

X. On *DINORNIS* (Part VI): containing a Description of the Bones of the Leg of *Dinornis* (Palapteryx) *struthioides* and of *Dinornis gracilis*, Owen.

By Professor OWEN, F.R.S., V.P.Z.S., &c.

Read November 14, 1854.

IN my memoir of 1843<sup>1</sup>, I described two femora of birds from tertiary deposits in New Zealand, agreeing in size with that bone in the Ostrich, and referred them to a species called *Dinornis struthioides*; one of these specimens however consisted only of the shaft; the other and more perfect specimen, figured in pl. 21. fig. 3, was mutilated at both its extremities. I have since received, through the kindness of the Rev. Mr. Colenso, M.A.<sup>2</sup>, and the Rev. William Cotton, M.A., three entire specimens of femora, ranging between 11 and 12 inches in length, and the shaft of a fourth femur of the *Din. struthioides*, confirming very satisfactorily that species, and completing our knowledge of the anatomical characters of the bone.

The head (Pl. XLI. fig. 2) is rather more than a hemisphere, more prominent than in the Ostrich, and with a smaller proportion cut off, as it were, from the upper and outer part, and roughened for the attachment of the strong 'ligamentum rotundum.' From the upper part of the base of the head, an almost flat, slightly concave, surface ascends, expanding, as it rises, to the broad semicircular ridge which crowns the great trochanter. In the Ostrich that process does not rise above the level of the head of the bone. In the *Din. struthioides* the upper trochanterian platform is broader proportionally than in the *Din. casuarinus*<sup>3</sup>. The anterior surface of the trochanter is also extensive through the continuation outwards of the great process: it is slightly concave, sculptured by muscular impressions with intervening ridges, and by a defined oval rough tract between the head and the base of the trochanter. The outer convex expanded surface of the trochanter is more strongly marked by the insertions of powerful tendons, surrounding an irregular smooth tract near the centre of the surface. The back part of the upper end of the femur in two of the specimens presents two or three small holes leading into the superficial cancelli, by which it is possible a little air may have been admitted to these cavities; but this is a very feeble representation of the wide orifice and canal at the same part of the Ostrich's femur which conducts directly to the large air-cavity in the body of that bone.

<sup>1</sup> Zool. Trans. vol. iii. pp. 247, 249, pl. 21. fig. 3.

<sup>2</sup> The specimen contributed by this gentleman is cited in the table of admeasurements, Zool. Trans. vol. iii. p. 329.

<sup>3</sup> *Ibid.* pl. 46. fig. 2.

The shaft of the entire femur of the *Din. struthioides* repeats the characters described and figured in the memoir above cited. The fore part of the external condyle begins to rise from the level of the shaft, about one-third from the distal end of the bone, and bends outwards, forwards and downwards, increasing in breadth and convexity, and forming the outer boundary of the characteristic broad rotular surface. The convex fore part of the inner condyle forming the inner boundary of that surface is shorter, and rises more abruptly. The deep oval fossa, above the vertical broad groove for the fibula, behind the outer condyle, is well-marked. The orifice of the medullary artery is at the middle of the back part of the shaft of the femur in two of the specimens.

With regard to the metatarsus of the *Dinornis struthioides*, the same satisfactory confirmation of the species has been received, as in the case of the femur, by the addition of three specimens repeating the characters of the original bone described at p. 240, and figured in pl. 27. fig. 2. of my memoir of 1843. One of these specimens, kindly sent to me by J. R. Gowen, Esq., F.G.S., Sec. H.S., was discovered in the tertiary deposits at Waikawaite, Middle Island of New Zealand, and has the two extremities more entire than in the original specimen figured. The middle of the distal trochlea is impressed by a shallow groove running its whole length, and becoming more shallow as it approaches the contracted back part of the trochlea, which terminates abruptly, projecting beyond the level of the back part of the distal end of the bone.

A second of the additional specimens of the metatarsus of the *Din. struthioides* was obtained by the Rev. Wm. Cotton, M.A., at Tarawaite, in the North Island of New Zealand: a third specimen (Pl. XLI. fig. 4) was discovered by Governor Sir George Grey, C.B., in a cave in the district which lies between the river Waikate and Mount Tongariro, in the North Island.

