, not contractile; *buckler* semicircular, flattened, with the angles produced backwards into flat spines; *cheeks* large, continuous beneath the front margin; *glabella* indistinctly clavate, with three very indistinct lateral segmental furrows on each side; *eyes* semicircular, moderate, corresponding in height to the two anterior lobes of the glabella, reniform; *eye-line* coinciding with the margin in the front, then abruptly bending towards the eye, over which each forms the eye-lobe, and thence diverges to cut the posterior margin about the outer third of each side; *thorax* of eight segments, axis narrow; pleuripedes straight, flat, at least twice as wide as the axis, pointed and falciformly bent backwards at the extremities; no facets, a fine mesial pleural furrow not reaching the end; *pygidium* semielliptical, with a narrow distinct articulated axis, the lateral lobes also with segmental furrows not reaching the margin, and each having a shorter slightly oblique duplicating furrow.

OGYGIA BUCHI (*Brong. Sp.*)

Syn. and Ref.—*Asaphus* id. Brongniart. Crust. Foss. and Murch. Sil. Syst. t. 25. f. 2.

Sp. Ch.—(*Female?*) Broad ovate, one-fourth longer than wide; *cephalic shield* widely arched, about twice and one-fifth wider than long, as long as the thorax; *pleuripedes* about twice and one-fifth wider than the axis; *pygidium* obtusely rounded, the width of the axis and one side lobe taken together at the anterior margin, slightly exceeding its length; *axis* of about fifteen segments, the sides with thirteen.

(*Males?*) Narrow ovate, one-third longer than wide; *cephalic shield* semielliptical, length half the width, as long as the thoracic and one pygidial segments; *pleuripedes* rather more than twice the width of the axis; *pygidium* semielliptical, length slightly exceeding the width of one side and the axis, about twelve double segmental furrows to the sides, and fifteen to the axis.

The figures of Brongniart, Murchison, and Burmeister, represent what I here suppose to be the female; the more lengthened elliptical form, with longer head and more pointed pygidium, which I suspect (from the general analogy of recent crustacea) to be the male of the same species, does not seem to have been previously observed, though nearly as common in all localities as the other*; with the exception of the more slender contour and difference of proportion indicated above, I see no grounds for thinking there is more than a sexual distinction—if others should consider it a distinct species, the name *O. elliptica* might be given to it.

Position and Locality.—Very abundant in the limestone, shales, and Llandeilo flag, three miles N. of Builth, Pen Cerrig and Wellfield, Builth, Radnorshire; Llandeilo, Caermarthenshire.

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* Since the above was written, Mr Salter has noticed the difference in proportion of different specimens, but without drawing any conclusion therefrom. (See the second Decade of the Geol. Survey.)

OGYGIA RADIANS (*M^cCoy*). Pl. 1. F. fig. 2.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—Pygidium nearly semicircular, slightly convex; axis conical, undefined at the end, having three narrow segmental furrows at the anterior end, lateral lobes with three broad radiating ribs faintly divided at their axal ends by a small pleural furrow; margin tumid, entire length four lines, width seven lines.

I provisionally give this name to a small pygidium not unlike that of the *Barrandia Cordai*, but which from the duplicate lateral furrows belongs more probably to *Ogygia*, and probably confirmatory of this view, I observe in the 2nd Decade of the "Geol. Surv." t. 7. f. 5, a small eight-jointed true *Ogygia* from Builth, having the pygidium almost identical with the present species, if, as I suspect, the duplicating furrows have been accidently omitted in the plate (the figure alluded to is given as the probable young of the *Ogygia dilatata* (Phill.) which abounds in the schists at Waterford).

Position and Locality.—Not uncommon in the black shale of Pen Cerrig, Builth, Radnorshire.

Explanation of Figures.—Pl. 1. F. fig. 2. Pygidium natural size, from the black shales of Pen Cerrig, Builth.—Fig. 2 *a*. The same magnified to shew the fine duplicating furrows, as in *Ogygia* generally.

Genus. BARRANDIA (*M^cCoy*).

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Gen. Char.—Body ovate, depressed; *cephalic shield* semicircular, with the lateral angles produced backwards into short spines; *glabella* widely clavate, the axal furrow strong and nearly parallel at the base, becoming obsolete towards the front; *eyes* large, narrow, reniform; *eye-line* behind the eye cutting the posterior margin about the middle, in front of the eyes, arching forwards, first outwards and then inwards; *thorax* of seven segments; *axis* convex, nearly as wide as the pleuræ, tapering towards the pygidium; pleuræ flat, their ends slightly falcate and bent backwards, no facets, a slightly oblique submesial pleural furrow not quite reaching the end; *pygidium* semicircular, entire, having very few simple segmental furrows placed near the anterior margin (one to three in number); *axis* short, having one to three small segmental furrows.

This I conceive to be a subgenus of *Ogygia*, from which it differs in its fewer thoracic segments, and having but very few and simple ribs to the tail. The genus agrees with the description given by Hawle and Corda of their genus *Alceste*, with the exception of this having seven thoracic rings, and that having but four—it is remarkable that *Alceste* is figured by those authors with three segmental furrows to the pygidium, while this has only one, making the *total* number of segments visible the same in both; the number of the pygidial segments, is, however, of course, liable to vary with the species, while the thoracic ones are allowed to be constant. I know but one species, the following. Since the above was written, Mr Salter has given a figure (2nd Decad. Geol. Surv. Pl. 7. f. 4) of a species of this genus, with three segments to the pygidium, which he gives without any apparent reason, as the young of an Irish species of *Ogygia* (*O. dilatata* Phill. = *O. Portlocki*, Salt.) My reasons for dissenting from this view, are, 1st, it is contrary to analogy of other *Trilobites* to suppose that the young and adult differ in the number of their thoracic segments; 2nd, in the Cambridge Collection, specimens of the *O. Buchi*, half an inch wide, have exactly the same number and character of segments as adults, six inches long; 3rd, his supposed young has only been found at Builth, where the Irish species (his supposed adult thereof) has never been found, being only known in the schists of Waterford, where it abounds, but where the supposed young has not occurred.

BARRANDIA CORDAI (*M^cCoy*). Pl. 1. F. fig. 1.

Sp. Ch.—Length one-fourth more than the width; length of head, thorax and pygidium almost equal; *cephalic shield* slightly more than twice as wide as long, lateral angles very short; *eyes* half their length from the axal furrows; *pygidium* depressed, length rather more than half the width, axis two-thirds the length, conical, segmental furrows obtuse. Length eleven lines.

Position and Locality.—Black shale of Builth, Radnorshire.

Explanation of Figures.—Pl. 1. F. fig. 1. Natural size from the black shale of Builth.—Fig. 1 *a.* Two thoracic segments of ditto, magnified to shew the coincidence of their form and pleural furrow with *Ogygia.*

Genus. LICHAS (*Dal.*)

Gen. Char.—*Body* ovate, very flat; *surface* granulated, *head* semicircular; *glabella* large, semioval, with one long segmental furrow curving inwards and downwards from the upper third of the glabella on each side, nearly to the neck-furrow, partially enclosing two large oval spaces, and close to the ends of the neck-furrow a posterior pair of furrows enclose a very small trigonal lobe on each side; *neck-segment* broader than the base of the glabella; *cheeks* small; *eyes* moderately large, reniform; *eye-line* cutting the outer margin in front of the angles; *thorax* of ten segments, *pleuræ* flat, falcate, each with a fine slightly sigmoid pleural furrow, not reaching the margin; *pygidium* semi-oval, axis undefined, the lateral furrows instead of encircling the end, converge about the middle, and diverge again towards the posterior margin, which they do not reach, two short segments at the anterior convex part; side-lobe, flat, of two broad falcate ribs on each side projecting beyond the margin, each with a fine mesial duplicating groove; middle lobe semielliptical, pointed, a small divisional line coming off from the middle of the dorsal furrow on each side, curving downwards and outwards towards its extremity, so as partially to include an oval space on each side.

LICHAS PROPINQUA? (*Bar.*)

Ref.—Barrande. Notice Prélimin. p. 54.

Sp. Ch.—Pygidium semielliptical, obtusely pointed; *axis* semicylindrical, about one-third the entire length, of two narrow ring-shaped joints and a conical slightly longer portion, which becoming abruptly narrow and depressed is continued as an obscure ridge to the end; the three flat side-lobes each duplicate by a strong sulcus reaching almost the whole length, and slightly nearer the posterior than the anterior margin; the posterior pair of lobes anchylosed with the centre in one lozenge-shaped piece, the ends of the two upper pairs slightly project separately at the margin; *surface* covered with very unequal, sharp, conical granules, their own diameter apart. Length one inch two lines, width the same.

The only doubt I have in referring this fossil to Barrande's species, with which it agrees in form and peculiar granulation, is that he compares the form with the *L. scabra* (Bey.), without saying whether the extremity is notched, as in that species, or not.

Position and Locality.—Coniston limestone, Coniston Water-Head, Lancashire.

Subgenus. ACANTHOPYGE (*Hawle and Corda*).

Gen. Char.—*Cephalic shield* semicircular, with the lateral angles produced backwards into small spines; *glabella* large, moderately gibbous, narrow at the base, from whence nearly to the anterior margin the middle portion is nearly parallel-sided, defined by the retroflexion of the anterior pair of segmental furrows, which enclose on each side a large oval, very gibbous, space by their confluence behind with the lateral bounding furrow of the glabella; a little below this a posterior segmental furrow forms a simple transverse line, parallel with the neck-furrow and a little anterior to it, the enclosed space about equalling the neck-segment in size, often with a tubercle at each end; *cheeks* triangular, gibbous, having a small rounded eye-lobe near their upper and outer part, from which the eye-line runs directly upwards and inwards towards the glabella, and backwards and outwards to cut the external margin a little in front of the lateral angles; *surface* granulated; *pygidium* semielliptical, the apex terminating in two long spines, axis suddenly attenuated posteriorly, of one joint, sides flat, each with two narrow prominent ribs, running out at the margin to long spines.

The simplicity of the head, there being but one enclosed space on each side of the glabella, and the transverse segmental furrow in front of the neck-furrow (which is not indicated clearly by Hawle and Corda), separate the genus from the other groups of *Lichas*, &c.

ACANTHOPYGE ANGLICA (*Bey. Sp.*)*

Ref. and Syn.—*Arges Anglicus* (Bey. Untersuch. über Trilobiten).

Sp. Ch.—*Cephalic shield* about four lines long; middle part of the glabella two lines wide, the gibbous oval space on each side about one and half lines wide; granulation scattered, of numerous unequal mammilated tubercles, the spaces between which are minutely granulated.

This species has been placed by Beyrich in the genus *Arges* from which the presence of the eye-lid alone would separate it; as it seems to agree correctly with *Acanthopyge* of Hawle and Corda, I have placed it in that genus. By the imperfect description I should have supposed the *Lichas parva* of Barrande allied to this, but as Hawle and Corda in redescribing that species, make no mention of Beyrich's figure, I suppose they are distinct.

Position and Locality.—Wenlock Limestone, Dudley.

Genus. TROCHURUS (*Barr.*)

Syn. = *Corydocephalus* (Hawle and Corda.)

Gen. Char.—*Cephalathorax* semicircular, lateral angles a little prolonged; *glabella* large, gibbous, middle portion narrow, subclavate; three segmental lobes on each side large, the anterior pair obliquely pyriform, the middle pair oblique, oval, the posterior pair much smaller, transversly oval; *neck-furrow* strong, not wider than the base of the glabella; *cheeks* triangular; *eyes* small; *eye-line* cutting the lateral margin in front of the angles; body of eleven segments, pleuræ flat, slightly falcate, and rather wider than the axis, each with a fine slightly sigmoid pleural furrow, not reaching the edge; no facets; *pygidium* semicircular, axis narrow, three-jointed, two first joints narrow, ring-shaped, third contracted, extending to the margin which is thickened, sides flat, each with two narrow straight segmental ridges, extending from the axis beyond the thickened margin into thick narrow spines, the middle of the margin at the end of the axis produced into two small spines, extending backwards like the rest.

The number of the body-rings, and form of the pygidium and glabella, separate this genus from *Lichas*. See description of *Staurocephalus* below.

TROCHURUS NODULOSUS (*Salt. Sp.*) Pl. 1. F. fig. 16.

Syn.—*Lichas nodulosus* (Salt. in Ap.)

Sp. Ch.—*Pygidium* semielliptical, *axis* semicylindrical, reaching little more than half-way to the margin, rather less than its anterior half occupied by three narrow ring-like segments, the terminal mass very gibbous, and connected with the thickened margin by an abruptly smaller slender prolongation; lateral lobes, with two broad segments on each side, gibbous, most so near the margin, each divided by a wide mesial sulcus, and extending beyond the margin in a long slender flattened spine directed backwards; the middle lobe has a broad thickened margin; on each side of the small mesial ridge two tumid spaces, separated by a longitudinal sulcus, not crossing the margin; two thick spines extending backwards, one on each side of the middle; *surface* with fine close granules and small scattered obtuse tubercles. Length, three and half lines, width five and half lines.

Position and Locality.—Rare in the schists of Pont y Glyn, Diffwys, near Corwen.

Explanation of Figure.—Pl. 1. F. fig. 16.—Pygidium natural size.

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* As this sheet was going to press I received the Journal of the Geological Society for August 1850, in which Mr Fletcher gives figures of this species under the name *Lichas Bucklandi* (Milne Edw. sp.)—but as M. Edwards' name was merely given to an unintelligible figure, without description of any of the essential parts, there can be little doubt that Beyrich's name is the proper one to use.

4th Subfamily. PARADOXINÆ.

Pleuræ flat, horizontal, without facets, with a straight pleural groove, and terminating in spines inclining backwards.

