I have applied to the principal elements the names of 'entometatarse' (II), 'mesometatarse' (III), and 'ectometatarse' (IV) respectively, for the convenience of description.

The shaft in *Palapteryx robustus* is subtriedral in its upper two-thirds, subcompressed from before backwards in its lower third, of equal breadth in its middle fourth, and thence expands to both extremities, but more to the inner than the outer side, and in a greater degree at the lower end; so that the inner margin is more concave than the outer one. This difference is not so great in the *Dinornis giganteus*, in which, also, the shaft continues gradually to diminish in breadth towards its lower third.

The proximal articular surface of the metatarse of the *Palapteryx robustus* is divided, as usual, into two concavities, that for the inner condyle of the tibia being the largest and deepest: it is of a triangular form bounded internally by a well-defined edge which extends in a nearly straight line from the anterior internal angle to the posterior angle of the concavity: the anterior external angle is formed by the prominent fore part of the intercondyloid protuberance. The more shallow concavity for the outer condyle is subcircular, its outer boundary being convex and most raised at its middle part; posteriorly the border subsides and the concavity passes into a convexity at that part. The non-articular surface of the proximal end is chiefly behind the concavities and extends upon the upper part of the calcaneal processes: these are, as usual, three in number, the internal and middle ones being most prominent: they are obtusely rounded, and separated by the deep and wide groove for the flexor tendons of the toes: the longitudinal extent of the inner process (the entocalcaneal one, fig. 2, *c e*) measures one inch and a half: its obtuse and thick upper end commences behind and half an inch below the posterior border of the entocondyloid cavity: the process gradually contracts to a point at its lower end, which overhangs the smooth groove continued obliquely downwards and outwards to the foramen formed by the persistent remnant of the interosseous space between the inner (II) and middle (III) metatarsal elements of the compound metatarse.

The mesocalcaneal process (fig. 2, *c m*) is the largest of the three: it is broad and rounded about, slightly grooved down its posterior surface, and supported by the rough posteriorly projecting buttress-like part of the mesometatarse, of which it seems to form the obtuse summit.

The ectocalcaneal process is the smallest: it is separated by a shallow open groove from the mesocalcaneal process: it begins to project half an inch below the posterior convexity of the ectocondyloid surface: its lower part subsides before it reaches the foramen between the ecto- and meso-metatarse. The interval between the two interosseous foramina, which gives the breadth of the mesometatarse at that point, is greater in the *Palapteryx robustus* than in the *Dinornis giganteus*, notwithstanding the greater length of the bone in the latter species.

The anterior intercondyloid protuberance sends a short obtuse ridge downwards and slightly outwards upon the fore part of the upper end of the tarso-metatarse. A large low rough protuberance projects forwards and outwards below the antero-internal angle of the entocondyloid surface; between this protuberance and the opposite angle the anterior surface is gently concave from side to side : the fossa between the proximal ends of the ento- and ecto-metatarsals commences two inches below the intercondyloid eminence : it is a vertical elongated ellipse, bounded behind by the mesometatarse, and below by the rough depression and protuberance, for the insertion of the *Tibialis anticus.* Below this protuberance a broad and very shallow depression extends to near the middle of the shaft, where it is filled up by the advance of the mesometatarse towards the anterior surface of the bone, where it forms a longitudinal prominence, which increases in breadth as it approaches the condyle of the same element : a shallow and longitudinal groove extends on each side of this median eminence to the interspaces between the middle and the lateral condyles. There is no perforation in either of the grooves leading to these interspaces.

The back part of the upper two-thirds of the shaft of the mesometatarse forms a buttress-like prominence extending from the mesocalcaneal process down to the lower third of the common shaft; the upper third of this process is very rugged; the rest is comparatively smooth : the borders of the back part of the common shaft are roughened for the attachment of the strong fascia that bound down the tendons traversing that aspect of the shaft : the rough tract on the inner side terminates in the rough oval depression for the attachment of the rudimental metatarse of the hallux : from the lower border of this depression to the division between the inner and middle condyle measures two inches eight lines ; the relative position of the depression being the same as in the *Apteryx*.

The distal trochlear or condyloid extremities of the three coalesced metatarsals terminate at different distances from the proximal ends of the bones, the outer one being the shortest—not the inner one, as in the *Apteryx* ; and the middle one, as in most birds, being the longest and the most prominent one anteriorly. The inner trochlea (II) presents a depression on its inner surface and another on its under surface, from which a shallow channel is continued a little way backwards upon the back part of the condyle and forwards upon the broad anterior convex articular surface : this surface slopes obliquely from the outer to the inner margin of the trochlea : the inner part of the hinder surface of the trochlea is the most produced : the outer surface of the condyle presents a wide and deep depression.

The articular surface of the middle trochlea is narrowest at its posterior commencement, gradually expands to its lower and fore part, and contracts, but in a less degree, to its anterior boundary : it describes three-fourths of a circle, and is grooved along its middle, the groove widening towards the posterior part of the bone. The outer portion of the posterior boundary projects from the level of the short stem of the condyle : the anterior boundary rises very gradually but somewhat obliquely from the level of the stem : the sides of the condyle are widely and deeply excavated for the lateral ligaments.

The outer trochlea (IV) has a deep and rough depression on its narrow outer side, and a wider depression on the side next the middle condyle; but it is not impressed on its under surface. The articular surface slopes from the inner to the outer side; it is moderately convex, with a faint median channel at its under part. The fore part of the stem of this condyle presents a transverse groove between two transverse ridges. The outer and hinder border of the trochlea is produced backwards. The rudimental metatarsal of the hallux is figured of its natural size at fig. 1, and in figs 4 and 5, Pl. I.: it is of a rhomboidal form, is subcompressed, with its lower end enlarged and convex for articulation with the proximal phalanx of the hallux. The opposite end of the bone is obliquely truncate and roughened for the attachment of the ligaments which connected it with the similarly rough articular depression on the entometatarse (II). The outer and anterior surface is slightly convex; the inner and posterior surface is concave lengthwise: the bone is slightly twisted upon itself, this character being best shown by the direction of the inner and longer border of the bone. It is longer in proportion to its breadth than in the *Apteryx*, and it doubtless supported, as in that genus, a small proximal phalanx terminated by an ungual one: the convex articular surface is impressed by a shallow longitudinal groove, indicative of a trochlear articulation with the phalanx.

The phalanges of the three anterior toes are present in the same progressively increasing number in the *Palapteryx* as in birds generally. The proximal phalanx (II. 1) of the second toe is distinguished from that of the third (middle) toe by the unsymmetrical form of the proximal articulation, and from that of the fourth (outer) toe by its greater length in proportion to its thickness. The form of the proximal articular surface is given in fig. 3, at II. 1: the outer half of the surface is most extended from before backwards, and its posterior rounded angle is produced, and divided by a groove from the corresponding part of the inner part of the joint. The under surface of the phalanx presents a rough tuberosity near each of these angles, and the inner surface of the inner angle is impressed with a pit for the insertion of the lateral ligament: the under surface of the middle of the phalanx is flattened: the section of the bone at that part would give almost a semicircle with the angles rounded off; but the inner side of the upper convex part of the phalanx is rather more extended and sloping than the outer one. The distal articulation is a convex trochlea describing rather more than a semicircle in the vertical direction, and divided by a wide and deep median channel: the inner moiety of the trochlea is rather the most produced: on each side of the distal end of the phalanx there is a depression for the lateral ligament; it is deepest on the outer side.

The second phalanx of the second toe (II. 2) has its expanded proximal articular surface divided by a submedian vertical ridge into two concavities, the inner one being broader in proportion to its vertical extent than the outer one, which shows reverse proportions: the section of the middle of the shaft is subtriedral with rounded angles; the outer and inner sides converging more to the upper surface than in II. 1, and the inner surface sloping rather more than the outer one: this character distinguishes the phalanx in question from the corresponding one in the other toes (III. 2 or IV. 2). The under surface is flattened, the upper one slightly concave lengthwise. The distal trochlea, divided by the vertical wide groove, is more contracted above than in II. 1. The pits for the lateral ligaments are large and well-marked; that on the outer side is the deepest and has a tuberosity beneath it.

The third or ungual phalanx (II. 3) is three inches in length; it is figured somewhat foreshortened, being viewed as it is naturally bent in Pl. I. It is a subtriedral long cone, bent slightly downwards. The proximal articular surface is shield-shaped with the base downwards; it is nearly equally divided by the vertical ridge which fits into the groove of II. 2: the under surface of the base of the phalanx presents a broad rough surface for the insertion of the flexor perforans tendon; the rest of the under surface is smooth and nearly flat transversely, slightly curved lengthwise. The lateral surfaces converge to an upper smooth convexity, which near the base of the phalanx shows the line of insertion of the expanded extensor tendon. The inner surface is most sloping and most extensive: the upper surface is smooth and convex; each side is impressed by a deep vascular groove extending half way towards the apex of the phalanx. The apex of the claw is pierced by many large vascular canals, for the issue of the vessels supplying the secreting organ of the powerful claw.