From the same cave Sir George Grey likewise obtained and very liberally transmitted to me, with a most valuable collection of other bones of *Dinornis* and *Palapteryx*, an entire tibia (Pl. XLII. fig. 2) agreeing with the portion of shaft, which, from the dimensions given in vol. iii. p. 329, I was induced to refer to the *Dinornis struthioides*, differing in its size and proportions from all the tibiae previously described and referred to other species, but presenting similar relations of size to the femur and metatarsus of the *Din. struthioides*, which the previously described tibiae have presented to the other bones of the leg of the respective species to which those tibiae have been referred.

I conclude, therefore, that in the tibia transmitted with the metatarsus of the *Din. struthioides* by Sir George Grey, I possess the bone, which I have been so long desirous to obtain in order to complete the leg of the *Din. struthioides*. Like the metatarsus above-cited, it is from the left side, and they appear to have belonged to the same individual bird.

	in.	lin.
The length of this bone is . . . . .	22	0
The breadth of the proximal extremity . . . . .	5	6
The breadth of the distal extremity . . . . .	3	2
The circumference of the middle of the shaft . . . . .	5	0
The fibular ridge extends down . . . . .	10	0

This ridge begins, as in the tibiæ of other species of *Dinornis*, below the expanded end of the tibia near the middle of its back part, inclining to its outer side.

In its slender proportions, and the relative positions of the procnemial (*p*) and ectocnemial (*e*) ridges, the tibia of the *Dinornis struthioides* agrees with that of the *D. dromioides*.

*Description of the Bones of the Leg of the Dinornis gracilis.*

The advantage of additional specimens, as confirming, by the repetition of the same characters, a species previously defined, is still greater in respect of the ground which they afford for the discrimination of a distinct but nearly allied species. Notwithstanding the well-marked differences observable between the femur of the *Dinornis struthioides* (Pl. XLI. fig. 2) and the *Dinornis gracilis* (*ibid.* fig. 1), I might have deemed them due to differences of sex or individuals, had I not had evidence of the fixity of the specific characters of the *Dinornis struthioides* by the successive arrivals of additional specimens of its bones. Attending the hoped-for confirmation from such arrivals, it appeared to be most prudent to refrain from announcing a new species of the rapidly increasing family of the great wingless birds of New Zealand until further evidence might be obtained by corresponding differences in the tibiæ and metatarsi of the two species.

Having had the good fortune at length to receive, through the kind contributions of the Rev. Richard Taylor, M.A., of Wanganui, and of W. E. Cormack, Esq., these additional illustrations of the *Din. gracilis*, I no longer delay communicating descriptions and figures of them to the learned Society, in whose Transactions my former Memoirs have appeared and have been so liberally illustrated.

*Femur.*

The bone (Pl. XLI. fig. 1) was obtained at the Bay of Opito, East Coast of the North Island, from beneath a sandy deposit, about three feet below the surface, by Mr. Cormack.

The following are the chief dimensions of this bone:—

	in.	lin.
Length . . . . .	11	0
Breadth of proximal end in the axis of the neck . . . . .	3	8
Breadth transverse of distal end . . . . .	4	0
Circumference of middle of shaft . . . . .	4	8

A small portion of the upper ridge of the great trochanter has been broken off: when entire, the femur of the *Din. gracilis* presents the average length of that of the *Din. struthioides*; but it is more slender in proportion, the head is smaller, and is supported by a better marked constriction or neck, especially at its under part. The upper platform of the trochanter is narrower, the anterior border of the trochanter not being extended so far forwards and outwards. The angle between the upper and fore surfaces of the trochanter is a right one, and they meet at a sharp ridge. The rough oval surface between the head of the femur and the base of the trochanter is smaller than that of the *Din. struthioides*. The outer irregular surface of the trochanter is of much less breadth in the *Din. gracilis*. The muscular impressions at the sides of the shaft meet and form a longitudinal ridge along the back part of the middle third of the shaft: they are separated by a tract of half an inch in the *Dinornis struthioides*, and terminate below in two tuberosities. The corresponding ridge formed by the meeting of the vasti-muscles along the fore part of the shaft is shorter in *Din. gracilis* than in *Din. struthioides*.