This subfamily is composed of a group of long-bodied Trilobites, having for the most part large cephalic shields, with the angles prolonged into spines, and very small flat caudal shields of few segments; none of them, I believe, can roll into a ball; their pleuræ are very wide and horizontal, not bent downwards at the ends, so that the body is flat; they are destitute of facets, and have a long straight pleural groove extending their whole length, dividing each into two tumid portions, one or both of which are extended into long sharp spines, inclining obliquely backwards. This latter character, of all the pleuræ terminating in separated spines, gives a peculiar physiognomy to the Trilobites of this group. The thoracic segments vary from eight to twenty-three in number;

The principal British Genera are, 1st, *Paradoxides* (*Olenus* being regarded as a subgenus); 2nd, *Acidaspis;* 3rd, *Staurocephalus;* 4th, *Ceraurus;* 5th, *Eccoptochile;* 6th, *Sphærexochus;* 7th, *Zethus.*

Genus. ACIDASPIS (*Murch.*)

Syn.—Odontopleura (Emmerich.)

Gen. Char.—Cephalic shield wider than long, subquadrate or semicircular, margin tumid, often spinous, lateral angles forming long slender spines; *glabella* convex, narrow in front, not reaching the front margin, with two or three lateral lobes on each side, base prolonged backwards into one or two long thick spines; antennary pores usually distinct, close to the front of the glabella; *eye-line* tumid, cutting the margin on each side in front of the glabella, and extending from the *eyes*, which are very small, to the posterior margin rather nearer the angles than the glabella on each side; *thorax* of eight joints, axis convex, narrow; *pleuræ* wide, perfectly flat, each with a nearly mesial pleural furrow parallel with the margin, the upper portion thickest, prolonged beyond the posterior, and terminating in a long spine deflected at a considerable angle backwards; *pygidium* small, semicircular, axis very short, of two joints, sides flat with but one segmental furrow, ending in a long spine at the margin of each side, the rest of the margin with many smaller spines.

ACIDASPIS BRIGHTII (*Murch.*)

Ref.—Murch. Sil. Syst. t. 14. f. 15.

Sp. Ch.—Cephalic shield convex, subsemicircular, front flattened, limb thick, rounded, denticulate at the sides, produced at the angles into long, slightly flexuous, obtusely rounded spines; *glabella* convex, strongly defined, narrow and rounded in front, widening towards the base, each side with a pair of large spheroidal segmental tubercles, the posterior ones largest; *cheeks* small, very tumid; *eyes* situated near the base of the glabella; a narrow ridge extends from the eye on each side to the antennary punctures, which are large, on each side of the front of the glabella; *neck-segment* prolonged horizontally backwards into an appendage, wide and triangular at its origin, rapidly tapering to a rounded extremity, equalling that of the lateral angles in size and shape; surface covered with a small, very unequal scattered granulation. Length of head excluding the neck-segment two and half lines, length of produced neck segment three and half lines, width at base of cheeks six lines.

Position and Locality.—Not uncommon in the Wenlock limestone of Dudley; of small size in the olive-schists Blain y Cwm, W. of Nantyre, Glyn Ceiriog, Denbighshire.

Genus. STAUROCEPHALUS (*Barr.*)

Syn.— = *Staurocephalus* + *Trochurus.*

Gen. Char.—Cephalic shield granulose, front half of the *glabella* spherical, posterior half abruptly contracted to a small cylindrical neck, marked on each side with two minute segmental furrows, exclusive of the *neck-furrow*, which is very broad and deep; *neck-segment* large, with a short spine on its middle; *cheeks* triangular, gibbous, the angles prolonged backwards into sharp spines; *eyes* large, prominent, near the outer margin; *eye-line* coming from the front to the eye with an outward curve, and extending thence with an outward curve to a little in front of the angle; *thorax* with nine segments; *pleuræ* broad, flat, straight, and longitudinally furrowed, one half only reaching the margin, the other thicker and produced beyond into a slender spine, bent abruptly backwards; *pygidium* small, quadrate, axis of four segments, the first three narrow, the last large, semicircular; side lobes flat, with three small segmental furrows, and the margin produced backwards into six slender spines.

The genus *Trochurus* of Beyrich was originally founded on the head of this genus and a tail belonging to the group of *Lichas*, and he only figured the latter part; subsequently Barrande proposed the generic term *Staurocephalus* for the head alone, which was adopted by Beyrich in his subsequent memoir, "Untersuchungen über Trilobiten," for the head; and the tail, formerly called by him *Trochurus*, for which he had now found the true head, was placed in the genus *Arges;* lastly, Hawle and Corda figured and described the entire animal, and restored to it Beyrich's old name *Trochurus;* and to the originally figured tail of *Trochurus* and its subsequently found true head they gave the name *Corydocephalus*. As this would be productive of much confusion, I have used Barrande's name (sanctioned by Beyrich) for the animal to which the head described belongs, and to the tail originally figured by Beyrich as the *T. speciosus*, the type of this genus *Trochurus*, (subsequently named by him, with its appropriate head, *Arges speciosus*, and perfect specimens of which have been figured by Hawle and Corda in their "Monog. böhm. Tril." under the new name *Corydocephalus flabellatus*) I have retained the original name *Trochurus*.

STAUROCEPHALUS MURCHISONI (*Bar.*) Pl. 1. F. fig. 15.

Ref.—Barrande, Notice, p. 53.

Sp. Ch.—Anterior half of glabella an oblate spheroid, slightly wider than long, posterior half abruptly narrowed to a small stem-like, cylindrical neck, about one-third the diameter of the front half; *cheeks* hemispherical; surface with a strong granulation, the granules sharp, subequal, and nearly their diameter apart. Length two and half lines, width four lines.

I have only seen the head of this interesting addition to our list of British Trilobites, which I detected in a small parcel of duplicate *Trinuclei* labelled *Trinucleus seticornis* by Mr Salter, to whom they had been lent to illustrate (I believe) his paper on *Trinucleus;* but the resemblance to that species and genus seem to me deceptive, the large eyes alone separating the heads easily, in my opinion.

Position and Locality.—Very rare in the limestone of Rhiwlas, W. of Bala Lake, Merionethshire.

Explanation of Figures.—Pl. 1. F. fig. 15. Glabella and part of cheeks, natural size.—Fig. 15 *a*. Ditto magnified.

Genus. CERAURUS (*Green.*) (as here redefined.)

= *Chirurus* (Beyrich).

Gen. Char.—*Cephalic shield* granulated, semicircular, lateral angles prolonged into spines; *glabella* clavate, reaching the front margin, gibbous, with three subequal segmental furrows on each side, the basal one retroflexed; *eyes* small in the midst of the cheeks; *eye-line* going from their base directly to the outer margin, which they cut considerably in front of the angles; *thorax* of eleven segments; *pleuræ* wider than the axis, each having its origin thickened into a large oblong tubercle cleft by a deep diagonal pleural sulcus; a little beyond this a small rounded tubercle, beyond which the extremity is flat and falcately pointed; *pygidium* with a short four-jointed axis, and the margin produced into three strong spines on each side, the anterior largest.

A careful examination of the details of the original specimen of Green's *Ceraurus*, recently published by Hall in his Palæontology of New York, satisfies me there is no difference between that genus and the *Chirurus* of Beyrich, as restricted by Hawle and Corda; which latter I therefore propose to suppress as a synonym, Green's type being *specifically* distinguished by the unusual length of the anterior marginal spine of the pygidium on each side.

CERAURUS CLAVIFRONS (*Dal. Sp.*) Pl. 1. F. fig. 11, 12; and Pl. 1. G. fig. 9.

Ref. and Syn.—*Calymene clavifrons* (Dal.) = *Chirurus globosus* (Bar.) = *Sphærexochus juvenis* (Salt.) Mem. Geol. Surv. (Pt. 1. t. 7. f. 1, 3.—Corrected to *S. clavifrons* Dalm. in list of plates in same work.)

Sp. Ch.—Cephalic shield semielliptical, width twice the length, lateral angles prolonged into short spines; glabella large, ovate, very gibbous, about one-fifth longer than wide, and half as high as wide, minutely granulose; basal pair of segmental furrows wide and deep, curved backwards nearly to the neck-furrow, but not confluent with it, partially enclosing a subovate space on each side about as wide* as the intervening portion of the glabella; middle and anterior pair of side furrows also curved downwards, and nearly as strong as the basal pair, the anterior pair about half the length of the basal, the middle pair rather more; neck-segment strong; cheeks tumid, triangular, much more closely pitted than the glabella; eyes small, on a line with the middle segmental furrow; eye-line going horizontally from thence to the outer margin. Length of head from five to nine lines.

This agrees exactly with the head Beyrich (Ueber, böhm. Tril. p. 22) supposes to be the *C. clavifrons* of Dalmann, and also with the head ascribed by Lovén to the same species, with the single exception of their not noticing the more gröber coarse pitting of the cheeks, which however might be easily overlooked—if there were any doubt on the point Barrande's name might be used, as his description under the name *Chirurus globosus* applies exactly. The discrepancy pointed out by Mr Salter in the Mem. of the Geol. Survey does not really exist; our specimen (figure three) shewing the commencement of the prolonged lateral angles beyond what he imagined to be the tumid rounded margin. The reference of the species to *Sphærexochus* is negatived by the presence of all the characters which distinguish the head of that genus from *Chirurus* (*Ceraurus*), namely, the direction of the eye-line, form of the lateral angles, and size of the two anterior pair of segmental furrows.

Position and Locality.—Applethwaite Common, Westmoreland; S. W. of Cefn Grugos, Llanfyllin, Montgomeryshire (passage beds); Cader Dinmael, Denbighshire; Llwyn y Ci, N. W. of Bala, Merionethshire.

? Caradoc (Bala) 17. p. 338, Murch. Sil. p. 79.

Explanation of Figures.—Pl. 1. F. fig. 11. Small specimen of glabella, shewing the extent of the segmental furrows, from the limestone of Llwyn y Ci.—Fig. 11 *a*. Profile of ditto, magnified.—Fig. 11 *b*. Granulation of ditto, magnified.—Fig. 12. Glabella and part of cheeks of large crushed specimen from Applethwaite Common.—Pl. 1. G. fig. 9. Profile of part of head, natural size, from Cefn Grugos.—Fig. 9 *a*. Front view of another specimen from schists of Cader Dinmael (spaces enclosed by posterior furrows too small in this figure of Mr Salter's.)

CERAURUS OCTO-LOBATUS (*M^cCoy*). Pl. 1. G. fig. 10.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—*Pygidium* transversely elliptical, twice as wide as long, two first rings of the axis narrow, distinct, third or terminal one large, terminating in four flattened elliptically pointed lobes; two rather larger similar lobes on each side. Length two and half lines.

This curious little species differs from all of this and the allied genera in having the terminal segment of the pygidium quadrilobate, so that the margin of the pygidium exhibits eight marginal pointed lobes in all. It is figured in the Memoirs of the Geol. Survey, from Shole's Hook, under the same reference as the cephalic shields there called *Sphærexochus juvenis* (Salter)†, but not alluded to in the text.

Position and Locality.—In the limestone of Rhiwlas, N. of Bala Lake, Merionethshire.

Explanation of Figures.—Pl. 1. G. fig. 10. Pygidium, natural size from Rhiwlas.—Fig. 10 *a*. Ditto, magnified.

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* Mr Salter's figure in this work, and those of this species in the Mem. of the Geol. Survey, are deceptive in this particular.

† Corrected subsequently to *S. clavifrons* (Dal.) in the list of plates prefixed to the same work.

CERAURUS WILLIAMSI (*M'Coy*). Pl. 1. F. fig. 13.

Ref.—M'Coy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—*Cephalic shield* semielliptical, length rather more than half the width; *glabella* semicylindrical, gibbous, rounded in front, with nearly parallel sides, three nearly equidistant, curved, segmental furrows on each side, the basal pair nearly confluent at their ends with the neck-furrow, enclosing a tumid ovate space on each side, separated by an undivided space about one-fourth of the width of the glabella; *thorax* twice the length of the glabella, axal segments large, two-thirds the width of the pleuræ, each of which has a very large, oblong tubercle at its margin, diagonally cleft by the pleural sulcus, and followed at one-third from axis by a hemispherical tubercle, about half its diameter distant from the first, beyond which the distal two-thirds of each pleura is falciformly dilated into a thin, flat, fin-like appendage, the anterior margin of which is very convex, posterior margin slightly concave, extremity pointed; *pygidium* small, the six marginal spines small, all extending about the same distance backwards, the anterior pair therefore longest; they are thick, triangular, and three or four times wider than the others. Length of entire animal one inch four lines, of glabella five lines, width about nine lines.

The disconnected, broadly falcate, paddle-shaped pleuræ help to distinguish this beautiful little species, which by its narrow elongate form resembles a *Remopleurides*.

Position and Locality.—One entire specimen, collected from the schists of Golu Goed, Myddfai, by Mr Williams, of Llandovery, and presented to Professor Sedgwick by him.

Explanation of Figures.—Pl. 1. F. fig. 13. Entire animal, natural size—Fig. 13 *a*. Profile of ditto.—Fig. 13 *b*. Two pleuræ and portion of axis magnified.

Genus. ECCOPTOCHILE (*Hawle and Corda*).

Syn. < *Chirurus* (Beyrich) and? *Cryphæus* pars Green.

