VII. *On some New Reptiles from the Elgin Sandstones.*

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Communicated by Sir Archibald Geikie, *For. Sec. R.S.*

Received November 28,—Read December 15, 1892.

[Plates 26–41.]

I.—INTRODUCTION.

The earliest discovery of Reptilian remains in the Elgin Sandstone, was made by Mr. A. Robertson, at Lossiemouth. The specimens consisted of a series of scutes, drawings of which were submitted to M. L. Agassiz, who, believing them to be of

Old Red Sandstone age, described them in 1844 (1*) as scales of a Ganoid Fish, which he named *Stagonolepis Robertsoni.*

In the year 1850 Captain LAMBART BRICKENDEN found some quadrupedal footprints at Cummingstone, in beds of the same age as those at Lossiemouth, which he described (5), and at the same time gave an account of these so-called Old Red Sandstone rocks. He also mentioned the discovery, by Mr. PATRICK DUFF, of a small Reptile at Spynie. This specimen was described in detail by Dr. G. A. MANTELL (26) in a paper immediately following that by Captain BRICKENDEN, as a small Lizard with certain Batrachian affinities.

In 1858, Sir R. I. MURCHISON (27) read a paper on the relations of the Elgin Sandstones, and concluded that they could not be separated from the Old Red Sandstone, but must be regarded as forming the upper part of the series. In a note to this paper (27, p. 434) Sir RODERICK quotes Mr. PATRICK DUFF'S short historical sketch of these early discoveries in the Elgin Sandstone, and then mentions in a postscript the finding of another fossil by the Rev. G. GORDON "in the same beds at Lossiemouth, in which *Stagonolepis* occurs," and says "Professor HUXLEY terms this new Reptile *Hyperodapedon Gordoni.*"

The Right Hon. Professor HUXLEY (12), in a paper following that by Sir RODERICK MURCHISON, described bones, teeth, and scutes which had been found at Lossiemouth and Findrassie, referring them to *Stagonolepis*; but showing that they belonged to a Crocodilian Reptile and not to a Fish as had previously been supposed. Among these remains was a portion of a jaw with four large teeth, the largest of which projected $2\frac{1}{4}$ inches beyond the alveolar margin. Although including this jaw provisionally with *Stagonolepis*, the Professor says, "there is no positive proof that this fragment of a jaw belonged to *Stagonolepis*;" and in his later Memoir in 1877 (18), the teeth of *Stagonolepis* having been found, this jaw, although of uncertain affinities, was called *Dasygnathus longidens.*

At p. 460 of the earlier paper (12) *Hyperodapedon* is alluded to, and then follows this noteworthy sentence, "its marked affinity with certain Triassic Reptiles, when taken together with the resemblance of *Stagonolepis* to Mesozoic Crocodilia, leads one to require the strongest stratigraphical proof before admitting the palæozoic age of the beds in which it occurs."

In the year 1866 Professor HUXLEY (14) described a new example of *Telerpeton Elginense* from Lossiemouth, which included the skull, lower jaw, vertebral column and ribs, with both pectoral and pelvic arches. In the concluding part of this paper (p. 83), the following conclusions are given. "From the description of the organization of *Telerpeton Elginense* which has now been given, it is obvious that this animal is one of the Reptilia, devoid of the slightest indication of affinity with *Amphibia.* It is Saurian in all its characters, . . . and must be referred to the true *Lacertilia.*"

* The numbers refer to the list of works, p. 495.

Sir RODERICK MURCHISON in 1867 (28), having heard from Professor HUXLEY of the discovery of *Hyperodapedon* in the Trias of Warwickshire (see 15), said, "To such fossil evidence as this, the field-geologist must bow; and instead, therefore, of any longer connecting these reptiliferous sandstones of Elgin and Ross with the Old Red Sandstones beneath them, I willingly adopt the view established by such fossil evidence, and consider that these overlying sandstones and limestones are of Upper Triassic age."

In 1869 Professor HUXLEY (15), described the remains of *Hyperodapedon* from Lossiemouth, to which he had alluded in his paper on *Stagonolepis* in 1858 (12, p. 460), as well as other specimens afterwards received from the same neighbourhood. In addition to these were noticed jaws with teeth referable to the same genus, if not to the same species, which had been found in the undoubted Triassic Sandstone of Coton End, Warwickshire; also a jaw from beds of similar age near High Peak, South Devon; and a number from the Maledi (Trias) beds of Central India, some of which had been presented to the Geological Society in the year 1860. The Indian forms have since been described by Mr. R. LYDEKKER (22).

In 1875 Professor HUXLEY (17) gave a further account of *Stagonolepis*, based on numerous remains from the Elgin Sandstone, which had from time to time been forwarded to him by Dr. GORDON and Mr. GRANT; but these were more fully described in the Geological Survey Memoir which appeared in 1877 (18). In the introductory remarks to this Memoir a short history of these discoveries is given, and at p. 43, the Professor refers to the jaw provisionally referred to *Stagonolepis*, and places it in a new genus and species, *Dasygnathus longidens*. At the end of this Memoir the Rev. Dr. GORDON gives a note on the geological structure of the Elgin district, accompanied by a sketch map.