The most marked distinction, however, is presented by the distal extremity of the bone, which is not only relatively less expanded in the *Din. gracilis*, but the rotular groove is narrower, and is bounded laterally by condyloid eminences of more nearly equal length; the external one not rising so high up, nor describing the sigmoid curve in descending, as in the *Din. struthioides*. The rotular groove in the *Din. gracilis* is impressed by a transversely oval rough depression, at its upper part, with sharp lateral borders, which depression does not appear in any of the femora of the *Din. struthioides*. The popliteal space is triangular and better defined in the *Din. gracilis*; the fibular groove is shorter and less angular, and the rough deep pit above it is smaller. The tibial surface on the inner condyle is relatively smaller.

#### *Tibia.*

The same character is repeated on the proximal end of this bone, where the surface applied to the inner condyle is absolutely smaller than in the *Din. struthioides*, although the entire bone, as shown in the subjoined admeasurements, is longer in the *Din. gracilis*: it is also, as the name of the species implies, more slender in proportion to its length.

This bone (Pl. XLII. fig. 1) was obtained from beneath a sandy deposit, about two feet below the surface, at a locality between Wanganui and Turakina, North Island of New Zealand, by the Rev. Mr. Taylor.

	<i>D. gracilis.</i>	
	in.	lin.
The entire length of the bone is . . . . .	23	6
The transverse breadth of its proximal end . . . . .	5	0
The transverse breadth of its distal end . . . . .	2	10
The circumference of the middle of the shaft . . . . .	4	6
The fibular ridge extends down the shaft . . . . .	9	6

But this ridge commences nearly three inches below the back part of the proximal end of the bone, nearer the outer side than in the *D. struthioides*: it is interrupted by an oblique smooth tract at the point indicated in the admeasurement, where the medullary artery penetrates the bone; it then reappears about an inch and a half below the interruption, and soon gradually subsides. This second lower part of a fibular ridge is better marked than in the *Din. struthioides*. The relative size and position of the procnemial, *p*, and ectocnemial, *e*, ridges are much the same as in the tibia of the *Din. struthioides* and *Din. dromioides*.

*Metatarsus* (Pl. XLI. fig. 3).

The difference between the *Din. struthioides* and the *Din. gracilis* is more obvious at first glance in a comparison of their metatarsi than in that of the above-described bones; especially to an eye accustomed to the comparison of the metatarsi of the different species. The superior length and slenderness of that bone in the *Din. gracilis* would at once prevent its being confounded with the metatarsus of the *Din. struthioides*.

The following are the chief dimensions of the bone in question: those of the extremities being approximative by reason of their worn margins:—

	<i>D. gracilis.</i>	
	in.	lin.
Length of the tarso-metatarsus . . . . .	13	0
Circumference at the middle of the shaft . . . . .	4	3
Transverse breadth of proximal end . . . . .	3	4
Transverse breadth of the distal end . . . . .	4	3
Breadth of the middle of the shaft . . . . .	1	7
Thickness or antero-posterior diameter of ditto . . . . .	1	2

The depressed surface for the back toe is better marked than in the *Din. struthioides*.

Subjoined is the "Note on the locality" affording the femur of the *Dinornis gracilis*, kindly contributed by W. E. Cormack, Esq.; with a sketch of the section of the strata, of which a woodcut is here given.

"The bone "(Pl. XLI. fig. 1)" of the *Dinornis* now presented to Professor Owen was found in the north part of the North Island of New Zealand, in the month of January 1849. Its locality was in a small bay called 'Opito,' at the east extremity of the projecting land between Mercury Bay and Wangapoua, on the east coast, in about the latitude of 36° 40' S., and fifty miles east from Auckland. The bay is about a mile in length, northerly and southerly, by about half a mile in depth, with high bluff heads or rocky cliffs projecting at each extremity; the semicircular sandy beach inside forming the bay. An irregular strip of low land lies inside of the beach, in some parts fertile, in other parts consisting of downs, and is overlooked in the rear by round hills of from 100 to 300 feet in height. The hills are composed of yellow-white and red burnt earth; very barren, producing stunted fern, and a solitary bush or scrubby tree here and there.