Gen. Char.—*Cephalic shield* rounded, glabella semicylindrical, convex, extending as far as the front margin, with three short segmental furrows on each side, the lower pair curving inwards and downwards; *cheeks* moderately convex, rugose, lateral angles extended into short spines; eye-line cutting the lateral margins, considerably in front of the angles; (eyes small, facetted *fid.* Corda); *thorax* of twelve joints, axis convex, smooth, pleuræ much wider than the axis, ending in thick deflected contracted points; *pleural groove* straight, nearly mesial, and parallel with the margins, pitted, ceasing at the thickened base of the terminal spine; *pygidium* of four joints, those of the axis simple, the terminal one subtrigonal; lateral ribs three on each side, two first pair with a pleural pitted groove, all six ending each in a broad ovate terminal expansion.

ECCOPTOCHILE SEDGWICKI (*M'Coy*). Pl. 1. F. fig. 14.

Ref. and Syn.—*Cryphæus Sedgwicki*, M'Coy, Ann. Nat. Hist. 2nd Series, Vol. IV. p. 406.

Sp. Ch.—*Cephalic shield* subsemicircular; *glabella* slightly clavate, smooth, three segmental furrows on each side, the posterior pair longest, turning backwards and inwards nearly to the neck-furrow, enclosing a triangular space on each side longer than wide, the width rather less than that of the undivided portion of the glabella between their bases, the two anterior pair of furrows shorter; *cheeks* broad, gently convex, closely and coarsely pitted; *neck-segment* thick, smooth; *eye-line* extending with a slight curve to the margin in front of the angles; *axal lobe* very convex, narrow, slightly tapering, nearly parallel-sided, smooth, of twelve segments, three similar belong to the pygidium, a fourth terminal one being obtusely trigonal; the *side lobes* are flattened, and more than double the width of the axal lobe; *pleuræ* nearly straight, narrow, and for the greater part of their length flattened, and having a broad, nearly mesial, pleural sulcus, deeply punctured like the cheeks, dividing each into two parts, the posterior largest and forming a thick, smooth, rounded ridge, in the distal third of its length bent down and a little backwards, swelling to a thick narrow ridge in the middle, the sides and the extremity expanding into a broad, thin, foliaceous appendage; the *pygidium* terminates in six broad, ovate, leaf-like, semimembranous flaps. Length of thorax and pygidium two inches two lines, width two inches three lines, width of axal lobe six lines.

This magnificent trilobite can only be confounded with the *Eccoptochile clavigera* (Bey. Sp.), from which it is distinguished by the much greater width of the lateral lobes of the thorax, and the thin, flat, leaf-like appendages of the pygidium, which in that species resemble thick pear-shaped clubs. A comparison with the old description and casts, published by Green, induces me to place this trilobite in his little-known genus *Cryphæus*, and to doubt very much the propriety of separating the genus *Eccoptochile* of Hawle and Corda from it; but as there are two forms confounded under this name by Green, and the one now best known in America by his name being the type allied to *Phacops arachnoides* (*Asteropyge* H. and C.), I use the Bohemian genus for the present fossil, in accordance with the suggestion of M. de Verneuil.

Position and Locality.—The nearly entire specimen described was collected by Prof. Sedgwick from the black shale, two miles N. of Builth, Radnorshire.

Explanation of Figure.—Pl. 1. F. fig. 14. Entire specimen, natural size.

Genus. ZETHUS (*Pand.*) (as defined by Volborth).

Syn. = *Cybele* Lovén. + *Atractopyge* Hawle and Corda.

Gen. Ch.—Ovate, rapidly tapering from the *cephalic shield* which is nearly semicircular, with the lateral angles forming short spines; *glabella* clavate, narrowing towards the axis, coarsely tuberculated, three small straight more or less distinct segmental furrows on each side of the base; *neck-segment* strong and smooth; *cheeks* triangular, flattened, coarsely tuberculated, posterior margin thick and smooth; *eyes* forming small tubercles near the middle of the anterior margin, with an apparently smooth cornea; *facial suture* terminating at the angles of the head behind; *thoracic segments* eleven*; *pleuræ* divided by a small angulated furrow, their extremities often produced; *pygidium* triangular, axis rounded with many joints, much curved downwards; side lobes nearly vertical, the ribs few (four to seven) deflected nearly from their origin.

This genus is intermediate between *Phacops* and *Calymene* in the form of its head and glabella, and agrees with the former in the number of body-segments, and with the latter in the course of the eye-line; the pygidium approaches in some measure to *Encrinurus*, which differs by its elevated eye-pedicles, and the Phacops-like course of the eye-line.

I follow Dr Volborth (see his paper *Ueber einige russischen Trilobiten* in the *Verhandlungen der russisch-kaiserlichen Min. Gesellschaft zu St Petersburg* for 1847) in referring *Cybele* of Lovén to *Zethus* of Pander; and after a most careful consideration of the different species, I find so imperceptible a gradation in structure of pygidium from *Atractopyge*, in which the four upper axal segments are prolonged into the side lobes, and deflected close along the axis (believing with Lovén that those are really pygidial segments), to those in which two or three more lateral ribs are added, that I also feel satisfied that *Atractopyge* of Hawle and Corda should be added to *Zethus*.

ZETHUS ATRACTOPYGE (*M^cCoy*). Pl. 1. G. fig. 1 to 5.

Syn.—*Cybele verrucosa* Lovén, (not *Zethus verrucosus* Pander) = *Atractopyge verrucosa* (Hawle and Corda).

Sp. Ch.—*Cephalic shield* coarsely tuberculated, rounded, about three times wider than long; *glabella* clavate, convex, front obtusely rounded, not reaching the margin, basal two-thirds narrowed, nearly parallel-sided, with three strong nearly equal segmental furrows on each side; *eyes* small, about one-third nearer the glabella than the lateral angles; *neck-segment* narrow; *thorax* having the segments narrow, those of the axis terminating in a tubercle at each end (not well shewn in the figure); *pleuræ* having a horizontal

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* The difficulty, without great care, of distinguishing between the thoracic and pygidial segments may account for the different numbers occasionally assigned to the former.

portion about as wide as the axis, divided by a straight pleural groove into a large, very convex, anterior, tuberculated portion, and a narrow smooth posterior portion; beyond this the extremities are free and gently arched backwards and a little downwards for nearly as great a length; *pygidium* subrhomboidal, length about two-thirds the width, anterior margin very much arched, longer than the posterior; axis narrow, conical, of about twenty narrow segments, of which only the first four reach entirely across; the others being confined to the sides, leave a smooth space down the middle, which is bordered by an obscure double row of tubercles (in the sandstone casts the axal segments all seem to go across); broad lateral lobes of only four ribs, which are continuous at their origin with the four anterior axal segments; each bears an irregular row of tubercles, and terminates in a slightly projecting blunt extremity. Length of head about seven lines, of pygidium nine lines.

In placing this species (which is the *Cybele verrucosa* of Lovén) in the genus *Zethus*, I have been obliged to propose a new specific name for it, as it is not the *Z. verrucosus* of Pander, and as I cannot agree with Volborth in referring it to the *C. bellatula* of Dalmann. Having in the article on the genus stated the reasons for uniting the genera *Zethus* of Pander and *Atractopyge* of Hawle and Corda, of which latter genus the present species formed the type, I have used the generic name of those authors to designate the species.

Position and Locality.—Not uncommon in the schists of Ravenstone Dale and Coniston, also in the sandstone of Alt yr Anker, Meifod, Montgomeryshire.

Explanation of Figures.—Pl. 1. G. fig. 1. Part of head and part of thorax, natural size, from the schist of Ravenstone Dale.—Fig. 2 and 3. Pygidium, natural size, from the slate of Coniston.—Fig. 4. Do. Magnified.—Fig. 5. Part of head a little larger than natural.—Fig. 5 *a*. Portion of fig. 5 magnified.

ZETHUS SEXCOSTATUS (*Salt. Sp.*) Pl. 1. G. fig. 6 and 7.

Ref. and Syn.—*Cybele sexcostata.* Salt. Mem. Geol. Surv. Vol. II. Pt. 1. t. 8. f. 9, 10.

Sp. Ch.—*Pygidium* twice as wide as long, subtriangular, or slightly rhomboidal from the backward curve of the front margin; axis narrow, cylindrical or very gradually tapering, of about twenty minute segments and an abruptly deflected tripartite smooth termination, and two obscure rows of minute tubercles, one pair on each segment; side lobes with six or seven strong obtuse ribs without tubercles, the first two pair nearly horizontal for the first third or half of their length, then abruptly curved almost vertically downwards, the others bent down nearly from their origin, the ends projecting beyond the margin in the casts. Average length six lines.

Position and Locality.—Abundant in the limestone of Rhiwlas N. of Bala Lake, Merionethshire, Llwyn y Ci, N.W. of Bala, Merionethshire.

Explanation of Figures.—Pl. 1. G. fig. 6. Pygidium, natural size, from the schists of Rhiwlas.—Fig. 7. Larger individual, same locality.

ZETHUS VARIOLARIS (*Brong. Sp.*)

Ref. and Syn.—*Calymene variolaris?* Brong. *pars* (t. 1. f. 3 B.) id Murch. Sil. Syst. t. 14. f. 1.

Sp. Ch.—*Cephalic shield* rather more than twice as wide as long, obscurely trilobed in front by the projection of the broad front of the glabella, which is broadly clavate; height and width of the cheeks about equal, lateral angles slightly produced; *eyes* nearly marginal, rather nearer to the glabella than to the lateral angles; tubercles of the surface coarse, irregular, obtuse, each with a little pit on its summit, three on each side of the base of the glabella larger than the rest (? segmental); posterior margin of the head, and neck-segment smooth, and resembling one of the thoracic segments in character; *thorax* one-third longer than the glabella, axis nearly as wide as the pleuræ above, narrowing posteriorly, the few last segments having obtuse tubercular ends; *pleuræ* with their posterior portion very small, anterior portion thickened and produced beyond the margin, anterior segments slightly bent down, and either horizontal or directed a little forwards at their extremities, posterior ones abruptly curved down about the middle or nearer the axis, nearly to right angles with their origin, and directed backwards, nearly smooth, with a few small irregular tubercles: *pygidium* much curved downwards, obtusely pointed, sides straight, nearly vertical; axis with about nine to eleven distinct segments, each of those near the end, and every alternate one above, with a strong tubercle at the middle, and all having one at each end; sides with seven or eight rounded ribs, having a tubercle at their origin, their ends blunt and prominent, and a few tubercles between. Length one inch three lines, width ten lines.

I have not ascertained whether the ends of the posterior pleuræ are prolonged in this species; they are all marked with obscure tubercles.—The distinction in character between the thoracic and pygidial segments is not marked in the figure in the Sil. System, giving the appearance of too many body-segments. (They are only eleven). Brongniart's figure, t. 1. f. 3. A. though agreeing closely in many respects with the other specimen, seems to differ in the great number of lateral segments to the axis of the pygidium, (so also Mr Curtis' original figure, apparently of the same specimen in Buckland Bridg. Treatise, t. 46. f. 6, under the name *Asaphus tuberculatus*); and finally Mr Fletcher has just published figures of exactly similar specimens in the Quarterly Geol. Journal of London, Vol. VI. t. 32. (under the name *Cybele punctata*), which clearly prove the species to be a good one of the genus *Encrinurus* by its eye-line and cephalic angles, and easily distinguishable from the true *E. punctatus* by the narrow, tuberculated body segments, &c.

Position and Locality.—Not uncommon in the Wenlock limestone of Dudley.

Genus. ENCRINURUS. (*Emmerich*).

Gen. Char.—Elongate ovate; *cephalic shield* semielliptical, tuberculated, the lateral angles produced backwards into spines; *glabella* pear-shaped, with three slightly-indicated segmental furrows at each side of the contracted base; *cheeks* flattened, triangular; *eyes* in the middle of the cheeks, elevated on tall footstalks; *eye-line* extending from behind the eye direct to the outer margin, which it cuts in front of the angles; eleven body-rings shaped as in *Zethus; pygidium* triangular, lateral lobes with about eight segments, very much deflected, sometimes ending in short points; axis narrow, convex, with very numerous, fine segmental lines, often only indicated at the sides, leaving a smooth space down the middle.

This genus has been confounded with *Cybele* of Lovén (*Zethus* Pand.), from which it differs in the course of the eye-line.

ENCRINURUS PUNCTATUS (*Brünn. Sp.*)

Ref. and Syn.—*Entomostracites punctatus* Wahlenberg, Nov. Acta Upsal. *E. Stokesii* M'Coy, Syn. Sil. Fos. Irel. t. 4. f. 15 (not *Cybele punctata* Fletcher, Geol. Jour. Vol. VI. t. 32. fig. 1 to 5).

Sp. Ch.—Entire animal elongate, ovate, more than twice as long as wide; *cephalic shield* semielliptical, length more than half the width, coarsely tuberculated, except the posterior margin, which is broad and smooth; body-rings broad, smooth, lateral lobes scarcely wider than the axis; *pygidium* triangular, pointed, a little longer than wide, having about eight narrow, nearly smooth ribs on each side, bent backwards and much downwards at their ends, the intervening spaces nearly as wide as the ribs, concave, smooth, coming off from the axis at an angle of about 45° (the upper ones rather more, those towards the apex less), the last few embracing the end of the tail; axis with a narrow smooth space down the middle, on which are six or seven small tubercles, each side marked with about twenty-eight segmental furrows, one pair corresponding to each tubercle, and usually three or four pair between one tubercle and the next. Length of entire animal two inches two lines, of pygidium, seven and half lines.