The length of the toe II, as given by the three phalanges, is seven inches and a half. The length of the proximal phalanx of the middle toe (III. 1) is four inches and a half; the form of its proximal articular surface is shown at fig. 3, III. 1. A rough, somewhat prominent tract, of a triangular shape, extends from the lower angles of the proximal surface forwards upon the lateral and under surface of the shaft, over more than one-third of its extent; and they bound a shallow channel which impresses the middle of the under surface of that part of the bone. The section of the middle of the shaft of this phalanx yields a full transverse ellipse, a little flattened at the under part. The upper surface of the phalanx is almost straight lengthwise: there is a slight depression above the upper border of the distal trochlea. This trochlea is more equally divided, and by a less deep median groove, into the two articular convexities, than in the phalanx II. 1: there is a depression at the middle of the under border of the surface, and a deep and large ligamentous depression on each side of the distal trochlea. The second phalanx, III. 2, differs from II. 2, not only by its greater size, but by its more symmetrical form, and by the straight line in which the upper surface extends from the posterior to the anterior trochlea. The inner of the two divisions of the proximal trochlea is rather the largest, but the inequality is less than in II. 2. The distal trochlea is almost symmetrical; the under surface is more deeply notched than in II. 2: the outer of the two impressions for the lateral ligament is the deepest.

The third phalanx, III. 3, has almost a square contour, with three of the sides slightly concave, and the fourth formed by the proximal articular surface slightly produced at the middle: the section of the middle of this phalanx would be nearly a semicircle, the under surface being flat transversely: the pits for the lateral ligaments, near the distal end of the bone, are large and well-marked: the median depression of the distal trochlea is shallower than in II. 2. The proximal surface of the ungual phalanx is consequently marked by a much more feeble median vertical prominence, and it is broader and of a more symmetrical form than that of the ungual phalanx of the inner toe (II. 3); it is very little longer than that phalanx, and in other respects closely resembles it.

The proximal phalanx of the outer toe (IV. 1) is characterized by its unsymmetrical proximal surface and its great breadth in proportion to its length. The proximal articular surface is less expanded in proportion to the shaft than in II. 1. The median concavity of that surface is smaller in proportion to its peripheral convexity: the inner moiety of the surface has a much greater vertical extent than the outer one, its lower angle being produced downwards and backwards, as shown in fig. 3: a deep notch divides it from the corresponding part of the outer surface; a broad rough tract extends forwards from the lower half of the outer surface along half the extent of the shaft: the similar rough tract from the lower anglé of the inner part of the proximal articulation is narrower and of less extent. The smooth under surface of the shaft is slightly concave; the upper surface is slightly concave lengthwise, convex transversely. The distal trochlea is divided by a deeper median vertical groove than in III. 1, and the inner convexity is broader, whilst the outer one is the most prominent: the inferior boundary of the distal trochlea is sharply defined and almost straight, not notched in the middle as in III. 1 and II. 1. The second phalanx (IV. 2) is almost as broad as it is long. The inner concavity of its proximal trochlea is the broadest: the upper surface extends straight from the proximal to the distal trochlea, and it is less convex from side to side than in III. 2. The under surface is nearly flat, and presents a ridge near to and nearly parallel with the lower margin of the proximal trochlea. The large and deep pits for the lateral ligaments occupy nearly the whole of the lateral surfaces of the phalanx. The distal trochlea is proportionally broader in comparison with its vertical extent than in III. 2 or II. 2; it is less contracted above than in III. 3, and is also more deeply impressed by the median channel: the inner division is the broadest.

The third phalanx (IV. 3) viewed from above is broader than it is long; but the production backwards of the inferior border of the proximal articulation makes its extreme length rather greater than its breadth: the section through the middle of this phalanx would be nearly quadrate, the upper surface being broader and flatter than in any of the previously described phalanges. The under surface developes a ridge along the outer half of the inferior border of the proximal articulation: the inner concavity of that articulation is the broadest. The ligament-pits occupy the whole lateral surface. The distal articulation is much broader than it is deep, and the median channel is wide and shallow; the inner convexity is the broadest.

The fourth phalanx (IV. 4), besides its smaller size, is shorter above in proportion to its breadth than the preceding (iv. 3): the proximal surface is divided by a less prominent ridge, and the distal one is still more feebly impressed by the median channel.

The ungual phalanx (iv. 5) consequently may be distinguished from that of the other toes by the almost uniform concavity in the vertical direction of its articular surface. It is the smallest of the three; the outer surface is more extensive and is flatter than the inner one. In its lateral grooves and general downward curvature it agrees with the ungual phalanges of the toes iii and ii.

The ungual phalanges are of great strength: the base of the cone bears the same proportion to its length as in the phalanx which terminates the strongest of the two toes of the Ostrich (iii. 4, fig. 7); and it exceeds that in the ungual phalanges of the Rhea and Emeu: notwithstanding which, the claw phalanges of the *Palapteryx* show a degree of downward curvature greater than in the Ostrich or Rhea, and such as is rarely seen except in claw-bones of more slender proportions.

The breadth of the base, or articular surface of the ungual phalanx of the middle toe in the *Palapteryx robustus* is one inch four lines, the length of the phalanx being three inches: the same admeasurements in the ungual phalanx of the inner toe, ii, give one inch three lines, and three inches, and in that of the outer toe, iv, one inch one line, and two inches four lines. These proportions, with the downward curvature of the claw-bones, indicate that the powerful claws with which they were sheathed must have been put to uses requiring great force, analogous to those for which the similarly proportioned claw-bones of the *Apteryx* are adapted. In this small species the power of scratching up the soil is exercised to such a degree that it excavates a burrow for its safe habitation: in the larger allied extinct species the rasorial actions would doubtless be restricted to the acquisition of food: and the ascertained structure of the foot thus accords with and bears out the conclusions deduced from the structure of the bones of the neck and head.

Amongst the toe-bones of smaller dimensions, which from time to time were transmitted to me, I soon found homologous ones presenting different proportions; and, finally, by means of the rich accession of specimens due to the enlightened exertions of Col. Wakefield, I have been enabled to recompose the entire feet of two species characterized by those different proportions of the phalanges. One of these feet is represented in Pl. II., the other in Pl. III.

As the coalesced metatarsals might be expected to manifest the same general proportions as the toes they sustained, I have referred the more slender phalanges to the *Palapteryx dromioides*, and the more robust ones to the *Dinornis rheides*, the articular condyles of the metatarsi of these species bearing the closest correspondence with the joints of the proximal phalanges to which they have been respectively adjusted in the specimens represented of the natural size in Plates II. & III.

The metatarse of the *Palapteryx dromioides* shows the articular depression for the small back-toe: but the bones of this toe have not yet reached me.

The proximal phalanx of the inner or second toe, II. 1, has the contour of the proximal articulation cordiform, the apex being superior, the notched base below: it is more concave than in the *Palapteryx robustus*, and the inner and lower angle is as much produced as the outer one. A well-marked rough surface extends from each of these angles forwards upon the under and outer surfaces of the bone. The vertical channel dividing the distal trochlea is deeper than in the *Palapteryx robustus*, especially at its upper part: the more gradual slope from the upper to the inner side of the bone, as contrasted with the more vertical outer side, is better marked than in the *Palapteryx robustus*. The inner depression at the distal end for the lateral ligament is deeper than the outer one. The second phalanx is characterized by the deep lateral cavities and the prominent median vertical ridge forming the proximal articulation, which is also more nearly symmetrical than in the *Palapteryx robustus*; the inner division is, nevertheless, the broadest. The distal articular surface extends further back upon both the upper and under surfaces of the bone. The ungual phalanx (II. 3) shows the same unsymmetrical character, produced by the more sloping inner side and the more vertical outer side, as the proximal phalanx (II. 1) does: the inner side terminates below in a ridge; the outer one is rounded off into the under surface: this is protuberant near the lateral vascular grooves, which are well-marked. The length and slenderness of the ungual phalanx contrast better with the proportions of the same bone in *Palapteryx robustus*, than do those of the preceding phalanges.

The proximal phalanx of the middle toe (III. 1) shows well the characters of length and slenderness: its proximal articulation differs from that in the *Palapteryx ingens* by the absence of any median vertical ridge: it is a single shallow concavity, a little deepened towards the upper part: each angle between the under and lateral surfaces, at the proximal expanded end of the bone, supports a rough triangular prominent surface: the distal trochlea repeats the same character of the deep median cleft as in the phalanx II. 1, but the divisions are more symmetrical: the articular surfaces extend further upon the upper and under surfaces of the bone than in the *Pal. robustus*. The second phalanx (III. 2) has its proximal articulation divided and adjusted by the development of the median prominence to the deeply cleft trochlea of the preceding phalanx: its distal trochlea repeats the deep-cleft character. In the third phalanx (III. 3) the distal trochlea is much less deeply cleft; and the articular surface of the ungual phalanx is correspondingly simplified. This claw-bone (III. 4) repeats the long and slender proportions of that of the second toe: the lower border of each lateral groove is notched, which gives a character something like that shown in the corresponding phalanx of the Ostrich (III. 4, Pl. I. fig. 7).

The proximal phalanx of the outer toe (IV. 1) is shorter and broader in proportion to III. 1 and II. 1 than in the *Palapteryx robustus*: its proximal articulation is more extended transversely, is less notched below and less concave: the inner half has the greater vertical extent, its lower angle being produced downwards: the shaft is depressed and slopes away towards the outer side: the distal trochlea is less deeply cleft than in III. 1 or II. 1.

The second (IV. 2), the third (IV. 3) and the fourth (IV. 4) phalanges repeat the characters of their homologues in the *Palapteryx robustus*, in regard to their shortness and breadth, and the flattening of their upper surface: the under border of the proximal joint of one phalanx underlaps the trochlea of the preceding phalanx, and the distal joint of the fourth phalanx is divided by the median groove to which a median ridge on the proximal joint of the last phalanx is adapted.

The extent of the articular surfaces of all the joints of the toes of the *Palapteryx dromioides* shows a corresponding freedom and extent of motion of those toes.