Towards the north end of the bay a small brook discharges itself, from a swamp at the foot of the hills in the rear: and at the mouth of the brook a short range of downs runs along the beach to the southward, presenting a line of earthy cliffs, wasting away and forming the shore as they fall down by the washing of the sea at the foot. These cliffs are about from twenty-five to thirty feet in height, and nearly perpendicular. The upper stratum of the cliffs is formed of sand, and is about three feet in thickness, producing the usual arenaceous shrubs, grasses, &c. Underneath, the line of demarcation being very distinct, is a thick stratum or bed of sandy earth, sand predominating: out of this substratum, about fifty or sixty yards south of the mouth of the brook, the *Moa's* bones were exposed, projecting, in consequence of a late falling away of that part of the cliff in which they were imbedded: they lay a foot or more beneath the upper surface of the substratum. At the same spot there was a '*kapura maori*,' or *native cooking fireplace*, dug into the surface of the substratum, and full of stones that had been once heated (to convey the heat to the food laid upon them),—and left, just as similar cooking-places are left at the present day by the natives;—about two feet from which lay the bones. Close to the fireplace, and similarly imbedded, were bones of smaller birds, and of fishes similar to those found at present in the sea adjacent; all, including those of the *Moa*, having been evidently the remains of the food cooked here at a former period and eaten, as my native attendant remarked, by the then native inhabitants. A part of a leg bone, about two feet in length, apparently belonging to the same leg as this femur<sup>1</sup>,—the bone having been broken near the middle (probably in order to be placed more conveniently over the fireplace), was also found close to the femur.

"The antiquity of these remains can only be arrived at by inference. How long it is since the superficial stratum of sand now exhibited at the top of the cliffs overlooking



the sea, was formed by water and winds, is a matter of induction for the geologist. The sea is now undoing, and claiming the privilege of, former lacustrine or marine

<sup>1</sup> It accords with the size of the tibia of the *Dinornis gracilis*.—R. O.

deposits. It would not be difficult to compute, with some shadow of approximation, the time required for the inroad of the ocean into strata of the nature of those described, supposing them to have extended from the summit of the cliffs to the ocean half a mile distant, along a line between the two heads or extremities of the bay: but that period would be conjectural only; for there are rocks, islets, and islands succeeding each other—mile beyond mile,—extending into the surrounding ocean, all of which are, by marine inroad, vestiges only of former rock-formations. Man and the *Moa*, however, were coeval at man's cooking fireplace upon this substratum.

"The mother ocean is altering, in some places very rapidly, the configuration of the coast of New Zealand. It is consuming some parts, and forming others by deposits; and again removing former deposits. In a general view, many parts of the east coast of the North Island are being disintegrated, not to reappear above water for many ages; while on the west coast, downs are not only being formed, stretching into the sea, but superimposing themselves—inland—in some places.

"These shiftings of the outline of the earth's crust are not limited to the sea-coast: for in the interior are many partial and violent settlings of the earth, evidently from earthquakes; submerging, in some instances many feet under the surface of fresh-water lakes, land with the natives' houses, fences, &c. upon it. This has happened in regard to the lake situated some miles from the east bank of the River Waipa, and south-eastwardly from the ruins of the famous sacked Pa (town) called 'Matakitaki.'

"W. E. CORMACK,

6, Percy Street, 22nd October, 1850."

"To Professor Owen,  
Royal College of Surgeons, London."