I have figured the perfect animal for the first time in my "Synopsis of the Silurian Fossils of Ireland," under the name *E. Stokesii*, a name which I gave from the difficulty of fixing what was the true species of Brünnich and Wahlenberg, as I was acquainted with many unpublished forms, all sufficiently like to have been confounded with that species. I have since, however, examined so many specimens identical with this, from his original locality, Gothland, that I believe I may safely recur to the old specific name, though the accordance is not at all perfect between the species and the account or figure either of Wahlenberg, in the "Nova Acta Reg. Soc." &c., Upsaliensis, or of Dalmann; the latter, however, agrees with the former, and shews the *smooth* body-rings, which separate the species so widely from that figured in

Brongniart, Pl. 1. fig. 3. A., which has been referred to it by several authors (Mem. Geol. Surv., Burmeister, Fletcher, in Geol. Jour. Vol. VI., &c.), but to which Dr Buckland has applied the specific name *tuberculatus*, which should be retained therefor.

Position and Locality.—Common in the Wenlock limestone, Dudley; sandstone of Pwllheli, Caernarvonshire; Middleton Park, near Sedburgh.

5th Subfamily. ASAPHINÆ (*M^cCoy*).

Pleuræ bent down at the end, and having distinct trigonal facets; thoracic segments eight to thirteen.

This subfamily may be looked on as the type of the entire group, and contains the most perfectly organised trilobites. They all, I believe, have the power of rolling themselves into a ball, and they are the only trilobites having the triangular facets at the anterior part of the extremities of the pleuræ. They have a compact ovate form, and from the deflection of the margin are all of considerable depth.

The subfamily contains the following British groups, to which the rank of families has been assigned by some writers, who, perhaps, magnified their importance from not studying them in connexion with the rest of the class *Crustacea*. I feel satisfied they are of only generic value, and each contains other groups hitherto called genera, but which seem to me only subgenera, and which I have grouped accordingly. 1st, *Phacops;* 2nd, *Calymene;* 3rd, *Trimerocephalus;* 4th, *Asaphus;* 5th, *Illænus;* 6th, *Forbesia;* 7th, *Phillipsia.*

Genus. PHACOPS (in a wider sense than Emmerich.)

Gen. Char.—*Head* large, with the angles prolonged backwards into large spines; *glabella* clavate, wider in front than at the base, and marked with three strong segmental furrows; *eyes* very large, reniform, with a coarsely granular, largely facetted inner cornea; *thoracic segments* eleven; *facial sutures* cutting the lateral margin of the head in front of the angles.

This genus contains the following British sub-genera:—1st, *Phacops;* 2nd, *Odontochile;* 3rd, *Portlockia;* 4th, *Chasmops.*

Sub-genus. PHACOPS (*Em.*)

Gen. Char.—Ovate, contractile; *cephalic shield* semicircular, with a strongly-developed margin, terminating in spinous lateral angles; *glabella* clavate, broadly rounded in front, narrowed posteriorly, sides divided into three lobes, the anterior one on each side much the largest; *eye-line* curving round the glabella in front, bordering the small eyelid over each eye, and then passing from the posterior end of each eye direct to the lateral margin, which it cuts considerably in front of the lateral angle; *eyes* large, reniform, prominent, of many large lenses; *thorax* of eleven segments; *pleuripedes* subtruncate at their ends, facets large, triangular, strongly marked; pleural groove strong, slightly bent downwards at an angle on a level with the apex of the facet; *pygidium* semicircular or pointed, with eight to twelve joints in the axis, sides with about five strong duplex ribs, margin thickened, entire.

PHACOPS ALIFRONS (*Salt. in Ap.*) Pl. 1. G. fig. 12 to 14.

Sp. Ch.—Cephalic shield about twice as wide as long, very gibbous; *glabella* narrow, clavate, elevated, sides nearly straight; front obtusely rounded, projecting beyond the margin, with which, at the sides, it is confluent by a thick wing or horn-shaped extension on each side; (? lateral angles obtusely rounded), surface of the glabella coarsely tuberculated, lateral segmental furrows rather small, not very unequal in size; first lobe largest, first furrow directed obliquely backwards, the rest nearly transverse, with a slight inclination forwards, neck-segment about as thick as the last glabellar segment; cheeks steeply inclined from the glabella towards the lateral angle; surface with smaller granules than the glabella; *eyes* small, reniform, close to the glabella. Length of head nine lines.

The horn-like running out of the sides of the front of the glabella into the thickened margin of the cheeks gives a very peculiar character to the species. The pygidium supposed to belong to it is tumid, very obtusely rounded, width rather more than twice the length, of three tumid lobes, the axis most convex and rather more than half the width of the side lobes, with eight strong rounded segments, lateral lobes with a narrow entire margin and seven strong rounded ridges, the first one or two of which shew a very fine mesial dividing line; length five lines.

Position and Locality.—Caradoc sandstone, Alt yr Anker, Meifod, Montgomeryshire; impure limestone of Capel Garmon, on the Cowney River, Denbighshire; Wilfa, near Penmachno; Pont y Glyn, Diffwys, near Corwen; Cwm of the Cymmerig, Bala, Merionethshire.

Explanation of Figures.—Pl. 1. G. fig. 12. Cephalic shield, natural size, (angles not perfect in specimen), from Capel Garmon.—Fig. 13 and 14. Pygidium natural size, from Pont y Glyn, Diffwys.

PHACOPS DOWNINGIÆ (*Murch. Sp.*)

Syn. and Ref.—*Calymene* Id. Murch. Sil. Syst. t. 14. f. 3.

Sp. Ch.—Ovate, depressed, head and pygidium of equal length; cephalic shield rotundato-trigonal, flattened, slightly more than twice as wide as long, margin obtusely angulated in front, (? lateral angles rounded); *glabella* very minutely and obscurely granulated, clavate depressed, anterior segmental furrows slightly sigmoid, oblique, second and third pair nearly transverse, all the furrows narrow and nearly reaching to the middle, the spaces behind the first pair are triangular, and broader than long, the second pair are transversely oblong, the space behind the third pair forms a nearly perfect transverse segment, only half as thick as the second space, or two-thirds that of the neck-furrow, which is very strong and prominent; first seven rings of the thorax equal to the length of the head; *pygidium* semi-oval, length more than half the width, axis prominent, of seven thick segments, sides with five flattened duplex segments. Length one inch two lines.

Neither the figures in the "Silurian System," nor the "Memoirs of the Geol. Survey," exhibit the intermediary or duplicating furrows on the lateral ribs of the pygidium, they however may be seen to exist.

Position and Locality.—Wenlock limestone of Dudley; Upper Ludlow of Benson Knot, Kendal; Moel Sessiog, Llanrwst.

Sub-genus. ODONTOCHILE (*Hawle and Corda.*)

Syn. = *Dalmannia* Emmerich, (not of Robineau-Desvoidy).

Gen. Char.—General form, *buckler*, *glabella*, *eyes* and *eye-lines*, as in *Phacops*, but the lateral lobes of the glabella more equal; not contractile; *thorax* of eleven segments; *pleuripedes* curved backwards and generally pointed at their extremities, facets very long, narrow rhomboidal, slightly defined; pleural groove strong, slightly sigmoid and oblique (not angulated); *pygidium* elongate, generally pointed, axis with from twelve to twenty-two segmental furrows, sides with fewer (about half the number) strong ribs, usually duplex, confluent at their ends with the thickened entire margin; hypostoma with a dentate edge.

This genus was first noticed by Emmerich under the name *Dalmannia*, which was used fifteen years before for a genus of insects by Robineau-Desvoidy, I therefore use the name of Hawle and Corda, who do not allude to Emmerich's having previously characterised the genus.

ODONTOCHILE CAUDATA (*Brong. Sp.*)

Ref. and Syn.—*Asaphus caudatus* Brong. Crus. Foss. t. 2. f. 4, and Murch. Sil. Syst. t. 7. f. 8.

Sp. Ch.—Ovate, *cephalic shield* depressed, semi-ovate, twice as wide as long, exclusive of the lateral spines, which extend backwards and a little outwards as far as the sixth or seventh segment, confluent at base with the thick strongly defined borders of the circumference and posterior margin; *glabella* broadly clavate, slightly angulated in front, coarsely and irregularly granulated, the anterior pair of segmental furrows broad, and inclining obliquely backwards and inwards, the two posterior pair much narrower and nearly transverse; *eyes* very large conico-reniform; axal segments of the thorax four-fifths the width of the pleuræ, each side with a small tubercle; *pleuræ* gently arched backwards towards their falciform extremity, each with a strong submesial furrow reaching nearly to the end; *pygidium* as long as the head but much narrower, semielliptical, abruptly narrowed towards the apex to form a short flattened solid mucronate point, an extension of the lateral margin; *axis* narrow, of twelve segments, with a faint tubercle at each end, lateral ribs eight, separated by deep furrows, and each divided by a fine medial sulcus. Average length of pygidium one inch, width thirteen lines.

At Underbarrow, and Benson Knot, Kendal, occurs a trilobite about one-third the ordinary size of this, and of which I have not seen the tail, but which seems identical in the characters of the head and body so far as I have seen, except, perhaps, the lateral cephalic spines may be smaller; it was figured in a cancelled plate of this work by Mr Salter as the *P. Downingiæ*, from which however it differs in its more elongate glabella, more equal side-lobes, and coarsely granulated surface (the latter character being overlooked, apparently, by Mr Salter, and not represented in the figure he made of the species). It may for the present be called *Odontochile caudata*, var. *minor*.

Position and Locality.—Very common in the Wenlock limestone of Dudley; Llandeilo, Caermarthenshire; Leintwardine; Llanfair Road, W. of Welshpool; above grits Park Lane.

ODONTOCHILE LONGICAUDATA (*Murch. Sp.*)

Ref. and Syn.—*Asaphus longicaudatus* Murch. Sil. Syst. t. 14. f. 11—13.

Sp. Ch.—Cephalic shield semioval, external defined margin very large, abruptly extended in front into a small, obtuse, tongue-shaped process, extending backwards into very long spines at the lateral angles; *glabella* clavate, moderately gibbous; *pygidium* triangular, sides slightly convex, apex running out into a slender spine as long as the rest of the pygidium, axis narrow, of fourteen or fifteen segments, eight or nine oblique, strongly defined, lateral ribs, each divided by a fine mesial sulcus. Average length of head nine lines, width one inch nine lines.

Position and Locality.—Wenlock shale, Chiney Longville, Shropshire; Middleton Park, Llandeilo.

ODONTOCHILE OBTUSI-CAUDATA (*Salt. Sp.*) Pl. 1. G. fig. 15, 16.

Ref. and Syn.—*Dalmannia obtusi-caudata* (Salt. in Ap.)

Sp. Ch.—Cephalic shield more than twice as wide as long, slightly angulated in front; *glabella* convex, clavate, front portion transversely oval, segmental furrows very strong, reaching nearly across, first pair inclining obliquely inwards and backwards, second pair slightly forwards, third pair horizontal; first lobe equal in size to the second and third together; *neck-furrow* and segment strong and large; *cheeks* depressed, lateral angles with a very small spine; *eyes* small, close to the glabella, little exceeding the first lobe in size, deeply lunate: *pygidium* semielliptical, about twice as wide as long (varies from mechanical causes affecting the matrix), margin narrow, angulated at the apex, but not extended into a point; axis very convex, gradually tapering, about two-thirds the width of the lateral lobes, having twelve rounded segments, lateral lobes flattened, with twelve flattened ribs, each divided by a very fine impressed line. Average length of head ten lines, of pygidium six lines.

In Mr Salter's engraving of this species the neck-furrow is represented as interrupted in the middle, like the lateral segmental furrows of the glabella, but in the specimens it is seen to go right across, as in the other Trilobites.

This species is allied to the *P.* (*O.*) *caudata*, but the margin does not become widened into a flat, triangular point, as in that species; the specimens are much distorted.

Position and Locality.—Very abundant in the calcareous flags over the Coniston limestone of Coldwell, Westmoreland.

Explanation of Figures.—Pl. 1. G. fig. 15. Cephalic shield natural size.—Fig. 16. Pygidium natural size.

ODONTOCHILE TRUNCATO-CAUDATA (*Portk. Sp.*) Pl. 1. G. fig. 20, 21.

Ref. and Syn.—Phacops truncato-caudatus Port. Geol. Rep. t. 2. f. 1. 4. *Dalmannia affinis* (Salt.) Mem. Geol. Surv. Vol. II. Pt. 1. t. 5. f. 5.

Sp. Ch.—Pygidium semielliptical or subtriangular, with the posterior end obtusely truncated and emarginate in the middle; *axis* gradually tapering, rather more than four-fifths the length of the pygidium, and about two-thirds the width of the lateral lobes in front (sometimes a little more or less), of sixteen or eighteen segments; *lateral lobes* with a very narrow entire margin, and fifteen or sixteen broad, flattened ribs, each divided by a very fine impressed line. Average length of pygidium one inch three lines, width the same.

The proportion of the width of the axis to that of the lateral lobes varies considerably from pressure both in the *D. affinis* and in English and Irish specimens of the *P. truncato-caudatus*. The figure given by Mr Salter of his *D. affinis*, in the Mem. Geol. Surv., shews the same proportion of axis to the lateral lobes as Portlock's figure t. 2. f. 4. of his species. Mr Salter in the same work mentions that his species has fifteen or sixteen lateral ribs, which is more than the *P. truncato-caudatus*, but Tyrone specimens of the latter now before me shew the same number; the length of the ribs is certainly the same in both. I at first thought *D. affinis* might be distinguished from the Irish species by the more acute angles at which the lateral ribs set off from the axis; I find this, however, to differ on two sides of the same specimen, and is as marked occasionally in one species as in the other. It is only the pygidium that has occurred to collectors as yet in England, and in the absence of distinctive characters I have reunited the species.

Position and Locality.—Shales of Blain y Cwm, W. of Nantyre, Glyn Ceiriog; the Hollies, Church Stretton, Shropshire.