The bones of the foot restored and figured in Pl. III. fig. 1, accord by their proportions with the tarso-metatarse of the *Dinornis rheïdes*, the distal trochleæ of which are quite adapted to the proximal joints of the proximal phalanges.

The tarso-metatarse of the *Dinornis rheïdes* differs from that of the *Palapteryx robustus*, by the absence of any rudiment of the ectocalcaneal process; by the greater elevation of the entocalcaneal process and its equality of size with the mesocalcaneal process; and by the presence of a tubercle at the middle of the inner border of the inner concavity for the tibia. There is no trace of a depression for the articulation of the back-toe.

The phalanges differ from those of the *Palapteryx dromioides*, not only by their thicker proportions, as shown in Pl. III. fig. 1, but by the less deep divisions of the trochlear surfaces. In the short cuboidal phalanges, 3 and 4, of the outer toe (IV), the distal trochlea presents an almost uniform convexity: and the ungual phalanx of this toe is distinguished from that of the other toes by the uniform concavity of its proximal surface. The greater strength of the toes of the *Dinornis casuarinus* accords with the superior thickness of the tarso-metatarse, compared with that bone in the *Palapteryx dromioides*; and a corresponding difference in the habits of the two birds may be inferred from these differences in the structure of the feet.

Description of the Femur and Tarso-metatarse of the Aptornis otidiformis.

In my Memoir on the *Dinornis* of 1843[1], I described and figured a tibia obtained by the Very Rev. Archdeacon Williams from a fluviatile deposit in the North Island of New Zealand, and referred it provisionally to a species of *Dinornis* under the name of *Dinornis otidiformis*. In a subsequent Memoir[2] read before the Zoological Society in 1848, I determined the tarso-metatarsal bone which articulated with that tibia, and pointed out some characters of the tarso-metatarsal bone which indicated the generic distinction of the bird to which it belonged, from the *Dinornis*, and accordingly I proposed for it the name of *Aptornis*[3]. I am now enabled further to advance the knowledge of the characters of the bones of the leg of this genus and species by a description and figures of the femur (Pl. III. figs. 3 & 4). This bone, which measures six inches three lines in length, has a straight, strong, subcylindrical shaft, with which the short and thick neck support-

[1] Zool. Trans. iii. Part iii. p. 235. pl. 25. figs. 5 & 6; pl. 26. figs. 5 & 6. [2] *Ib.* p. 347.

[3] By syncope for " Apterygiornis," from *α priv.*, πτέρυξ *wing*, ὄρνις *bird*.

ing the head stands inwards at right angles. The head is impressed by a large pit for the "ligamentum teres." The great trochanter rises above the level of the smooth upper surface continued to it from the head: there is a well-marked ridge which extends from the inner and back part of the shaft of the bone to the upper and back part of the inner condyle; in this character it resembles the femur of the *Apteryx*, as well as in its relative length to the tibia. The inner condyle reaches downwards nearly as far as the outer condyle. The fibular fossa, outside the outer condyle, is well-marked: above it is a deep and rough depression. The fore part of both condyles is more prominent than in the femora of *Dinornis*. There is no pneumatic foramen: the compact wall of the shaft of the femur is between one and two lines in thickness. As compared with the femur of the Bustard, that of the *Aptornis* is thicker in proportion to its length, and longer in proportion to the tibia; and the ridge extending in the Bustard's femur from the middle of the back part of the shaft towards the outer condyle, is not present in that of the *Aptornis*.

The tarso-metatarse (Pl. III. figs. 5–8) measures three inches ten lines in length; its proportions in comparison with the tibia and femur resembling those of the *Apteryx*. The ecto- and ento-condyloid cavities at the proximal end of the bone (Pl. III. fig. 6) are deeper than in *Palapteryx* or *Dinornis*, are more equal in size, and are more widely separated by the intercondyloid tract and eminence: these modifications accord with those of the distal end of the tibia figured in vol. iii. pl. 25. fig. 6. The intercondyloid eminence is obtuse and relatively higher than in *Dinornis* or *Palapteryx*. The calcaneal processes project further back and blend together in a smooth convex plate behind, converting the groove for the flexor tendons into a foramen which is remarkable for its width: its shape is shown in Pl. III. figs. 5 & 6. Figure 7 shows another character of the calcaneal prominence by which the *Aptornis* differs from the *Dinornis* and *Palapteryx*, viz. in the absence of the buttress-like support formed in those genera by the posteriorly projecting shaft of the mesometatarsal element. The back part of the shaft is even and almost flat, the surface being broken only by one or two narrow intermuscular or intertendinous ridges: just below the best-developed ridge near the inner side of the bone, is the large and well-marked surface for the attachment of the metatarsal bone of the hallux, I. The anterior surface of the tarso-metatarse is convex transversely, slightly concave lengthwise: the distal end of the bone is so equally expanded, that both the inner and outer sides show a nearly equal degree of concavity. A short groove on the outer third of the fore part of the bone leads to the canal which pierces the confluent parts of the outer and middle metatarsals, two lines above the space between the two condyles of those bones: this canal answers to that which in the *Notornis*, *Didus*, *Diomedæa* and many other birds, transmits the tendon of the adductor muscle of the fourth toe (IV). The relative size and position of the condyles of the three coalesced metatarsals are shown in figs. 5 & 8. The middle one advances further in front of the others than in the *Apteryx*, *Palapteryx* and *Dinornis*: each condyle is impressed by a well-marked median groove.

Bones of the Leg of Notornis.

The genus *Notornis*, of the family of the *Rallidæ*, and most nearly allied to the *Porphyrio*, was established on a skull described and figured in my Memoir of 1848[1].

It is to this genus that I refer the femur, tibia and tarso-metatarse about to be described, on account of their similar correspondence with the same bones in *Porphyrio*, and their proportional agreement in size with the skull of the *Notornis*.

The specimens were obtained from the North Island of New Zealand, and were transmitted by the Rev. William Cotton, M.A. The femur (Pl. II. fig. 3) is moderately long and slightly bent with the convexity forwards, as in the *Brachypteryx*. A small head supported on a short and thick neck is impressed on its upper part by a large fossa for the 'ligamentum teres': the apex of the three-sided trochanter is bent upwards and forwards: the broad irregular convex outer surface of the trochanter extends between a concavity at the inner and fore part of the trochanter and a smaller concavity at the back part of the upper surface of the shaft. A narrow intermuscular ridge extends down the middle of the back part of the shaft to the shallow popliteal space, above the inner condyle, as in the *Brachypteryx*: the shaft is nearly cylindrical. The rotular intercondyloid surface is wide and slightly inclined inwards. The fibular notch behind the outer condyle, and the rough fossa above it, closely accord with those of the *Brachypteryx*.

The tibia (Pl. II. fig. 4) measures seven inches ten lines in length, and like the femur is more slender in proportion to its length than in the *Aptornis*: the proximal articular surface is almost confined to the entocondyloid division, which is very slightly concave in adaptation to the almost flattened broad inferior surface of the inner condyle of the femur: the intercondyloid tuberosity is low. The epicnemial ridge rises much above it, and equals in extent the breadth of the articular surface of the tibia: it forms an angle at the fore part of the middle of the proximal end of the tibia and extends thence obliquely outwards and backwards, where it terminates by meeting at a right angle the ectocnemial ridge: this is short, and descending obliquely inwards terminates or subsides upon the prominent fore part of the tibia about an inch below its upper angle. The procnemial ridge has an equally short origin, which is oblique and parallel with the ectocnemial ridge: it is broken in the specimen under description, but from the analogy of the *Brachypteryx* probably projects far forwards: where it subsides at the inner side of the tibia there is a tuberosity, from which a low ridge extends bounding internally the fore part of the tibia as far as the canal for the extensor tendon. The fibular ridge is well-marked; it begins on the outer side of the shaft one inch below the epicnemial ridge, extends nearly two inches down the shaft, and after a smooth tract of half an inch, reappears as a rough tract of an inch and a half in extent: a low narrow ridge is continued thence to the outer side of the fossa, lodging the extensor canal. The shaft of the tibia is compressed from before backwards, is smooth and rounded on the inner

[1] Zoological Transactions, p. 366.

side which is thicker than on the outer side. The hinder and under part of the distal articular surface is convex from behind forwards, slightly concave from side to side, increasing in breadth as it extends forwards, and bounded laterally by two prominent ridges: the division of this surface into condyles is limited to its fore part, where they project forwards, are of small size, and are divided by a very wide concave interspace, immediately above which is the bony canal for the extensor tendons. The distal end of the tibia is expanded chiefly at its inner side, towards which it seems to be slightly bent.

The tarso-metatarse (Pl. II. fig. 5) a little exceeds the femur in length: its proximal condyloid cavities are small and widely separated by a large intercondyloid prominence, and a non-articular tract behind extended upon a calcaneal process: the entocondyloid cavity is as usual the deepest. The calcaneal process is simple, imperforate, and subsides eight lines below its upper end upon the back part of the mesometatarse. The concavity on the inner side of the calcaneal process is bounded internally by a ridge continued from a tuberosity behind the entocondyloid cavity about two-thirds down the shaft, below which is the well-marked oval depression for the back-toe (i). A small foramen, indicating the interosseous space between the inner and middle metatarsals, opens into the upper part of the concavity below and at the inner side of the calcaneal process. On the outer side of that process, but at a lower level, is a similar remnant of the primitive space between the middle and external metatarsals: both these foramina unite as usual into a single median foramen at the fore part of the proximal end of the bone. A deep and wide concavity occupies the upper half of the fore part of the tarso-metatarse: it is gradually filled up by the advance forwards of the middle metatarsal element, which is placed as usual rather obliquely between the outer and inner elements. A slight groove between the distal portion of the middle metatarsal and the outer one, leads to the canal for the transmission of the adductor tendon of the fourth toe. The outer and inner trochleæ are nearly of equal extent, the outer one being a little longer or lower: the middle trochlea is the longest as well as largest: it does not advance so far forwards as in the *Aptornis*: each condyle is slightly grooved.