## DESCRIPTION OF THE PLATES.

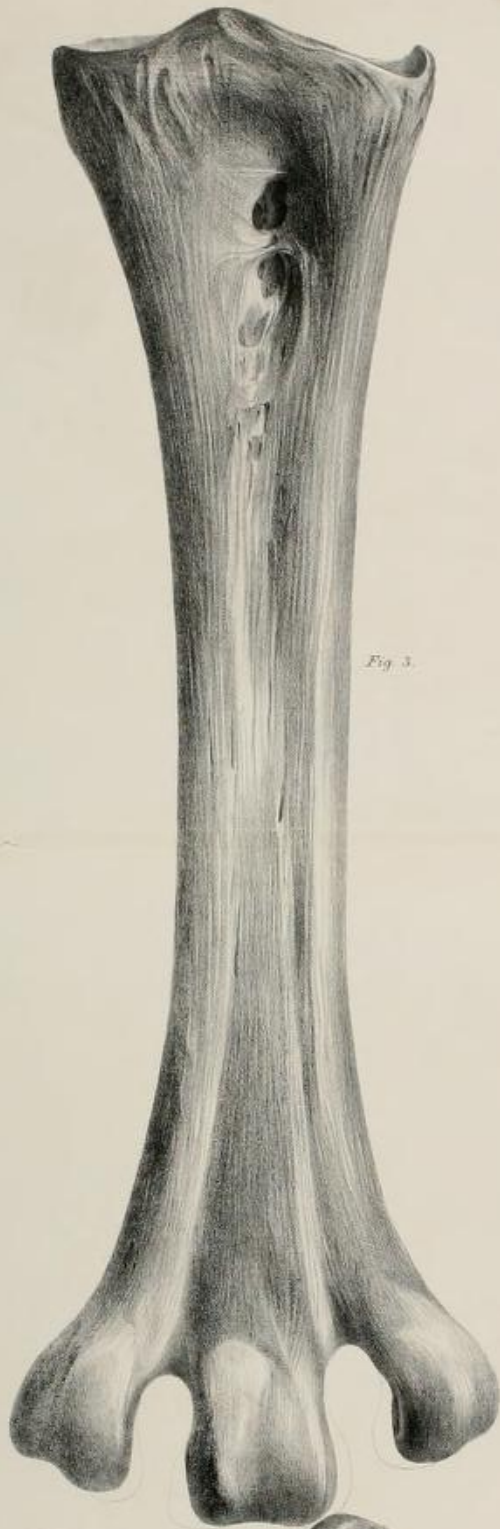
### PLATE XLI.

- Fig. 1. Front view of the femur of the *Dinornis gracilis*.  
 Fig. 2. Front view of the femur of the *Dinornis struthioides*.  
 Fig. 3. Front view of the metatarsus of the *Dinornis gracilis*.  
 Fig. 4. Front view of the metatarsus of the *Dinornis struthioides*.

### PLATE XLII.

- Fig. 1. Front view of the tibia of the *Dinornis gracilis*.  
 Fig. 2. Front view of the tibia of the *Dinornis struthioides*.  
 p. Procnemial ridge. e. Ectocnemial ridge.

All the figures are of the natural size.



*Fig. 3.*



*Fig. 4.*







Fig. 1.