Explanation of Figures.—Pl. 1. G. fig. 20. Pygidium natural size (type specimen of the *Phacops affinis*, Salt.) - Fig. 21. Small specimen.

Subgenus. PORTLOCKIA (*M^cCoy*).

Gen. Char.—Cephalic shield truncato-orbicular, lateral angles not produced into spines; glabella very large, broad in front, sides converging to a narrow base behind and having (on the outer crust) but one small, segmental furrow at base; *cheeks* small, triangular; *eyes* large, reniform; *eye-lines* extending from the base of the eye to the outer margin, a little in front of the angles; *abdomen* of eleven segments, resembling those of *Phacops; pygidium* small, semielliptically rounded, with a simple, entire margin, of about five to eight segments to the axis and about five to the lateral lobes, each with a very fine mesial divisional line in the distal portion.

I originally proposed this genus in my Sil. Fos. of Ireland in 1846, for those species of *Phacops* in which the two anterior pairs of great segmental lobes of the sides of the glabella were deficient, and the lateral angles of the cephalic shield were not prolonged. The *Calymene Bufo* of Green, *C. macrophthalma* of Murchison, &c. being the types of the genus, which has been recognised as a natural group by Goldfuss, Burmeister, &c., as well as by my friend Col. Portlock, to whom I dedicated the group.

PORTLOCKIA? APICULATA (*Salt. Sp.*) Pl. 1. G. fig. 17 to 19.

Syn.—Phacops apiculatus (Salt. in Ap.)

Sp. Ch.—Cephalic shield moderately convex, semioval, length slightly exceeding half the width. *glabella* semicylindrical, front obtusely rounded, not very much wider than the base, sides nearly straight, converging from the front to the wide neck-furrow; segmental furrows three, nearly equidistant, on each side, the two upper (or anterior) pairs very fine and almost obsolete, basal pair very strong and gently arched backwards; *eyes* long, narrow, semilunar; *cheeks* triangular, longer than wide, sloping from the eye to the rounded lateral angles, furrow at the posterior margin much stronger than the one at the external margin; surface smooth; *pygidium* (supposed of the same species) depressed, semielliptical, length about two-thirds the width, slightly pointed, margin narrow, entire, axis narrow, tapering, strongly projecting at the end, with seven or eight narrow segments, sides slightly convex, with five flattened ribs, each divided by a fine mesial sulcus. Average length of head four lines, of pygidium three lines

This interesting species blends in some measure the characters of the subgenus *Portlockia* with those of *Phacops* proper. I have noticed that all the *Portlockiæ*, though when perfect shewing but the basal pair of segmental furrows to the glabella, yet when decorticated shew faint and delicate traces of the other two pairs, never comparable in strength, however, to the basal pair. All the specimens of the present species are internal casts, therefore shewing the three sets of furrows, but the basal pair being so much stronger than the others favours the idea of its being a *Portlockia*, as no such difference exists in *Phacops* proper. The head and pygidium, here noted, have not been absolutely found in contact.

Position and Locality.—Very common at Maes Meillion, Bala, Merionethshire; Glyn Ceiriog; Bryn Melyn, Bala, Merionethshire; S. W. of Pwllheli, Caernarvonshire; Rhiwargor, near Llanwddyn; Cowney River, Montgomeryshire; Cefn Goch, Llansantfraid; schists of Hengurt Uchaf.

Explanation of Figures.—Pl. 1. G. fig. 17 and 18. Cephalic shields, natural size.—Fig. 19. Pygidium natural size.

PORTLOCKIA STOKESII (*M. Edw. Sp.*)

Ref. and Syn.—*Asaphus macrophthalmus* (Brong. pars. t. 1. fig. 5). *Calymene* id. Sil. Syst. t. 14. f. 2.

Sp. Ch.—*Cephalic shield* semicircular, twice as wide as long; *glabella* subrhomboidal, clavate, the broad front slightly pointed in the middle, granulated; *neck segment* thick and strong, one strong segmental furrow on each side of the narrow base immediately above the neck-furrow, reaching nearly across (on casts of the inner surface I have seen traces of the other two segments as delicate impressed lines not visible on the external crust); *cheeks* tumid, small; *eyes* very large, reniform, coarsely reticulated; lateral and posterior margins strongly defined, thickened, lateral angles obtusely rounded; *pygidium* nearly semicircular, slightly more than twice as wide as long, axis of five segments, side lobes with about four fine segmental furrows; length of head about three lines.

Position and Locality.—Wenlock Limestone of Dudley, Staffordshire; Llangynyw Rectory, Montgomeryshire; Garden Quarry, Aymestry, Herefordshire.

Genus. CHASMOPS (*McCoy*).

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Gen. Char.—*Cephalic shield* sub-semicircular, lateral angles produced backwards into triangular spines; *glabella* very large, clavate, frontal portion very wide, transversely oval, only two distinct pairs of segmental lobes, the anterior pair very large, triangular, posterior pair small, middle pair entirely obsolete or reduced to minute tubercles; *neck segment* strong; *cheeks* small, triangular; *eyes* small, prominent, rounded, corresponding in length to the middle portion of the first lateral lobes of the glabella; *eye-line* encircles the front of the glabella close to the margin, descends with an inward inclination to the eye, extending from behind the eye directly outwards to the lateral margin, which it cuts considerably in advance of the angle (*thorax* of eleven joints, *fid. Eichwald*); *pygidium* obtusely rounded, posterior margin deflected, anterior margin wider than the posterior, axis of about ten ribs, lateral ribs about two less, duplex.

The *Calymene Odini* of Eichwald may be looked upon as the type of this genus. It differs from *Calymene* in the glabella being so much wider in front than at base, in the anterior lateral lobes being largest, in having but eleven (?) body segments, and in its eye-line cutting the external margin in front of the produced angles; these differences become agreements when compared with *Phacops*, from which it differs in the size and shape of the eyes. Of these organs in the present genus, and in *Calymene*, nothing is known beyond that they were of so tender and delicate a nature as readily to fall out after death so as seldom or never to be found in the fossil state, their position being merely indicated by a hole, roughly filled by the matrix, forming the "hiant" eyes of systematists; in *Phacops*, on the contrary, the cornea is of extraordinary strength and so firmly united to the rest of the cephalic shield, that no matter how much crushed the specimens may be the eye always remains, and from its constant presence, coarse reticulation, and large lenses, gives an appropriate name to the genus, and one which is in antagonism with that I have adopted for the present group*. *Chasmops* differs, besides, from both these genera in the almost complete suppression of the middle pair of segmental lobes of the glabella.

CHASMOPS ODINI? (*Eich. Sp.*) Pl. 1. G. fig. 22, 23.

Ref. and Syn.—*Calymene Odini* Eich. Sil. Syst. in Esthl. *Phacops felinus* Salt. in Ray ed. of Burmeister, p. 125. *Asaphus Powisii* (head only) Murch. Sil. Syst. t. 23. f. 9.

Sp. Ch.—*Cephalic shield* semicircular, lateral angles extending backwards into triangular flat spines; *glabella* gently convex, nearly one-fourth wider than long, broadly clavate, first segmental furrow of each side arched obliquely backwards and inwards, having about one-fourth the width of the glabella between them, second pair of furrows inclining forwards and inwards so as nearly to meet the ends of the first pair; space behind the anterior segmental furrow very large, triangular, extending nearly to the neck-furrow, middle lobe entirely obsolete or reduced to a minute granule; third lobe much larger but less than the neck-furrow; *neck-segment* thick, strongly defined; *cheeks* triangular, slightly convex, a little wider than high; *eyes* rounded, their diameter less than half the length of the first lateral lobe of the glabella, close to the axal furrows; *surface* granulated; *pygidium* elevated, marginal third deflected almost vertically, axis of ten segments, convex, two-thirds the width of the side-lobes in front, abruptly narrowed after the fifth segment, lateral segments thick, about eight, each divided by a fine mesial line; entire part of margin narrow. Average length of head nine lines, width one inch nine lines; length of *pygidium* nine lines, width one inch four lines.

On examining the specimen figured on the plate by Mr Salter, I find that the angles are broken, but shew evident traces of the large spines on both sides, and another specimen from Applethwaite Common shews one of them distinctly, and of great size.

Position and Locality.—Common in the limestone at Llandeilo, Caermarthenshire; in the beds under the limestone Glyn Ceiriog, Denbighshire; Llansantfraid; Alt yr Anker, Meifod, Montgomeryshire; Applethwaite Common, Westmoreland; Coniston Water-Head, Lancashire; Tre Gil, S. of Llandeilo; Selottyn Road.

Explanation of Figures.—Pl. 1. G. fig. 22. Cephalic shield, natural size (Mr Salter's figure on this plate erroneously represents the angles as rounded—they are produced into long, flattened spines, partially broken off in the specimens); schists of Llansantfraid.—Fig. 23. Pygidium, natural size, same locality.

Genus. CALYMENE (in a wider sense than heretofore).

Gen. Char.—Lateral angles of the head obtusely rounded, exactly bisected by the facial sutures; *eyes* small, "hiant;" *glabella* narrower in front than at the base; *thoracic segments* thirteen.

These trilobites differ remarkably from *Phacops* in the structure of their small eyes, which are seldom or never preserved, seeming to have been of so delicate a nature as to fall out on the animals death, leaving a hole in the cephalic shield where they were set, whence Dalman's term "hiant." The head differs from *Phacops* in its blunt lateral angles, and the glabella being wider at base than in front, and in the course of the eye-line; the body differs in having thirteen instead of eleven segments.

The two following are British subgenera; 1, *Calymene*, 2, *Homalonotus*.

Subgenus. CALYMENE (*Brong.*)

Gen. Char.—*Buckler* semicircular, with a reflected anterior margin and obtusely rounded lateral angles; *glabella* narrower in front than at base, sides marked with three maxillary furrows and tubercles on each side, the anterior smallest; *eyes* about the middle of the cheeks, reniform, prominent, strongly facetted; *eye-line* advancing to the anterior margin, where being confluent with the marginal suture it joins that of the opposite side; over the eye it makes a small curve outward, defining a semicircular eyelobe, from whence

* I need scarcely say, that of course, both this genus and *Calymene* had originally eyes, like other Trilobites in general structure, but differing remarkably from their allies in form, or strength of cornea.

it extends to the lateral angles, which it bisects on each side: *thorax* of thirteen rings, axis very convex, lateral lobes wider than the axis, bent down at their ends with large facets, each with a strong pleural groove angularly bent down and confluent at its end with the posterior margin; *pygidium* narrower than the buckler, semioval, with distinct seven, nine, or eleven joints, prominent axis, and broad, convex, lateral lobes, the segments of which are flat, about equal to the axal in number, and divided by a sulcus at their ends.

CALYMENE BAYLEI (*Barr.*) Pl. 1. F. fig. 8.

Ref.—Barrande, *Notice Prélim.* p. 51.

Sp. Ch.—*Glabella* about one-fifth longer than wide, not very prominent, front subtruncate, about half the width of the base, anterior lateral tubercle scarcely perceptible, two posterior pairs large, rounded; *neck-segment* and furrow small; margin in front of the glabella flat, truncated in front, parallel with the posterior margin, less than half the length of the glabella; *eyes* small, on a level with the anterior and middle tubercle of the glabella; *cheeks* convex, nearly as prominent as the glabella near it, gradually becoming depressed and produced backwards into short spines at the lateral angles; *surface* covered with a minute unequal granulation. Length of head about six lines.

This differs from the *C. brevicapitata* in the length of the glabella and the flat truncated margin in front of the glabella, while the shortness of this margin separates it from the *C. Tristani* and *C. parvifrons*, as well as the backward position of the eyes.

Position and Locality.—Common in the limestone of Golden Grove, Llandeilo; Sandy beds of Tre Gil, S. of Llandeilo.

Explanation of Figures.—Pl. 1. F. fig. 8. Cephalic shield, natural size, from Tre Gil (antennary punctures on each side near the front of the glabella).—Fig. 8 *a*. Profile of ditto.—Fig. 8 *b*. Granulation magnified from flat plate in front of head of a specimen from the limestone of Golden Grove.

CALYMENE BLUMENBACHI (*Brong.*)

Ref.—Murch. Sil. Syst. Pl. 7. f. 6. and 7.

Sp. Ch.—*Body* deep, compressed posteriorly, the pygidium and outer two-thirds of the pleuræ steeply inclined; *cephalic shield* minutely granulated, and with irregular small tubercles, semicircular, twice as wide as long, with the lateral angles obtusely rounded; *glabella* touching the narrow thickened anterior margin with its obtusely rounded front; three flattened, spheroidal tubercles on each side, anterior one small: *eyes* small, on a level with the second tubercle; *cheeks* triangular, a little longer than wide, slightly convex; *pleuræ* about one-fifth wider than the axis, the portions each side of the pleural furrow of nearly equal prominence; pleural grooves angularly bent down about their middle, towards the posterior margin; the ends of the axal segments very slightly thickened: *pygidium* having the lateral and posterior edges nearly horizontal (in one plane), anterior margin one-third larger than the posterior, length more than half the width of the posterior margin, and less than half the width of the anterior margin; axis convex of seven segments, lateral lobe flattened, of five flattened ribs separated by strong furrows, each divided by a mesial sulcus, extending almost half-way from the margin; *surface* of tail minutely and closely granulated, of head and body with small irregular tubercles among the granules.

Position and Locality.—Very common in the Wenlock limestone of Dudley, Staffordshire; Llanwddyn, in the Berwyn Mountains; schists of Drummuck.

CALYMENE BREVICAPITATA (*Portk.*) Pl. 1. F. fig. 4, 5, 6.

Ref. and Syn.—*C. Blumenbachii* (Port. not of Brong.) and *C. brevicapitata* id. Geol. Rep. t. 3. f. 1. 3.