Remains of the Apteryx.

In the fluviatile deposits and in the cavern at the base of Tongariro, in the North Island of New Zealand, bones of the *Apteryx* have been discovered so associated with those of *Dinornis*, *Palapteryx*, *Aptornis* and *Notornis*, as to lead to the conclusion that they had been buried at the same period and were of equal antiquity. Most of these remains, of which a femur (fig. 6), and a tarso-metatarse (figs. 7 & 8) are figured in Pl. II., agree in size and other characters with the corresponding parts of the existing species (*Apteryx australis*): but amongst the specimens transmitted by Governor Grey from the cavern at Tongariro there is a femur, which agrees in size with that of the smaller species of *Apteryx* figured and described by my friend Mr. Gould under the name of *Apteryx Owenii*[1].

[1] Zool. Trans. vol. iii. p. 379. pl. 57.

The shaft of the femur of the *Apteryx* is characterized by the convexity of the fore part of the shaft in the direction of its axis, which is due, not only to a slight bending of the whole shaft forwards, but to an enlargement in that direction of the middle of the fore part of the shaft: the trochanter does not rise much above the neck and head of the bone: its anterior border, which is thick and rounded, is produced: the broad outer and back part of the condyle is impressed by coarse irregular grooves and pits. Two intermuscular ridges diverge from the middle of the back part of the bone to each condyle. The fore part of the outer condyle is slightly inclined inwards. There is no 'foramen pneumaticum.'

The tarso-metatarse (figs. 7 & 8) presents the general characters of that compound bone in the *Palapteryx*: but the intercondyloid tubercle is relatively higher, and the inner border of the entocondyloid fossa is more convex: the ectocalcaneal process is also better developed and more distinct from the mesocalcaneal one: the chief tendinous groove lies, however, between this and the entocalcaneal process. The back part of the mesometatarse projects and supports, as a buttress, the mesocalcaneal process: on each side of this are the interosseous foramina which converge as they extend forwards, but open separately into the anterior fossa below the proximal end of the bone. This fossa is relatively larger and deeper than in *Palapteryx* or *Dinornis*, but is not extended so far down the bone as in *Notornis*. The rough articular depression (I, fig. 7) for the syndosmosis of the hallux is well-marked. The meso-metatarse advancing forwards at its lower half, makes a median prominence at that part of the common shaft: the groove between it and the ectometatarse is well-marked, and just before its termination it shows a small perforation from before backwards: this is the most distinctive mark between the tarso-metatarse of the *Apteryx* and that of the *Palapteryx*. The inner condyle is the least produced, the middle one the most, and in a somewhat greater degree than in the *Palapteryx*. The trochlear groove deeply impresses the whole extent of the middle condyle: it is more feebly marked on the lateral condyles, except posteriorly where the lateral border of each is produced backwards.

When the general results of the restoration of extinct species and their relations to existing species of the different continents and islands of the globe are first received, they commonly suggest the idea that the races of animals have deteriorated in respect of size. The more striking phænomena first and most strongly impress the mind; which contrasts, for example, the great Cave-Bears of Europe with the actual Brown Bear; the Megatherioids of South America with the small existing Sloths; and the gigantic Glyptodons with the Armadillos. The huge *Diprotodon* and *Nototherium* afford a similar contrast with the Kangaroos of Australia; and the towering *Dinornis* and *Palapteryx* with the humble *Apteryx* of New Zealand. But the comparatively diminutive animals of South America, Australia and New Zealand that form the nearest allies of the gigantic extinct species respectively characteristic of such tracts of dry land, are yet specifically if not generically distinct from them, nor have such small species been more recently introduced.

In England, for example, our Moles, Water-voles, Hares, Weasels, Stoats, Badgers and Foxes are of the same species as those that existed when the Hippopotamus swam the rivers, the Hyæna, Bear and Lion lurked in the caves, and the Rhinoceros and Elephant trod the land. So likewise the remains of small Sloths and Armadillos are found associated with the Megatherium and Glyptodon in South America; and the fossil remains of species as diminutive as the present Kangaroos and Dasyures occur abundantly in Australia with those of herbivorous Marsupials as large as Tapirs and Rhinoceroses, and of carnivorous Marsupials as large as the Lion or Tiger. So likewise in New Zealand we find that the small *Apteryx* has co-existed with the great *Dinornis* and *Palapteryx.*

We have not a particle of evidence that any species of bird or beast that lived during the pliocene period has had its characters modified in any respect by the influence of time or of change of external influences. In proportion to its bulk is the difficulty of the contest which, as a living organized whole, the individual of such species has to maintain against the surrounding agencies that are ever tending to dissolve the vital bond, and subjugate the living matter to the ordinary chemical and physical forces. Any changes, therefore, in such external agencies as a species may have been originally adapted to exist in, will militate against that existence in a degree proportionate, perhaps in a geometrical ratio, to the bulk of the species. If a dry season be gradually prolonged, the large Mammal will suffer from the drought sooner than the small one: if such alteration of climate affect the quantity of vegetable food, the bulky Herbivore will first feel the effects of stinted nourishment: if new enemies are introduced, the large and conspicuous quadruped or bird will fall a prey, whilst the smaller species conceal themselves and escape. Smaller animals are usually, also, more prolific than larger ones.

The actual presence, therefore, of small species of animals in countries where larger species of the same natural families formerly existed, is not the consequence of any gradual diminution of the size of such species, but is the result of circumstances, which may be illustrated by the fable of the 'oak and the reed': the smaller and feebler animals have bent and accommodated themselves to changes which have destroyed the larger species. We find, nevertheless, that the same peculiar forms or families of animals exist and characterize particular portions of dry land, such *e. g.* as South America, Australia, and New Zealand, at the present day, as at a period long antecedent to Human history or existence; and although many species have perished, there has been no general sweeping away of the peculiar aboriginal land animals of those continents or islands. But just as the smaller Sloths and Armadillos still linger in South America, so the smaller Kangaroos, Wombats, Dasyures, and other Marsupials have continued to exist in Australia, and a few species of the comparatively diminutive wingless birds of the genera *Apteryx* and *Brachypteryx* still exist in the island where their peculiar families were once much more richly represented and by species on a far larger scale.

Sternum of Palapteryx *and* Aptornis.

The most simple form of *sternum* in the class of *Birds* is that which is presented by the terrestrial species deprived of the power of flight, in which, however, the size and especially the breadth of the bone surpass those of the sternum of any of the terrestrial mammals, and relate to the peculiar mode of respiration in the class of Birds. The mechanical part of this function is effected by alternately bringing the sternum nearer to the back and pushing it farther from it, these movements of elevation and depression being performed chiefly upon the synovial joints between the sternal and vertebral ribs; by these movements the large air-cells interposed between the concave surface of the sternum and the lungs, which lungs are fixed in intercostal cavities at the back of the thorax, are alternately expanded and contracted, receiving the air in expansion from the orifices on the sternal aspect of the lungs, and expelling it on contraction through the same apertures back into the lungs; or, if, as is commonly the case, other air-cells be developed beyond the sternum, into those extrasternal cells. The suprasternal or thoracic air-cells being those which are most essential to this mode of respiration, are constantly developed in Birds, and are present in the *Apteryx*[1], where no other extra-pulmonary air-cells exist; in which bird accordingly we find the sternum of greater relative breadth[2] than in any Mammalian animal, notwithstanding the wings are reduced to mere rudiments; the primary and essential relations of the sternum being to the ornithic mode of respiration above described. The other modifications of the sternum in Birds relate to the functions and actions of the anterior extremities. The great extent, however, of its diversity of shape and proportion has not, as yet, been fully or satisfactorily explained on the principle of final causes; but they are characteristic, to a certain degree, of natural groups, and are useful as accessory guides to the natural arrangement and affinities of the class.

The relation of particular forms of sternum to particular genera of Birds is illustrated by those which characterize the different genera of the Struthious family, in which the secondary modifications are superinduced upon a common family type of the bone exemplified by its resemblance to a buckler and the total absence of the keel. They are so constant and well-marked, that the Comparative Osteologist, who had had the opportunity of comparing them, would afterwards readily distinguish the genera *Struthio*, *Rhea*, *Casuarius* and *Dromaius*, by the sternum alone. That bone in the *Apteryx* is still more characteristic of the genus, and it is to this particular modification of the keel-less sternum that the sternum of one or both genera of the gigantic wingless birds of New Zealand makes the nearest approach. This is exemplified in the attempted restoration of the sternum of a large species[3] referred to *Dinornis* prior to the reception of the evidence afforded by the cranium and beak of two genera of large wingless birds in New

[1] Zool. Trans. vol. ii. p. 278. pl. 51. fig. 4.
[2] *Ib.* vol. iii. p. 318. pl. 43. fig. 8.
[3] *Ib.* vol. iii. p. 316. pl. 43. figs. 1, 2 & 3.