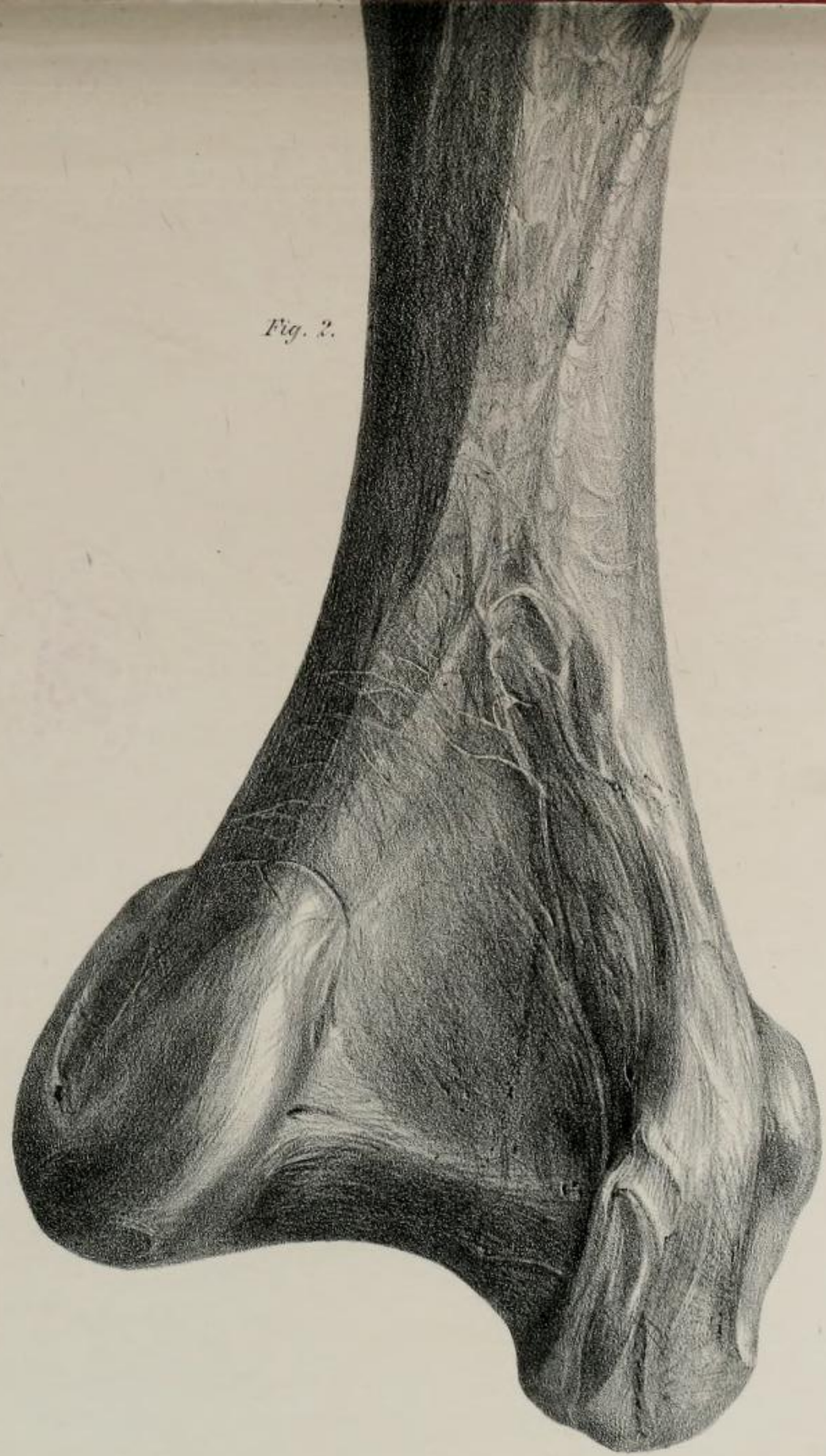


Fig. 2.

From Nat. on Stone by J. Erxleben.

Day & Son, Lith<sup>rs</sup> to the Queen.

Trans. Zool. Soc. Vol. 4. Pl. 41. p. 141.

Fig. 1 & 3. *Dinornis gracilis*. — Fig. 2 & 4. *Dinornis struthioides*.