Sp. Ch.—In size and form resembling *C. Blumenbachii*, but the body narrower and flatter; the *glabella* triangular, the narrow rounded front little more than half the width of the base, and having a concave space between it and the thickened anterior margin equal to the width of this latter, the two together being nearly equal to half the length of the glabella, excluding the neck-segment; *cheeks* triangular, about one-fifth longer than wide, the part anterior to the eyes elevated into a gibbous, oblique, ridge running inwards and forwards towards the margin, the posterior half gently convex; *antennary pores* large; *eyes* small, in the middle of the width of the cheeks, extending from the top of the basal to the top of the middle tubercle of the glabella; *axis* of the body exceeding the width of the pleuræ by nearly one-fifth, and having tubercles at each end nearly one-third of the width of the axis in length; the line of angulation of the pleural furrows, and at which the pleuræ bend down, is about one-third the width of the pleuræ from the axis near the head, but gradually approaching the axis towards the tail; *tail* minutely granulose, flattened, about seven or eight segmental furrows in the axis, and seven flat lateral ribs, separated by narrow sulci, and each divided by a fine mesial line.

The triangular narrow-fronted glabella, with the space between it and the margin, and the strongly ridged cheeks in front of the eyes, distinguish the head from *C. Blumenbachii;* the great proportional width of the axis, with the very large tubercles at the ends of the segments, distinguish the body, and the flatness of the lateral ribs, their duplicating furrows extending to the axis, and narrow divisional sulci, distinguish the tail from the same. The great width of the axal, and narrowness of the lateral lobes, separate the body from that of the *C. tuberculosa* (see the latter), while the less wide and flat anterior margin, and the width of the base of the glabella equalling, or a little exceeding the cheek, separate the head. I cannot think, with Mr Salter (Mem. Geol. Surv.) this species referrible to the *C. parvula* of Barrande and Beyrich, in which the position of the eyes is much further back (on a level with the middle of the basal lobe), the segmental furrow very small, and the shield as remarkably long and angulated as this is wide and obtusely rounded. It is possible some of the so-called varieties of the *C. senaria* of the American geologists may be identical with this species.

Position and Locality.—Abundant in the schists of Nant yr Cwm; Acton Scott, Church Stretton, Shropshire; Llandeilo, Caermarthenshire; Applethwaite Common, Westmoreland; Alt yr Anker, Meifod, Montgomeryshire; Mathyrafal, S. of Meifod, Montgomeryshire; Bryn Melyn, Bala, Merionethshire; Llangynyw Rectory, Montgomeryshire.

Explanation of Figures.—Pl. 1. F. fig. 4. Cephalic shield from the schists of Nant yr Arian (antennary punctures distinct at each side of the front of the glabella).—Fig. 5. Pygidium of ditto, from the same mass.—Fig. 6. Profile of head from Applethwaite Common.

CALYMENE SUB-DIADEMATA* (*M^cCoy*). Pl. 1. F. fig. 9, 10.

Ref.—*C. diademata* Barrande, Beyrich *Untersuchungen*, &c. t. 2. fig. 4.

Sp. Ch.—*Cephalic shield* nearly twice and half wider than long; *glabella* broad, tumid, subcylindrical, front two-thirds the width of the base, very obtusely rounded, two posterior pair of lateral tubercles large, rounded, anterior first pair very minute; a prominent reflexed rounded margin about as thick as the neck-segment and rising nearly to the height of the glabella, is separated from it in front by a deep sulcus, equal to the thickened margin in width, the two together equal to about one-third the length of the glabella (exclusive of the neck-segment); *cheeks* wider than high, gibbous, particularly in front of the eyes, which are small, and on a level with the anterior and middle lateral tubercles; *neck-segment* thick. Usual length of cephalic shield ten or eleven lines.

This species differs from the *Calymene brevicapitata* in the greater width and obtuseness of the front of the glabella, the wider side-lobes of head and body, and the shorter front margin, while from *C. Blumenbachii* it differs in the greater width of the shield, and the broad furrow and high reflexed margin in front of the glabella, as well as wider pleuræ; imperfect casts of the middle part of the head of the latter species are in some cases, however, I think, undistinguishable.

* This fossil seemed to me perfectly identical with Beyrich's figure of what he considered Barrande's undoubted *C. diademata*, and I think so still, but M. Barrande assures me that these specimens are not of his species, and as his suggestion that they belong to *C. brevicapitata*, is clearly negatived by the great proportional width of the side-lobes both of the body and head, as well as the wider front of the glabella, I am obliged, as these sheets pass through the press, to propose a separate name. It is a representative of the American *C. senaria* of the New York Llandeilo flag, or Trenton limestone—differing by its greater width and the tubercular ends of the axal segments of the thorax.

Position and Locality.—Caradoc sandstone of Mulock, Dalquorhan; schists of Pwllheli; schists of High Haume; limestone of Acton Scott; limestone of Leintwardine; a small variety at Coed Sion, and Coniston Water, seems only to differ in size, giving the following additions:—axis narrow, the segments tubercular at their ends; pleuræ more than twice as wide as the axis, abruptly bent downwards at about one-third their length from the axal lobe in front, but almost directly from their origin nearer the pygidium; pygidium nearly vertical, as in the *C. Blumenbachi*, the middle lobe with about five segments, five lateral ribs separated by large furrows, each divided by a small medial sulcus.

Explanation of Figures.—Pl. 1. F. fig 9. Imperfect head, natural size, from the limestone of Leintwardine.—Fig. 9 *a*. Profile of ditto.—Fig. 10. Perfect specimen of small variety from Coniston.—Fig. 10 *a*. Profile of ditto magnified, shewing the great width of the side portions both of the head and body.

CALYMENE PARVIFRONS (*Salt. in Ap.*) Pl. 1. F. fig. 7.

Sp. Ch.—Width of the *cheeks* equal to the length of the cephalic shield; front three-fourths the length of the glabella, margin subtruncate, not reflected, tumid in the middle; *glabella* slightly wider than long, but little convex, lateral lobes prolonged very obliquely forwards and outwards, the anterior pair obsolete; *neck-furrow* small; *cheeks* large, tumid; antennary punctures large; *eyes* very small, their upper edges on a line with the upper edge of the glabella. Length of cephalic shield six lines, width one inch four lines.

The general depression and great size of the margin in front of the glabella, and very forward position of the eyes, seem to distinguish this species.

Is this the *Calymene incerta* of Barrande? It is possibly a *Pharostoma* of Hawle and Corda, but as we have only the middle piece of the head, it is not certain.

Position and Locality.—Only one specimen has occurred in the Porphyry Slates of Tahirion, near Arennig Fawr, Merionethshire.

Explanation of Figures.—Pl. 1. F. fig. 7. Cephalic shield, natural size.—Fig. 7 *a*. Profile of ditto.

CALYMENE TUBERCULOSA (*Salt.*)

Ref.—Mem. Geol. Surv. Vol. II. t. 12.

Sp. Char.—*Cephalic shield* minutely granulose, nearly semicircular, depressed, front rounded, a slightly reflexed margin-plate, nearly one-half the length of the glabella, in front of its anterior end; *glabella* as in the *C. brevicapitata*, but only two-thirds the width of the cheeks at base; *eyes* rather before the second glabellar tubercle, near the upper angle of the cheeks, which are moderately convex; *body* depressed; *axis* convex, narrow, the segments with a small rounded tubercle at each end; *pleuræ* at least one-third wider than the axis, flattened at their axal half, and rapidly curved downwards from thence to the extremities; knee at about half their length from the axis in the anterior portion, approaching the axis towards the tail portion behind; the pleural sulcus most prominent at the angle; *pygidium* granulose with more convex lobes, and more rounded posterior margin than the *C. Blumenbachii;* axis flattened with seven rounded segments ending in obscure tubercles; five lateral ribs with strong dividing furrows becoming gradually obsolete at the margin.

The broad margin in front of the short conical glabella, the great width and flatness of the pleuripedes in proportion to the axis, and the convexity of the rounded pygidium, separate all the parts of this from the *C. Blumenbachii.* The head closely resembles that of the *C. brevicapitata*, but is easily distinguished by the narrowness of the base of the glabella when compared with the posterior margin of the cheeks.

Position and Locality.—Common in the Lower Ludlow shale of Garden Quarry, Aymestry, Herefordshire; Wenlock, S. Cheney Longville, Shropshire; upper Ludlow rock of High Thorns, Underbarrow.

Subgenus. HOMALONOTUS (*König*).

Syn. = *Trimerus* + *Dipleura.* (Green).

Gen. Char.—*Buckler* semielliptical, convex in the middle, obtusely pointed in front, lateral angles not produced; *glabella* indistinct, simple, subquadrate, with concave sides, narrower in front than behind, not reaching to the front margin; *eyes* small, hiant, reniform, in the midst of the cheeks, opposite about the middle of the glabella; *eye-line* continuous from one side to the other, all anterior to the eyes being nearly parallel with the margin of the buckler, pointed in front, forming the usual small outward lobes over each eye, and from thence to the lateral angles or a little in front of them; *thorax* slightly arched, imperfectly trilobed, of thirteen segments; axis wider than the lateral lobes, which have subtruncate ends with large distinct facets; pleural sulcus as in *Calymene*, arising from the posterior margin near the undefined axis, and at half its length abruptly bent down again to it; *pygidium* subtrigonal, pointed, with a very narrow axis or none, the lateral ribs undivided.

HOMALONOTUS BISULCATUS (*Salt. in Ap.*) Pl. 1. G. fig. 24 to 31.

Sp. Ch.—*Pygidium* semielliptical, edge compressed, convex anterior margin widely arched, sides nearly straight, converging to an obtusely rounded termination; *axis* gradually tapering, nearly as wide as the side lobes, flat, indistinctly marked, not quite reaching the margin, eleven or twelve segmental furrows, the two anterior stronger than the rest; *sides* with about seven broad flat ribs, separated by narrow sulci, the two anterior of which are disproportionably deep furrows, the rest very shallow; surface smooth; pygidium from half to one and quarter inches in length.

The disproportionate strength of the two anterior segmental furrows of the pygidium, and the obtusely rounded extremities, characterize this species well. There is a small variety in which only eight or nine segments can be counted in the axis, and the first two furrows not so strongly marked. The head supposed to belong to this species has the glabella oblong, one-third longer than wide, distinctly bounded by a strong furrow at the sides, more obscurely in front.

Position and Locality.—Caradoc sandstone of Acton Scott, Church Stretton, Shropshire; Alt yr Anker, Meifod, Montgomeryshire; Maes Meillion, S. of Bala, Merionethshire; Ravenstone Dale, Westmoreland; Capel Garmon, Denbighshire.

Explanation of Figures.—Pl. 1. G. figs. 24 and 25. Portions of cephalic shield, natural size, from near Pwllheli.—Fig. 26. Pygidium and part of thorax (this specimen is not in the collection).—Figs. 27 and 28. Pygidia natural size, from near Acton Scott.—Fig. 29. Part of small cephalic shield.—Figs. 30 and 31. Pygidia of supposed varieties from Ravenstone Dale.

HOMALONOTUS KNIGHTII (*König*).

Ref. and Syn.—*H. Knightii* König, Icon. Fos. Sec. *H. Ludensis* and *H. Knightii* Murch. Sil. Syst. t. 7. f. 1, 2.

Sp. Ch.—Axis of the abdomen very wide and obscurely defined; *pygidium* ovate, convex, anterior margin nearly semicircular, sides converging rapidly to a smooth, simple, undivided, subtrigonal pointed truncation; about nine gently curved distinct, narrow segments, separated by strong sulci, the axal and lateral portions appearing continuous, a slight oblique depression on each side marking the axis. Average length of the pygidium nine lines, width one inch.

Position and Locality.—Upper Ludlow rock of Tenter Fell, Kendal, Westmoreland; schists of Middleton Park, near Sedburgh.

HOMALONOTUS RUDIS (*Salt. in Ap.*) Pl. 1. E. fig. 20.

Sp. Ch.—*Pygidium* semielliptical, elevated, axis defined by strong furrows, gradually tapering, convex, of about seven or eight strong nodulous segments; sides slightly convex, sloping downwards and outwards from the axis, of six strongly defined, broad, nodulous ribs. Length of pygidium about one and a quarter inches.

One of the specimens seems to shew but three great ribs on the anterior half of the axis, and may possibly be distinct.

Position and Locality.—In the coarse grey schists of Capel Garmon, Denbighshire.

Explanation of Figures.—Pl. 1. E. fig. 20. Pygidium, natural size.—Fig. 20 *a*. Portion of much larger ditto.

Genus. ASAPHUS (in a wider sense than *Brong.*)

Gen. Char.—Head and tail nearly equal; *eyes* with a firmly fixed, thick cornea, with a smooth external surface; *facial suture* cutting the *posterior* margin of the cephalic shield within the lateral angles; *thorax* with eight to ten segments, having large facets and distinct, wide, nearly straight pleural grooves, not reaching the margin; *glabella* indistinctly defined in front; *pygidium* with the segments usually indistinctly marked, the axis generally distinct and annulated, when traceable, always elongate conic (of the ordinary type).

Contains among others the following subgenera, 1st, *Asaphus* (not British, taking the *A. cornigerus* as the type); 2nd, *Isotelus*.

Subgenus. ISOTELUS (*Dekay*).

Gen. Char.—Large, elliptical; *buckler* semielliptical, with the angles rounded, or produced backwards into spines; *glabella* indistinctly defined; *eye-lines* meeting at an acute angle at the front margin, thence diverging backwards, slightly approximating again about the middle of their length, where the "hiant" *eyes* are situated, and again diverging to cut the posterior margin near the angles; *thorax* of eight segments, axis as wide or wider than the lateral lobe, the ends of the pleuræ rounded, with a strongly marked triangular facet and pleural groove; *pygidium* resembling the buckler in size and shape, trilobed, and generally with a broad smooth margin; axis and lateral lobes with fine segmental furrows, or smooth.