Zealand. That sternum may, however, belong to the *Palapteryx robustus*: it was obtained, it will be remembered, from the same deposit at Waikawaite in the Middle Island, from which the most abundant and instructive evidences of that species have been had. The restoration was unavoidably imperfect, as regards especially the form and extent of the anterior or costal angles (*a*, pl. 43, vol. iii.), but was sufficiently established to illustrate the nearer resemblance of the sternum in form to that of the *Apteryx* than to that of any of the larger existing Struthious birds.

A much more perfect specimen of the sternum (Pl. IV. figs. 1–4) of a smaller species of the great wingless birds of New Zealand confirms the general accuracy of the restoration attempted in my Memoir of 1846, and affords additional illustration of a near affinity to the *Apteryx*. For this reason I refer the sternum in question to the genus *Palapteryx*. Like that of the *Apteryx*, this sternum is remarkable for its shortness in comparison with its breadth, and for the breadth and depth of the two posterior notches. The chief difference is presented by the anterior border, which extends in almost a straight line from one costal angle to the other. These angles (*a*, *a*) are produced into short, broad, subcompressed processes, rounded and thick at their free and expanded ends, and slightly twisted upon their neck, or point of attachment. Only three articular surfaces for sternal ribs are indicated (fig. 3), the intervening fossæ being very shallow; and the whole extent of the costal border is shorter than in the *Apteryx*, and resembles in this respect that in the Gallinæ, Pigeons, and Penguins. The coracoid fossæ (*c*, *c*) are small and unusually shallow; there is a large depression on each side of the fore part of the concave surface of the sternum nearly opposite the coracoid fossæ, the bottom of which is cribriform; numerous small foramina having apparently conducted air from the anterior thoracic cells into the sternum. That bone in the *Apteryx* shows no trace of such depressions. The bone, which is cellular at the thicker parts of the periphery, is very thin and compact at the middle of the body of the sternum.

The posterior border is marked by two deep and wide angular emarginations leaving a broad middle process with two very long and narrow diverging lateral ones; but the extremities of all these processes have been broken away. The chief specific distinction of the sternum in question, which is that of a mature bird, from the sternum figured in vol. iii. pl. 43, is its smaller size, and the angular form of the posterior notch, which was rounded at the bottom in the larger sternum, as in the *Apteryx*.

A distinct form of sternum, although evidently appertaining to a bird which was deprived of the power of flight, is that which is represented in Pl. IV. figs. 5–8. The specimen is part of the collection obtained by Mr. W. Mantell at Waingongoro, and which was sold by Dr. Mantell to the British Museum; where, for the facilities afforded for describing and figuring the specimen, I feel indebted to the kindness and urbanity of the learned Keeper of the Department, Charles König, K.H., and of his able Assistant Mr. Waterhouse.

Its proportions would justify its reference to a bird of the size of that to which the skull[1], referred in my Memoir of 1848 to the genus *Notornis*, has belonged ; and although its shape, so far as I at present know, is unique in the class of Birds, I conceive it to be a modification of that type which characterises the Rail and Coot tribe (*Rallidæ*). The grounds for this opinion will, perhaps, be best illustrated if I premise a description of the sternum of that existing species of the family in New Zealand, which, being incapable of flight from the shortness of its wings, I have referred to a genus called *Brachypteryx*.

The sternum of the *Brachypteryx* is almost as remarkable for its narrowness as in the *Apteryx* for its breadth. The anterior border has a deep rounded median emargination, between the projecting borders of which, and the more produced costal angles, the wide coracoid grooves are placed. The costal border occupies one-fifth of the lateral margin of the sternum and presents articulations for five sternal ribs: the narrow posterior border has a deep and moderately wide median emargination and two lateral, very narrow and very deep ones, like fissures, equaling one-third of the entire length of the sternum, the outer border of each fissure being a long slender filiform process. Two ridges commencing on the outer surface of the sternum behind the coracoid grooves, converge to support the fore part of a shallow keel which subsides before it reaches the posterior border of the sternum. The outer surface of the bone is slightly concave between the keel and the costal margins of the bone. The upper or concave surface of the sternum presents two pneumatic depressions behind the coracoid grooves.

The sternum of the *Notornis* (Pl. IV. figs. 5 & 6) resembles that of the *Brachypteryx* in its elongated and narrow proportions, and in the rudiment of a keel which commences by two ridges converging from the inner ends of the coracoid grooves: but the lateral styliform appendages, and consequently the lateral fissures of the posterior part of the bone, are wholly wanting, and the intermediate part of the body of the bone is narrower, and gradually contracts to what seems to have been an obtusely pointed extremity: but this is broken in the specimen. The keel does not project so far from the surface of the bone as in the *Brachypteryx*. The coracoid grooves are more shallow, and the whole sternum, although its general form and proportions are indicative of a bird of the same natural family as the *Brachypteryx*, shows that the wings were still less developed than in that genus. The costal border exhibits articulations for five sternal ribs (fig. 7) on each side, as in the *Brachypteryx* ; the anterior border shows a wide and shallow concavity, not the deep narrow median notch. There are no pneumatic fossæ on the upper surface. The anterior buttresses of the keel divide the fore part of the anterior surface of the sternum into three parts, as shown in fig. 8, where the coracoid grooves are represented near the fractured anterior or costal angles of the bone.

[1] Zool. Trans. iii. p. 366. pl. 56. fig. 7.

DESCRIPTION OF THE PLATES.

PLATE I.

Restoration of the foot of *Palapteryx robustus.*

Fig. 1. Front view of the bones.
i. Detached metatarse of the rudimental hallux.
ii. Distal trochlea of entometatarse, or that of the second toe: its three phalanges are numbered 1, 2, 3.
iii. Distal trochlea of mesometatarse, or that of the third toe: its four phalanges are numbered 1, 2, 3 and 4: a side view of the last is added in outline.
iv. Distal trochlea of ectometatarse, or that of the fourth toe: its five phalanges are numbered 1, 2, 3, 4, 5.

Fig. 2. Outline of the proximal end of the compound tarso-metatarsal bone.
3. Distal ends of the trochleæ of the three metatarsal elements, numbered as in fig. 1: below these are the proximal articulations of their respective proximal phalanges.
4. A side view of the metatarse of the hallux, showing its characteristic twist.
5. Back view of the metatarse of the hallux.
6. Distal ends of the trochleæ of the three metatarsal elements of the compound bone of the Cassowary (*Casuarius indicus*): below these are the proximal articulations of their respective proximal phalanges.
7. Outline of the bones of the foot, front view, of an Ostrich (*Struthio camelus*): the homologous phalanges with those of the *Palapteryx* are indicated by the same symbols.

All the figures are of the natural size.

PLATE II.

Restoration of the foot of *Palapteryx dromioides.*

Fig. 1. Front view of the bones. Only the distal ends of the coalesced metatarsals are figured. The bones of the toes are indicated by the same symbols as in Pl. I.
2. A side view of the ungual phalanx of the third toe.
3. Back view of the femur of *Notornis Mantelli.*
4. Front view of the tibia of ditto.
5. Back view of the tarso-metatarse of ditto.

Fig. 6. Side view of the femur of *Apteryx australis*.
7. Back view of tarso-metatarse of ditto.
8. Front view of ditto of ditto.

All the figures are of the natural size.

PLATE III.

Restoration of the foot of *Dinornis rheïdes*.

Fig. 1. Front view of the bones. Only the distal ends of the coalesced metatarsals are figured. The bones of the toes are indicated by the same symbols as in Plates I. and II.
2. A side view of the ungual phalanx of the middle toe.
3. Back view of the femur of *Aptornis otidiformis*.
4. Front view of distal end of ditto, with part of the medullary cavity and its compact walls exposed.
5. Back view of the tarso-metatarse of *Aptornis otidiformis*.
6. Proximal end of ditto.
7. Side view of ditto.
8. Distal end of ditto.

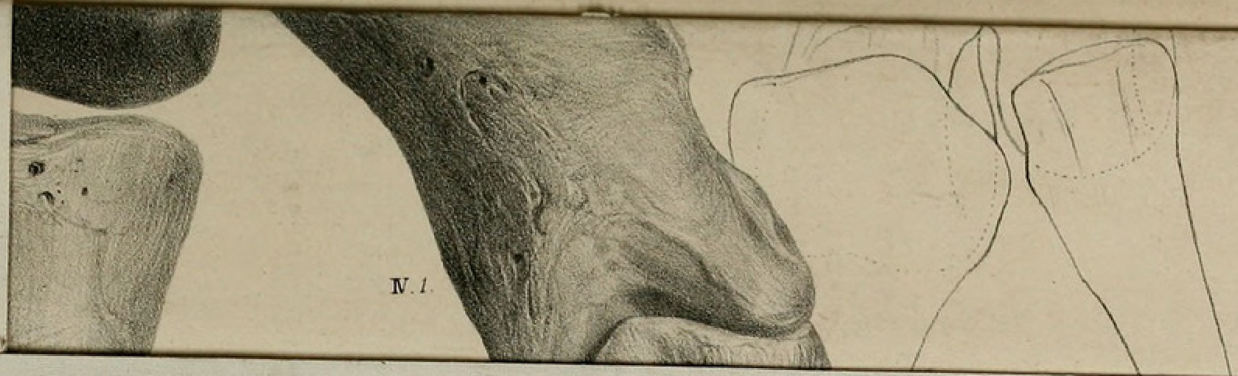
All the figures are of the natural size.