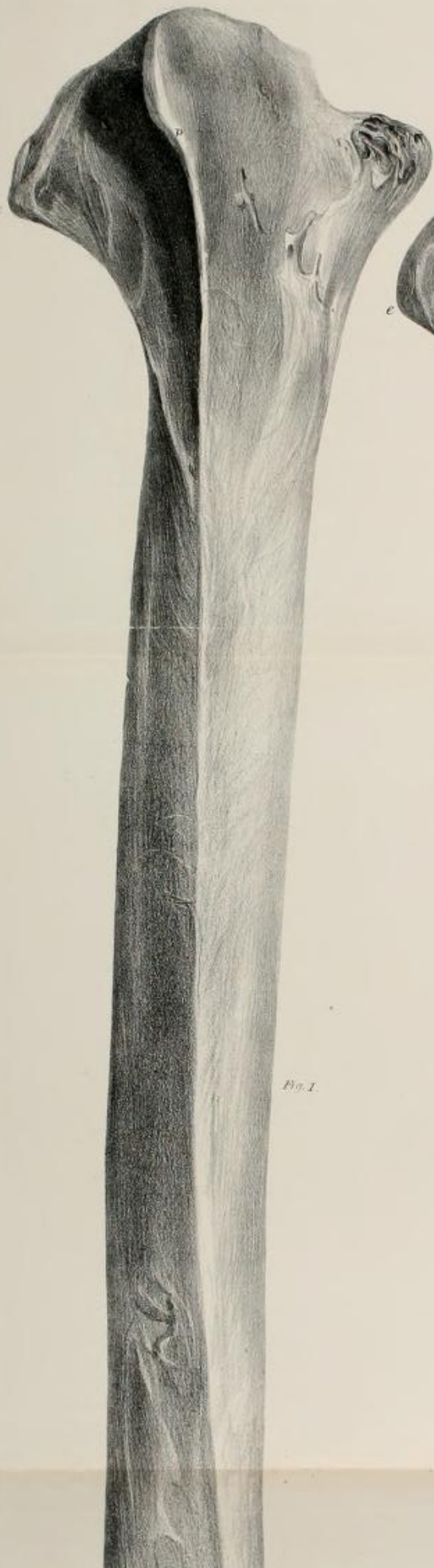


Fig. 1.

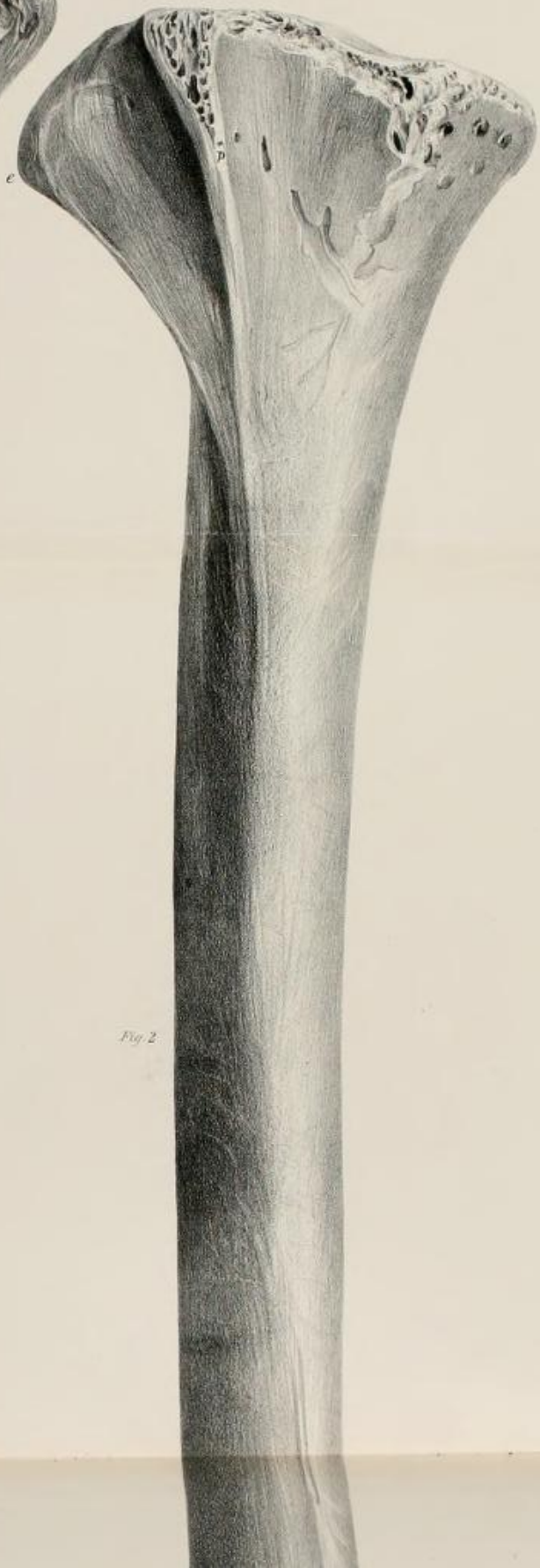


Fig. 2.



*From Nat. on Stone by J. Erxleben.*



*Day & Son, Lith<sup>rs</sup> to the Queen.*

*Trans. Zool. Soc. Vol. II. Pl. 12. p. 141.*

*Fig. 1. Dinornis gracilis. — Fig. 2. Dinornis struthioides.*