There seem to be two types, 1st, the ISOTELUS (*gigas*, &c.), having the angles at the head rounded, and no distinct segmental divisions of the pygidium; 2nd, (*Asaphus tyrannus*, &c.) having the lateral cephalic angles produced into spines, and both the axis and lateral lobes of the pygidium distinctly defined and divided into simple segments. After a careful review of all the species I do not, however, feel competent to separate them; if it should be found convenient to distinguish them as subgenera, the name *Isotelus* should be retained for the former, and the latter might be called *Basilicus*, as suggested by Mr Salter, in the 2nd Decade of the Geol. Survey. *Basilicus* differs from *Ogygia*, which it closely resembles in shape, in the facets of the pleuræ, as well as the simple (not duplex) furrows of the pygidium; the glabella is more prominent than in *Isotelus* proper.

ISOTELUS AFFINIS (*M^cCoy*). Pl. 1. F. fig. 3.

Syn. and Ref.—*Isot. gigas*, *I. planus* and *I. Powisii* of Portk. Geol. Rep. (not of the writers he refers to) Pl. 6. f. 1. and t. 7. f. 2 and 3.

Sp. Ch.—Axis of the body only slightly exceeding the pleuræ in width; *pleuræ* gently arched downwards at a very obtuse angle; from about half way between the axis and the extremity, a large pleural furrow reaches from the axis to about one-third of the truncated extremity of each; *pygidium* flattened, semielliptical, or slightly trigonal, from the straightness of the sides; *axis* narrow, sharply defined, gently convex, reaching as far as the concave space round the margin.

In general proportion this resembles the *Isotelus gigas* (Dekay), from all the varieties of which it is distinguished when specimens of the same size are compared, by the much greater flatness or depression of all its parts, the long, narrow, sharply defined axal lobe of the pygidium, and the much greater length of the pleural groove of the pleuræ (nearly double that of the *I. gigas*), and distance of knee from the axis, as well as their slight degree of deflection (being bent at nearly right angles at one-third from the axis in *I. gigas*). The pygidium differs from that of the *I. Powisii* (Murch. Sp.) by the absence of all segmental furrows on the lateral lobes, except the first, and by the more pointed outline and narrow margin.

Position and Locality.—Not uncommon in a schist over the iron-works at Tremadoc, Merionethshire; very similar in appearance to that at Pomeroy, county Tyrone, which afforded the species to Col. Portlock.

Explanation of Figures.—Pl. 1. F. fig. 3. Pygidium and thorax natural size, from the fine slates over the iron-works of Tremadoc.

ISOTELUS (*Basilicus*)? LATICOSTATUS (*Green Sp.*) Pl. 1. E. fig. 18.

Ref. and Syn.—*Asaphus laticostatus* Green, Monog. cast 13. = *Ogygia? radiata* Salt. Ap. Ray ed. of Burmeister, p. 125.

Sp. Ch.—Obtusely oval; *cephalic shield* obtusely rounded about three times wider than long; *thorax* (indistinctly seen) shorter than the head, of eight very slender segments; *axis* rather less than two-thirds the width of the pleuræ, which are nearly straight, slightly bent downwards and backwards at the tip; *pygidium* nearly semicircular, length rather more than half the width, and about one-third longer than the thorax; *axis* flattened, undefined at the end, the axal furrows converging most at about the ninth furrow, and then slightly diverging, of ten distinct and about four very faint terminal segments, sides gently convex, of nine broad, convex, simple ridges, ending in a wide, flattened, simple margin. Length of pygidium from nine lines to two inches.

The pygidium of this species strongly resembles (as Green remarks) the *A. Hausmanni* of Brongniart, but has much fewer segments: our large specimen from Maen Goran exactly agrees in size and all characters with Green's cast; the small perfect specimen has much the habit of *Bronteus*. Mr Salter probably overlooked Green's species when he proposed it as new, and his reference of it to *Ogygia* is negatived by the simple (not duplex) lateral ribs of the pygidium.

"This is the species referred to in Prof. Sedgwick's papers as *O. Buchi*, from the Bala limestone."—Salter in letter referring to our fig. 18.

Position and Locality.—Limestone of Rhiwlas, Bala Lake, Merionethshire; schists of Maen Goran, Llangollen; Black shale, near Builth, Radnorshire (in a newly-opened trial-pit for coal.)

Explanation of Figures.—Pl. 1. E. fig. 18. Small nearly perfect specimen, natural size, from Rhiwlas.—Fig. 18 *a*. A very large pygidium, natural size, from Maen Goran.

ISOTELUS (*Basilicus*) POWISII (*Murch.*)

Ref. and Syn.—*Asaphus Powisi* Murchison, Sil. Syst. t. 23. f. 9. = *A. elevatus* Salter in Ray ed. of Burmeister, p. 125.

Sp. Ch.—Axis of the pygidium as long as the thorax, width slightly less than twice the length, nearly semicircular, with the sides slightly straightened; axis rapidly tapering two-thirds the width of the side at the anterior margin, less than half that width at the middle, segmental furrows almost obsolete, except the first one; lateral lobes with about eight broad, simple radiating furrows, the radiated portion gently convex, surrounded by a flattened, less steeply inclined margin of equal width all round (about one-third the anterior margin); this is only crossed by the first or strong articular furrow; axis of the thoracic segments nearly one-third wider than the pleuræ, gently convex in the middle, abruptly flattened towards the two ends (so as to form, when connected, a narrow flattened band on each side of the middle portion), middle portion corresponding in width to the anterior end of the pygidial axis; *pleuræ* each with a very strong facet, and wide diagonal pleural furrow, truncated at the end. Average length of pygidium one inch nine lines.

The head supposed to belong to this species has the portion within the eye-line flattened, truncate in front, sides nearly straight, diverging slightly to the eyes, from whence on each side it turns abruptly outwards, parallel with the posterior margin, then gently arching nearly to the lateral angles; a sharp segmental furrow a little in advance of the straight posterior margin; two slightly converging, shallow axal furrows extend from the posterior margin towards the front, obscurely defining an oblong glabella.

The specimens I have examined of the body and pygidium of the *Asaphus elevatus* (Salter) only differ in a slight lateral compression (I should think mechanical); but, as far as I can see, there is no real difference of proportion, or any other character, if a slight allowance of this kind be made.

Position and Locality.—Llanwddyn in the Berwyns (in limestone) Bryn Eithin, Penmachno, S. of Mathyrafal, Montgomeryshire; Ravenstone Dale, Westmoreland; Pen Cerrig, two miles N. of Builth, Radnorshire; Alt yr Anker, Meifod, Montgomeryshire.

ISOTELUS (*Basilicus*) TYRANNUS (*Murch. Sp.*)

Ref. and Syn.—*Asaphus tyrannus* Murch. Sil. Syst. t. 25. f. 1.

Sp. Ch.—*Cephalic shield* semicircular, about twice as wide as long, length equalling the thoracic and three first pygidial segments; *glabella* obscurely pyriform, convex, not reaching the front margin, with an obscure tubercle on the neck and an oval swelling on each side between the neck and the eye-lobe; *eyes* with very minute lenses, narrow, crescent-shaped; *thorax*, axal as wide as the lateral lobes; *pygidium* elevated, one-third longer than the head, obtusely triangular, one-fifth wider than long, axis less than half the width of the lateral lobes, moderately convex, of about fifteen distinct and many minute segments, sides with about thirteen strong, equal, rounded ribs reaching about two-thirds to the margin, the upper ones reaching nearest to the margin, and nearly at right-angles to the axis, becoming gradually more oblique, and reaching a shorter way as they approach the extremity, leaving a steep, concave, smooth margin, one-third the width of the pleuræ all round. Average length of pygidium two to three inches.

Position and Locality.—Llandeilo, Caermarthenshire; Craig y Glyn, near Llanarmon Fach, E. of the Berwyns; Rhiwlas, N. of Bala Lake, Merionethshire; Goldengrove, Llandeilo; Nant yr Arian; Tre Gil, S. of Llandeilo.

Genus. ILLÆNUS (*Dal.*)

Gen. Char.—*Cephalic* and *caudal shields* forming two nearly equal and similar portions of hemispheroids, the articular margin of each being truncated, the base of the glabella and caudal axis only indicated in the respective shields by two short axal sulci; nine or ten body-segments, destitute of pleural grooves, and with long, very narrow, nearly obsolete facets. *Eyes* and *eye-line* nearly as in *Asaphus*.

There are three British subgenera:—1st *Illænus*, having ten body-rings and the lateral cephalic angles rounded. 2nd *Bumastus* (Murch.), differing only in having no trilobation of the body. 3rd *Dysplanus* (Burm.), having the lateral cephalic angles produced backwards into spines, and only nine body-rings, otherwise like *Illænus*.

Subgenus. ILLÆNUS (*Dal.*) restricted.

Gen. Char.—Body subcylindrical, with equal rounded ends; *cephalic shield* subhemispherical; *glabella* only defined by two short, parallel, unconnected longitudinal furrows at the posterior margin; *eyes* smooth, small, semicircular, placed very far apart on the sides of the head; *eye-lines* subparallel, longitudinal, cutting the posterior margin near the middle of the cheeks, forming the small eye-lobe over the eye and extending thence to two widely-distant points of the anterior margin, where they are connected by a transverse suture; *thorax* three-lobed, of ten equal segments; *pygidium* resembling the buckler in size and shape; *axis* only indicated at the anterior margin by two short parallel unconnected furrows.

ILLÆNUS DAVISII (*Salt.*) Pl. 1. G. fig. 36.

Ref.—Mem. Geol. Surv. Dec. 2. t. 2.

Sp. Ch.—*Head*, *thorax*, and *pygidium*, of nearly equal length, gibbous; *cephalic shield* semioval, length rather more than two-thirds the width, very gibbous, the front nearly vertical; axal furrows sigmoid, half the length of the head, slightly nearer in front than at base; the included space about one-fourth wider than the cheeks; *eyes* rather more than their own length in advance of the posterior margin, and half-way between the axal furrows and the margin; *thoracic segments* with the axal and lateral portions of about equal width, deflexion from the knee close to the axis in the anterior segments, gradually removing to one third of the width in the posterior ones; *pygidium* semioval, length two-thirds the width, moderately convex, the outer third of the circumference rather abruptly sloping to the margin, axal furrows barely indenting the margin. Surface smooth. Average length of head nine lines.

On comparison with Swedish specimens of the *I. crassicauda* of Dalman, I find the present species differs in the greater length of the head in proportion to its width; the *cheeks* also of *I. crassicauda* are wider than the glabella, while they are much less wide in the present species; the caudal shield is also considerably wider in proportion to the length in the Gothland trilobite, and the axal lobe of the thorax is one-fourth wider than the pleuræ.

Position and Locality.—Abundant in the calcareous schists of Rhiwlas, N. of Bala Lake, Merionethshire; Llwyn y Ci, N. W. of Bala Lake, Merionethshire; Llanwddyn, E. of the Berwyn Mountains; Pont y Glyn, Diffwys, W. of Corwen.

Explanation of Figures.—Pl. 1. G. fig. 36. Perfect specimen, natural size, from Rhiwlas (the example figured belongs to the cabinet of Mr Davis.)

ILLÆNUS LATUS (*M^cCoy*). Pl. 1. E. fig. 17.

Ref.—McCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—*Cephalic shield* more than twice as wide as long, moderately gibbous towards the base, but about half of the front arched over to a vertical position (or at right angles to the basal portion or plane of the body); axal furrows considerably less than half the length of the head, width of the included space or glabella equal to two-thirds the length of the head; *eyes* small, near the lateral angles, their own length in front of the posterior margin, two-thirds the width of the glabella distant from the axal furrows. Length of head ten lines, width one inch nine lines.

This is only likely to be confounded with the *I. crassicauda* (Dal.), from Gothland specimens of which it differs by the greater width of the head and less depth of the deflected front, and most remarkably, by the very small size of the cheeks, resulting from the eyes being removed almost to the lateral angles—in the *I. crassicauda* they are only half the width of the glabella distant from the axal furrow, and the portions of the cheeks from the eyes to the lateral angles is nearly one-third more than from the eye to the axal-furrows, while in the present species the cheek beyond the eye is little more than half the width of from them to the side of the glabella. Heads of the *Dysplanus centrotus* (Dal. Sp. = *I. Bowmani* Salt.) differ in their much greater proportionate length.

Position and Locality.—In the limestone of Wrae Quarry, Upper Tweed, near Broughton, S. W. of Peebles. A young specimen of the head, possibly of this species, little more than one line long, and with a front not quite so much deflected, and the glabella slightly longer and narrower, has occurred in the schistose "Chazy limestone" of Knockdollian, three miles from Ballintrae.

Explanation of Figures.—Pl. 1. E. fig. 17. Head, natural size, from the limestone of Wrae Quarry. —Fig. 17 *a*. Profile of ditto.

ILLÆNUS ROSENBERGI (*Eich.*) Pl. 1. G. fig. 33 to 35.

Ref. and Syn.—*Cryptonymus id.* Eichwald per Ingriam, &c. t. 3. f. 3. = *Illænus Murchisoni* Salter, Mem. Geol. Surv.