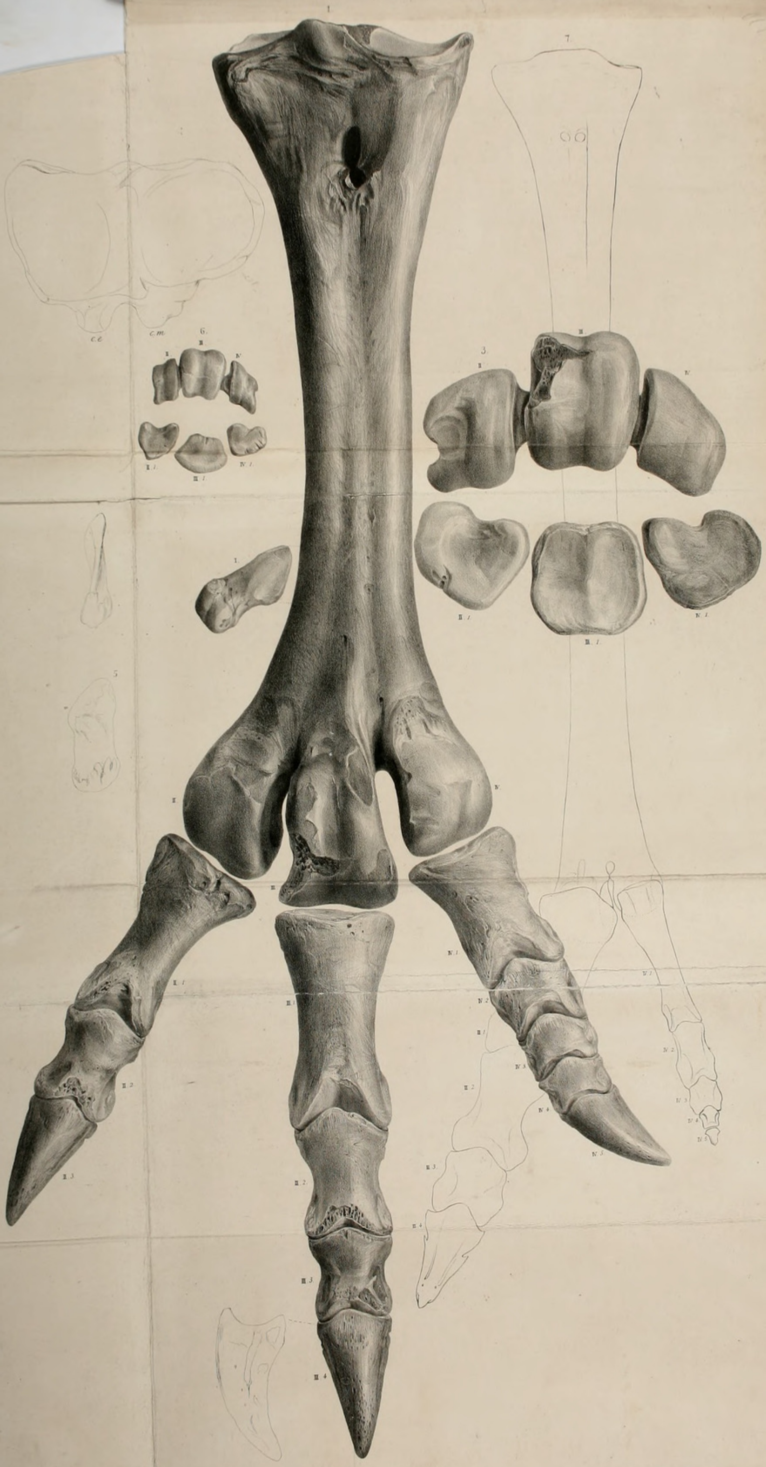
PLATE IV.

Fig. 1. Outer or under view of the sternum of a species of *Palapteryx*.
2. Inner or upper view of ditto.
3. Lateral border of ditto.
4. Anterior border of ditto.
5. Outer view of the sternum of *Notornis Mantelli*.
6. Inner view of ditto.
7. Lateral border of ditto.
8. Anterior border of ditto.

All the figures are of the natural size.

1

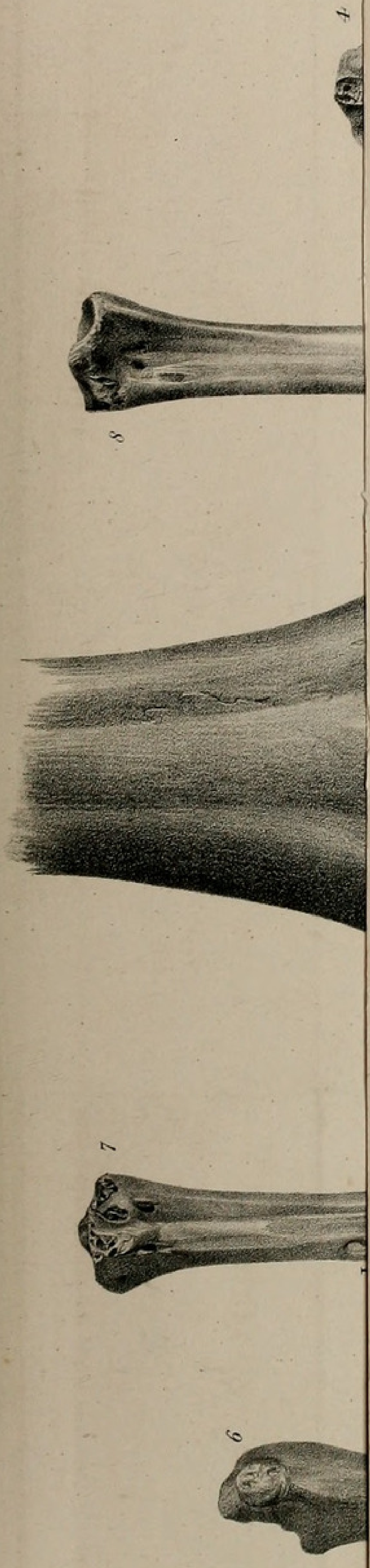




From Nature on Stone by J. Erxleben.

Palapteryx robustus.

Day & Son, Lithrs to the Queen.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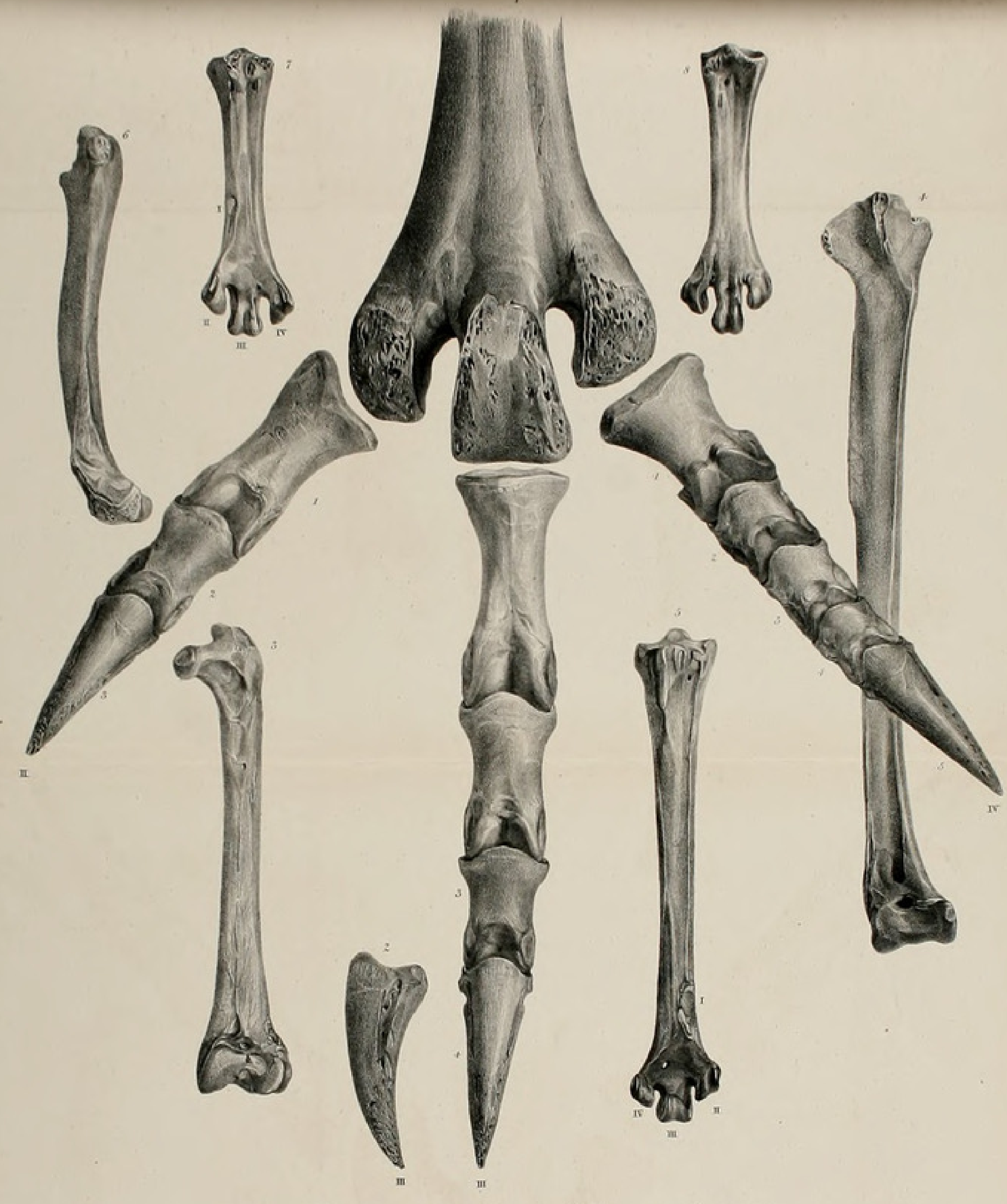

1 & 2. Palapteryx dromioides _ 3.5. Notornis _ 6.8. Apteryx.

J. Erxleben

Day & Son, Lith.rs to The Queen

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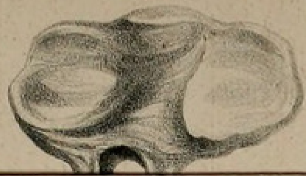

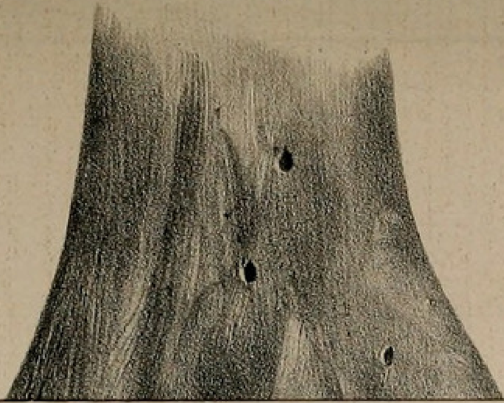

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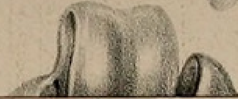

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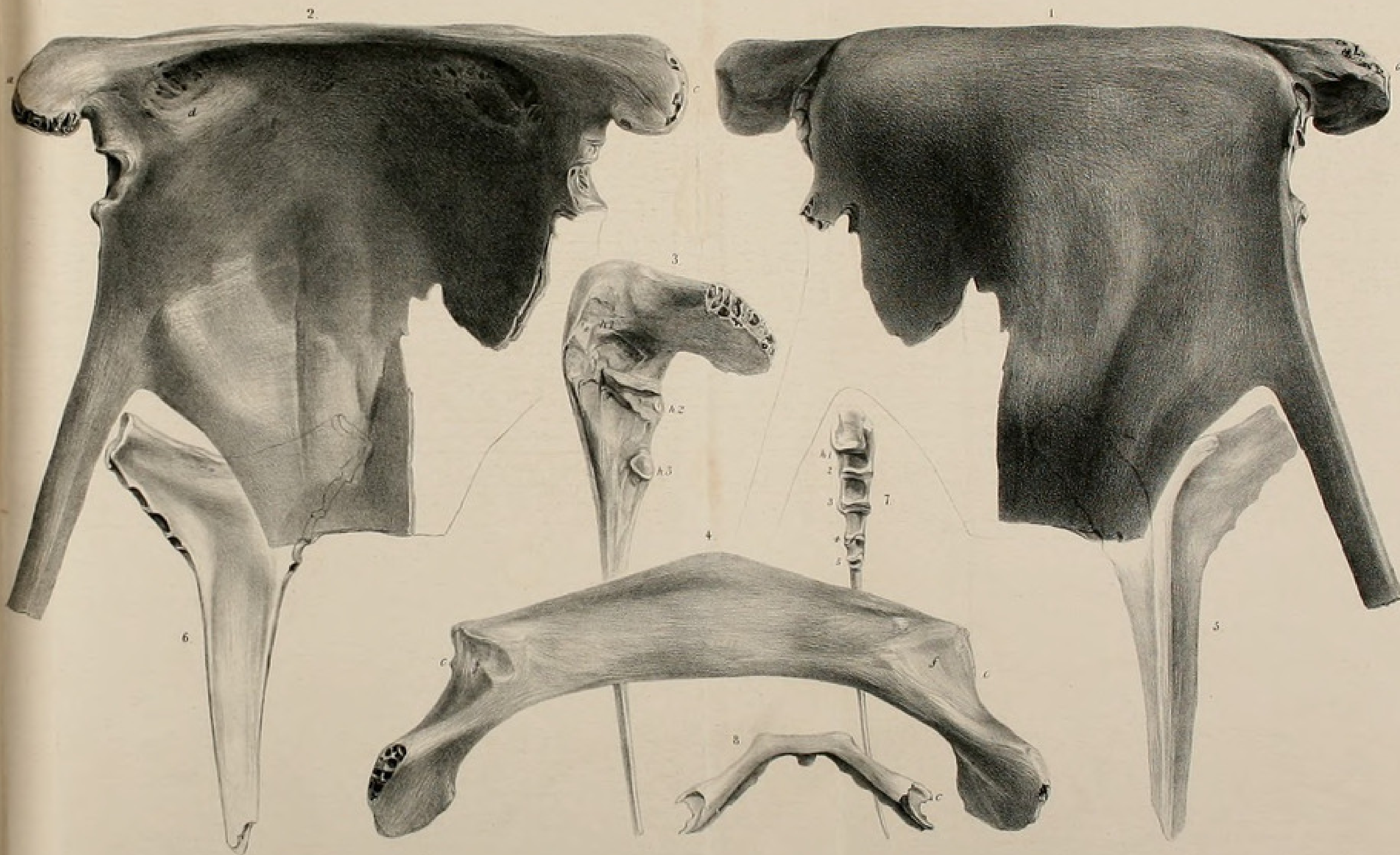
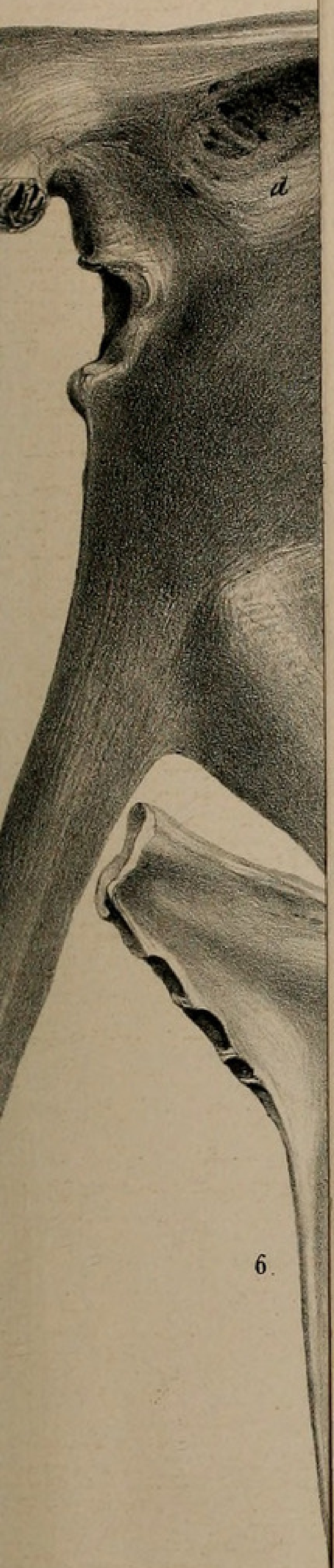


1.4. Palapteryx 5_8 Notornis. nat size.

J. Erxleben

Day & Son, Lith.



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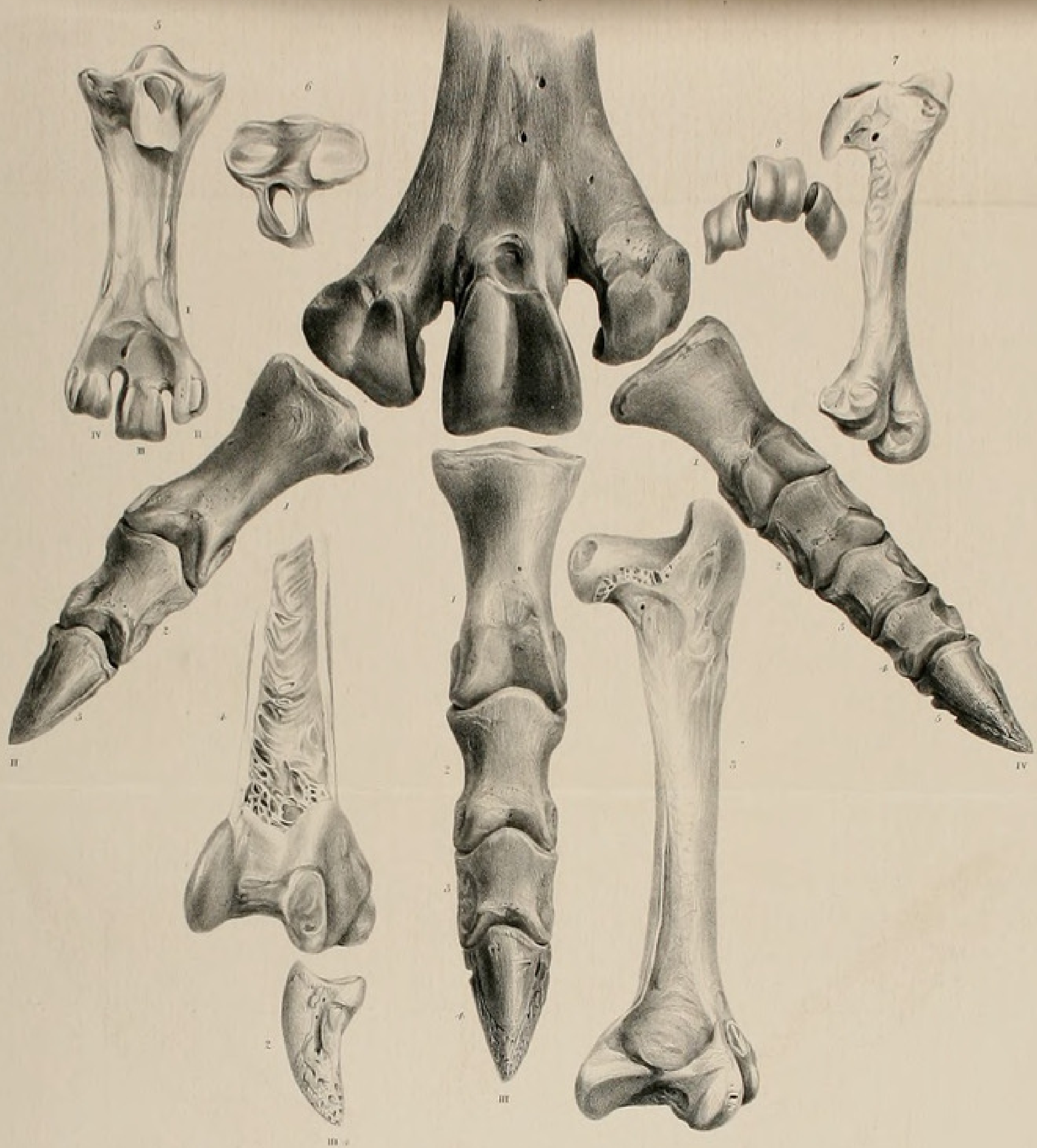