Sp. Ch.—*Cephalic shield* semielliptical, front narrow, much inflated, and curved inwards towards the margin; axal furrows slightly sigmoidal, about half the length of the unbent part of the head, rather nearer to each other in front than at base, width of the enclosed space equal to the length of the furrows; *eyes* scarcely their own length from the posterior margin, and about half the width of the glabella from the axal furrows: *thorax* about as long as the unbent portion of the head, of ten very broad flat segments; axis twice the width of the pleuræ, which are square at their extremities, abruptly deflected at right angles from the knee, which is tumid, close to the axis in front, and about one-fourth the width of the pleuræ from it towards the tail; the anterior pleuræ are directed backwards, the posterior ones a little forwards, and the middle ones are slightly narrowed at the ends and extend at right angles to the axis; *pygidium* larger than the head, semi-elliptical, its length slightly exceeding the width, moderately convex, most so in the middle, axal furrows short, obtuse, parallel: entire surface, in some states of preservation, marked with minute flexuous striæ and puncta, and the extremities of the pleuræ with elevated striæ parallel to their anterior margin. Average length of head one and a half inches.

The width (about one and a half lines) and flatness of the segments, and the narrow, inflated and much-inflected front, distinguish this species.

Position and Locality. — Abundant in the Coniston limestone at Coniston Water-Head, Lancashire; Coniston limestone of Sunny Brow, near Coniston; Blain y Cwm, W. of Nantyre, Glyn Ceiriog.

Explanation of Figures.—Pl. 1. G. fig. 33. Part of cephalic shield, natural size, from Coniston. Fig. 34 thorax, and fig. 35 pygidium, same locality.

DYSPLANUS CENTROTUS (*Dal. Sp.*) Pl. 1. E. fig. 19.

Ref. and Syn.—Illœnus centrotus Dal. and Portlock. Geol. Rep. Pl. x. f. 3 to 6.
= *Illœnus* Bowmani (Salt.) Mem. Geol. Surv. Vol. II. t. 8. fig. 1, 2.

Sp. Ch.—Thorax little more than half the length of the head, of nine short weak segments, axal portion about equal to the pleuræ, which are abruptly bent downwards and backwards at rather less than half their width from the axis; *cephalic shield* slightly longer than the pygidium, about one-third wider than long, moderately convex, axal furrows one-third the length of the head, slightly arched, the enclosed space one-third wider than the cheeks; *eyes* small, their own length in advance of the posterior margin of the head, and nearer to the external margin than to the glabella; *pygidium* one-sixth wider than long, gently convex at the anterior portion, becoming more depressed towards the margin, axal furrows barely forming a short rounded sinus on each side; average length of head one inch three lines.

I see no grounds for Mr Salter's opinion (Mem. Geol. Surv.), that the present fossil had not the lateral angles of the cephalic shield prolonged, and consequently differed from the *I. centrotus* (Dal.) All the English and Irish specimens recorded, or which I have seen, have this part broken; and when we consider that in all other respects the species are identical, I think Col Portlock is correct in uniting them; the more so, as in the foreign perfect examples rounded angles to the buckler are only found in those species having ten joints to the thorax, while the *I. centrotus* forms the type of the genus *Dysplanus* from having but nine segments, like the example before us, and the cephalic angles prolonged. The very circumstance of the angles being broken off seems rather to indicate their having been prolonged, the projecting portion acting as a lever, while if they were *naturally* rounded they would probably present the rounded angle entire, like that of the pygidium. The greater length of the pygidium in proportion to its width distinguishes it from that of the *I. crassicauda.*

Position and Locality.—Very common in the limestone of Llanwddyn in the Berwyn mountains; rare, of large size in the Coniston limestone of Llandeilo, Caermarthenshire.

Explanation of Figures.—Pl. 1. E. fig. 19. Entire specimen, natural size.—Fig. 19 *a.* Head, natural size, of a rolled-up specimen.

Genus. FORBESIA (*M^cCoy*).

Ref.—M^cCoy, Synop. Sil. Foss. Irel.

Gen. Char.—Head semielliptical, with distinctly defined glabella; *eyes* finely reticulated; *eye-lines* nearly parallel, cutting the middle of the posterior margin; *body-rings* ten, facets large, pleural furrow slightly oblique, not reaching the margin; *pygidium* smaller than the head, with duplicate lateral furrows, and a distinct conical articulate axis.

Two Subgenera: 1st, *Forbesia;* 2nd, *Proetus.*

Subgenus. FORBESIA (*M^cCoy*).

Ref. and Syn.—Æonia (Burmeister). Ray 2nd Ed. Organ. of Trilobites.

Gen. Char.—Cephalic shield semielliptical, the lateral angles produced backwards into long spines; *glabella* oblong, contracted in the middle, with three small transverse segmental furrows on each side, the basal one largest and curved downwards; *neck-furrow* terminating in a large oblique tubercle at each end; *eye-line* nearly vertical, cutting the anterior and posterior margins in a line with the eyes, which are lunate and smooth; *thorax* of ten joints, pleuræ with distinct facets and obtuse ends, pleural furrow slightly oblique; *pygidium* semielliptical, with a smooth margin, both the axis and side lobes with distinct segmental furrows, the latter duplicate at their ends.

This genus differs from *Proetus* in the lateral angles of the buckler being produced into long spines, in the lateral segmental furrows to the glabella, the large oblique tubercles terminating the neck-furrow, and the distinct segmental furrows of the lateral lobes of the pygidium.

Subsequently to the publication of this genus under the above name, in my Synopsis of the Silurian Fossils of Ireland, Burmeister, in the second edition of his work on Trilobites, p. 100, characterised it similarly, and pointed out particularly its distinctions from *Proetus*.

FORBESIA LATIFRONS (*MCoy*).

Ref.—McCoy, Sil. Foss. Irel. t. 4. f. 11. Mem. Geol. Surv. Vol. II. Pt. 1. t. 6. fig. 1.

Sp. Ch.—Ovate; head and thorax of equal length; pygidium as long as six segments of the thorax; cephalic shield nearly semicircular; spinose angles reaching to the sixth thoracic segment; glabella wider at base than in front, not reaching the anterior margin; *limb* thick, tumid; articular margin and neck-segment also thickened, the extremities of the latter forming very large tubercles; *eye-lines* cutting the anterior and posterior margins nearly in a line with the outer edge of the eye, inclining outwards and forwards from the eye-lobe in front, running parallel to the axis behind, till it reaches the articular margin, which it cuts obliquely outwards nearly in the middle; *eyes* large, very close to the glabella; axis of body about as wide as the pleuræ, the segments strongly tubercular at the ends; *pygidium* semicircular, nearly twice as wide as long, with a broad smooth margin; *axis* conical, not reaching the margin of seven narrow ridges; side lobes with fine broad, obscurely-defined ribs, each with a faint duplicating furrow. Length ten lines; length of head four lines, width of head seven lines.

Position and Locality.—Very abundant in the Upper Ludlow rock of Underbarrow, Kendal.

FORBESIA STOKESII (*Murch. Sp.*)

Ref. and Syn.—*Asaphus Stokesii* Murch. Sil. Syst. t. 14. f. 6.

Sp. Ch.—Ovate; *head* semielliptical, the angles reaching as far as the pygidium, length of the middle portion equal to half the width; *thorax* as long as the head, axis only as wide as the pleuræ in front, and considerably less wide behind, knee at about one-third the width from the axis (a little more in front, a little less behind), ends of the axal segments not distinctly tubercular; *pygidium* semielliptical, with a broad tumid margin and six wider flattened ribs on each side, each divided by a fine mesial impressed line. Length five and half lines, width of head three and half lines.

This species differs from the *F. latifrons* (McCoy), by the much greater size of the lateral cephalic angles, by the longer and narrower head, the narrower axis, and want of the distinct tubercles to the ends of the axal segments.

Position and Locality.—Wenlock limestone of Ledbury, Herefordshire.

2nd Tribe. PŒCILOPODA.

In this tribe the feet are constructed on two different types, the thoracic ones (six pairs) being strong, crustaceous, didactyle, and ambulatory; but the abdominal ones forming transverse, membraneous leaflets subservient to respiration. In the recent type, the mouth is without jaws, but the bases of the feet which surround it are toothed and shaped so as to serve for mastication. The head and thorax are confounded under one semicircular shield-like carapace.

There seem to be only two families: 1st, *Limulidæ*, having the abdominal segments anchylosed into a shield (*Limulus, &c.*) 2nd, *Eurypteridæ*, with the abdominal segments distinct, simple (*Eurypterus, Pterygotus, Bellinurus, &c.*)

Genus. EURYPTERUS (*Harlan.*)

Gen. Char.—Body crustaceous, elongate, ovate, very convex, attenuated posteriorly; cephalo-thorax covered by a small, semiorbicular or rotundato-quadrate shield, truncate behind, margin obscurely depressed, often with a faint V-shaped, re-entering angle in front; two large reniform eyes, one on each side of the middle of the cephalic shield; at least three pairs of large, unequal, crustacean, didactyle, thoracic legs; *abdomen* semicylindrical, of thirteen distinct, transversely arched segments, gradually narrowing towards the terminal one, which forms a short spine, serrated on the sides as in *Limulus*.

I have little doubt, from the figure, and description of Conrad and Römer (see the paper on the American species in Dunker and Von Meyer, "*Beiträge zur Naturgeschicte der Vorwelt*," &c.), that the present genus is closely allied to *Limulus;* we might therefore expect that the thorax would bear crustacean prehensile feet, but each joint of the abdomen a pair of membraneous gill-feet.

Eurypterus cephalaspis (*Salt. Sp.**) Pl. 1. E. fig. 21.

Ref. and Syn.—Homalonotus cephalaspis Salt., in Appendix to Ray ed. of Burmeister, p. 125.

Sp. Ch.—Cephalic shield semielliptical, length one inch, width one inch three lines, strongly and evenly convex, the anterior and lateral arched margins with a narrow, flattened, horizontal rim, all in one plane, with the edge deflected; posterior margin simple, truncate, elevated by the general convexity; *eyes* hiant, obscurely reniform, about three lines long, four lines apart, and their own length within the front margin; a very obscure indication of a mesial ridge branching at an acute angle from between the eyes towards the front; surface obscure.

This is about double the linear measurement of the head of the *E. tetragonophthalmus* of Fisher (Bull. de la Soc. Imper. des Natur. de Moscou. Vol. for 1839).

Position and Locality.—Rare in the hard green micaceous quartzite of Kirkby Moor, Kendal, Westmoreland.

Explanation of Figure.—Pl. 1. E. fig. 21. Head, natural size.

Pterygotus lepto-dactylus (*M^cCoy*). Pl. 1. E. fig. 7.

Ref.—M^cCoy, Ann. Nat. Hist. 2nd Series, Vol. IV.

Sp. Ch.—Scale-like sculpturing of the surface very irregular, but of two principal very unequal sizes, the larger about six times the size of the smaller and more numerous size, averaging rather less than one line in diameter; large *pincers* having the hand about five lines wide, the penultimate or immoveable finger compressed, about two inches ten lines long, and two lines wide at base, gradually tapering to less than a line towards its obtuse point, nearly straight, with a scarcely perceptible inward curvature; sides divided into ridges by three or four longitudinal furrows, thicker towards the back, inner edges of both fingers destitute of teeth or tubercles; moveable finger similar to the immoveable one, but rather smaller.

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* Mr Salter, on becoming aware of my referring his species to *Eurypterus*, instead of to the trilobites, now adopts the same view.

The semicircular scale-like ridges of the carapace are rather irregular in size, but the larger entirely covered by the smaller, otherwise resembling the fragment in Sir R. Murchison's Sil. Syst. from the Upper Ludlow, and named *Pterygotus problematicus* by Agassiz. The pincers are very remarkable; instead of being excessively thick and strong and armed on the inner edges with powerful teeth, as in the *Pterygotus Anglicus*, they are perfectly unarmed, and so long and slender as possibly to indicate a separate genus, which might be named *Leptocheles* (λεπτὸς, *tenuis*, and χηλή, *forceps*). It strikes me forcibly (judging from the figures) that the *Onchus Murchisoni* (Ag.), figured in the same work and from the same bed as the *P. problematicus*, is not an *Ichthyodorulite*, but the long fingers of the chelæ of this crustacean, the size, form, and sculpturing, agreeing very nearly. In the same bed as the long chelæ and fragments of carapace here described, were found one moveable finger, and one perfect claw with both fingers *in situ* of a much shorter form, the hand about three lines wide, the penultimate immoveable finger about one inch long and rapidly tapering from two and half lines wide at the base to the tip; it is longitudinally sulcated like the one above described: the last joint or moveable finger is very different, being perfectly flat, triangular, seven lines long, one and half lines wide at base, and tapering rapidly to a point, the inner edge being straight and simple, the outer edge slightly convex. The hands of both kinds of chelæ are similarly sculptured with fine sharp, short, irregular, longitudinal, curved plicæ. It seems probable therefore that more than one pair of feet were didactyle.

Position and Locality.—In the fine olive-schists, Leintwardine.

Explanation of Figures.—Pl. 1. E. fig. 7. The long penultimate or immoveable *Onchus*-like finger of one of the didactyle pincers, with a portion of the peculiarly sculptured crustaceous hand connected with its base, natural size; from Leintwardine.—Fig. 7 *a*. The terminal or moveable finger of probably the same pincer, seen from the opposite side, also shewing trace of the peculiar sculpturing of the hand near its expanded articular base; same locality.—Fig. 7 *b*. Portion of the sculpturing of the hand of fig. 7 magnified three diameters.—Fig. 7 *c*. A shorter didactyle claw, or pincer, with both fingers *in situ* belonging to a different pair from fig. 7, having a portion of the crustaceous hand and carpus attached, with traces of sculpturing resembling that of fig. 7 in character; same locality.—Fig. 7 *d*. A detached terminal joint (or the moveable finger) of a pincer identical with that of 7 *c*; same locality.