1 & 2 *Dinornis rheides* _ 3.8. *Aptornis*

Day & Son, Lith^rs to The Queen

II. *Contributions to the Knowledge of the Animal of* Nautilus Pompilius. *By* J. Van der Hoeven.

Read January 8, 1850.

THERE are hitherto but three original figures of the animal of *Nautilus Pompilius*. The first is that of Rumphius, in his 'Amboinsche Rariteitkamer' (No. xvii. at p. 62); the second that of Professor Owen in his accomplished 'Memoir on the Pearly Nautilus' (London, 1832, pl. 1); the third, drawn by M. Laurillard, was given by Professor Valenciennes in the 'Archives du Muséum d'Hist. Natur.,' ii. 1841, pl. 8.

The figure of Rumphius could only be deciphered after the discovery of a new specimen. As Professor Owen has observed, the animal is represented in that figure in an inverse position. Guided by that observation, it is possible to explain some parts in that enigmatical figure, but many obscurities still remain, and the whole gives the impression of a drawing made by recollection, and after the doubtful suggestions of a discomposed memory. This seems still more probable, because the text informs us (p. 61) that the figures to which the indications of the description allude, have been lost.

The animals represented by Professors Owen and Valenciennes were detached from the shells before they were presented to those distinguished cultivators of comparative anatomy and structural zoology. This circumstance explains some imperfections in the figures given by both. Professor Owen, for instance, gives an incorrect form to that production of the mantle which covers the convex part of the shell's circumvolution projecting in the aperture, or to the part which the author calls "the dorsal fold" (see his pl. 1 *b*); the superior free margin of the mantle is lower than it ought to be, as it conceals in the natural state a great part of the funnel and the inferior half of the eyes. In regard to the last circumstance, the drawing of Laurillard given in M. Valenciennes' paper is more correct; but in other particulars it is deficient, chiefly because the soft part of the integuments which forms the visceral sac was torn off and wholly wanting. It ought to be observed also, that those two figures represent the animal replaced in a shell of the same species indeed, but not its own.

I suppose then that it may be perhaps of some interest to publish some drawings I made, chiefly after two specimens, one of which was kindly presented to me in 1848 by Professor Reinwardt; the other I received lately from our settlements in the East, by the kind exertions of His Excellency Mr. T. C. Baud, formerly His Majesty the King of the Netherlands' Minister for the Colonial Department.

The first figure (1) represents the animal from the left side in its own shell, which has been opened with a file at such a height, that the whole last chamber was visible, together with a part of the three following compartments. The hood (*a*), composed according to Professor Owen by the conjunction in the mesial line of the two superior, excessively large digitations, covers with its projecting margin the superior surface of the pedunculated eye (*b*). The inferior half of the eye is concealed by the superior margin of the mantle, which covers also the greatest part of the digitations or lateral processes of the head (*c*, *c*). The extremity of the funnel (*d*) is visible and uncovered, the rest being contained in the anterior part of the mantle. There is no perforation or excision at this part of the mantle[1], but the margin of it is entire and slightly convex.

The mantle (*f*, *f*, *f'*, *i*) has its anterior part of a more thick and fibrose texture and a yellowish colour ; the posterior part (*i*) forms a thin and nearly transparent membranous sac, containing the different viscera. The free superior margin of the mantle ascends behind the hood (*f'*) and forms the dorsal fold of Professor Owen's memoir ; but at the side view only a small portion of this fold is visible. Beneath the posterior part of the hood, the mantle offers on each side a large aponeurotic flat piece (*g*), of a bluish white colour and a kidney-like shape, being convex at its anterior side and somewhat concave at the posterior border. This plate is the posterior insertion of a strong muscular mass—the great muscle of the shell—which goes from this attachment in an oblique course, converging with that of the opposite side, to its anterior termination at the cartilage of the head. From this oblong patch arises a narrow aponeurotic stripe, both at the superior and at the inferior extremity of it. The oblong plate may be considered as an expansion and development of this band, which, encircling the whole mantle, separates its posterior soft part or the visceral sac (*i*) from its free and thicker anterior part. The thin and membranous posterior part of the mantle is of a bluish white colour, but being imperfectly transparent, it seems to be dark at all places where it covers the bulky liver, whose colour is a dark red-brown, or chocolate-like purple. At the inferior part of the free portion of the mantle is a convexity (*h*), where lies a glandular laminated organ, secreting, as it seems, a covering to the eggs, and which projects at this place, being partly visible through the integuments. This glandular mass connected with the female generative system is situated behind the gills, at the inner surface of the mantle.

A more complete idea of the external form of the animal may be had by comparing the two following figures. Fig. 2 represents the animal taken out of the shell from a dorsal aspect. The circumference appears oblong, and of an irregular oval form. The whole is divided into two chief parts ; the first (*a*) is the hood, exactly filling up the shell's aperture[2] ; the second part (*i*) was concealed in the lower and posterior part of the terminating chamber of the shell. The dorsal fold (*f'*) appears now wholly visible ; it forms a thin lamellar production of the mantle, and ascends to the protuberant internal labium

[1] Professor Owen speaks of a large aperture through which the funnel passes. (Memoir on the Nautilus, p. 9.)

[2] It may be allowed to hazard here the opinion, that the two juxtaposed fossil shells, known by palæontographs as *Aptychus*, were two shelly supports of the hood of *Ammonites*, extinct Cephalopods not very different in structure from the *Nautilus*, and belonging, like that genus, to Prof. Owen's tetrabranchiate group.

or anfractus of the revoluted shell. Hence the upper surface of this fold is excavated, forming the exact counterpart of the shell's protuberance. Under that fold is a smaller plate of nearly the same form, but adherent to the posterior declivous surface of the hood, and only free at its circumference. This plate is of an aponeurotic texture and a white colour : at both sides it is united to the dorsal fold, and below it seems to have an intimate connection with the two side parts of the funnel, and indeed to be a continuation of those parts. The dorsal or superior part of the aponeurotic band, which forms, as we have said already, the continuation of the oblong side-plate (fig. 1 *g*), is here visible at *g*, *g*. Three small longitudinal bands or tendinous inscriptions (*h*, *h*, *h*) seem to give some firmness to the dorsal part of the abdominal portion of the mantle. Near the posterior end of this visceral sac, nearer however to the superior surface of it, is the beginning of the siphon (*j*) ; it seems nearly superfluous to say that this siphon is a tubular production of the visceral part of the mantle, protected by a calcareous covering, and penetrating by the central perforation of the several septa in all the following compartments of the shell.

At the inferior surface (fig. 3) a part of the funnel is visible in the middle of the digitations of the head. The inferior face of those digitations is of a white colour, contrasting with the brown and dark colour of the hood and of the superior surface of the digitations which are nearest to it. The free inferior and anterior margin of the mantle appears rounded and somewhat convex ; it conceals the basal part of the funnel and of the appendages of the head.

More instructive is an inferior view of the animal if the mantle has been removed or reflected backwards ; in this manner the branchial cavity is visible (fig. 4).

The two overlapping sides of the funnel form a striking particularity of the structure of the Nautilus. It is interesting that the embryo in the dibranchiate group, as we learn from Dr. Kölliker's observations[1], shows the funnel composed in the beginning of two lateral separate parts. The embryonic condition in the dibranchiate Cephalopods proves thus to be a persistent structure in the tetrabranchiate group.

Between the basal part of the second pair of gills the anal aperture is visible. This part has been misrepresented by Professor Valenciennes. It seems that a longitudinal fold connecting the integuments of the viscera with the two large shell-muscles was disrupted in his specimen, and that the author believed this to be the rectum. The oviduct in this supine position is situated at the left side, before the anus, and terminates with a transverse bilabiated and protuberant aperture or vulva. [Consequently, when the animal is in its natural position in the shell, the termination of the oviduct lies at the right side.]

There are three little slits on each side at the roots of the branchiæ. The first pair of those apertures is situated at the anterior surface of the first branchia, near the posterior margin of the large shell-muscle. Between the first and second branchiæ are the

[1] Entwickelungsgeschichte der Cephalopoden. Von Dr. A. Kölliker; Zurich, 1843, 4to, p. 41 &c.