Mr. J. G. PHILLIPS, in 1885, at the British Association Meeting (40), gave some account of the Elgin Sandstones, and pointed out that, at Cuttie's Hillock Quarry, near Elgin, *Holoptychius* had been found in the lower part, and Reptile remains in the upper part, of what did not appear to him a quite conformable series of deposits; and he thought that the true relations of these beds had not been definitely settled.

Dr. R. H. TRAQUAIR (45), in the same volume of the 'British Association Reports,' in a "Preliminary Report on a New Fossil Reptile recently discovered at New Spynie, near Elgin" [now known as Cuttie's Hillock Quarry], says the presence of a large tusk immediately behind the premaxillary region, and the whole appearance of the skull, indicate a Reptile belonging to the group of the Dicynodontia.

Professor JUDD, in the latter part of 1885 (20), read a paper before the Royal Society, "On the Relation of the Reptiliferous Sandstone of Elgin to the Upper Old Red Sandstone," in which he gives an account of the discoveries of Reptile remains in these Elgin Sandstones, and mentions two specimens obtained near Elgin [Cuttie's Hillock]; one of these was at first thought to show Dinosaurian characters, but this has not been confirmed; while the other exhibited the characteristic features of *Dicynodon*

—it is, in fact, the specimen noticed by Dr. TRAQUAIR (45), and belongs to the Geological Survey. The more important point in Professor JUDD'S paper is the description of the section at Cuttie's Hillock Quarry (also known as New Spynie), in which, as he believes, the reptiliferous beds rest unconformably upon Old Red Sandstone, the junction being marked by a bed of conglomerate, called by the workmen "pebbly post." The Geological Survey, however, has failed to trace this unconformability.

In 1887, "Further Observations upon *Hyperodapedon Gordoni*" were made by Professor HUXLEY (19), when he described in detail a fine specimen of this Lizard from Lossiemouth, which had been secured for the British Museum. In this paper the affinities of *Hyperodapedon* are discussed, and its close relationship to *Sphenodon* fully established.

Within the last few years the Elgin Museum has obtained several specimens of Reptilian remains from the Elgin Sandstone of Cuttie's Hillock, and, through the courtesy of the Directors of that Institution, and the kind intervention of the veteran geologist, the Rev. Dr. G. GORDON, they have been sent to the Geological Survey in London for examination and description. Three other examples from the same horizon and locality are in the possession of the Geological Survey.

My colleague, Mr. J. HORNE, pointed out the desirability of these specimens being definitely determined, and, at the desire of Sir ARCHIBALD GEIKIE, the Director-General of the Geological Survey, I undertook the task of working out these fossil remains. The results of this investigation form the subject of the present communication.

When the specimens from the Elgin Museum first reached me they did not promise very satisfactory returns for the labour of developing them, although it was evident that they belonged to forms which had not before been described. They were still in the condition in which they had come from the quarry, except that some had the faces much rubbed; and the edges of the cavities, for they were all in the condition of hollow moulds, had lost their sharpness. Each example, with one or two exceptions, was in several pieces, and had to be fitted together before the task of developing it could be commenced. When the Survey specimens came into my hands they were in a similar state to those belonging to the Elgin Museum, but the skulls were in a much more promising condition, and supplied information which was not obtainable from the others.

The reptiliferous sandstone from Cuttie's Hillock Quarry is variable in texture, most of the specimens being coarser than those from Lossiemouth, which contain the remains of the *Stagonolepis*, described by Professor HUXLEY in 1875 (17), and consequently it is not so satisfactory for the preservation of the imbedded bones. Like many of the *Stagonolepis* remains, these Cuttie's Hillock specimens have not a particle of the bones left, the whole having been dissolved, leaving merely the cavities where the bones have been. The surfaces of these cavities are stained more or less with iron, and are thus a little darker than the surrounding matrix; they are also

frequently marked with black spots and patches, which are sometimes sufficiently thick to allow of pieces being removed with a penknife. My colleague, Mr. G. BARROW, has been good enough to analyse some of this black substance, and finds it to contain iron, manganese, and a trace of cobalt. In some instances the cavities have been partly refilled by fine sand and oxide of iron; in others, their sides have been pressed together and the space nearly obliterated; while some are distorted by pressure, apparently before the dissolution of the bones. It will readily be understood that the task of developing these fossils was by no means an easy one; and indeed great caution had to be used to prevent some of the parts being broken away without being seen. In many cases the cavities differed so little in colour from the surrounding matrix, and were so easily obliterated, both by bleaching and by the crumbling of the surface, that it became necessary to find some means of preserving them as soon as possible after being exposed. For this purpose shellac varnish was used, which had the effect of hardening the stone and deepening the colour. In working out the specimens, the impressions which had been exposed by the splitting open of the block were in the first place varnished, and, when dry, wherever a cavity could be seen passing under the stone it was carefully followed, little by little, with small chisels, one side of the cavity being removed, and the newly-exposed parts varnished. In many cases it was found possible to split open the cavities, thus exposing and preserving the impressions of both sides of the bone. The surrounding matrix was subsequently treated with gelatine. From the specimens thus prepared, casts in gutta-percha were taken, which reproduced the forms of the original bones. In many instances, more especially in the case of the skulls, separate casts of the various parts had to be taken, and afterwards fitted together. The interpretation of many of the bones would have been almost impossible without such casts, which, it must be remembered, are not merely *models* of the specimens, which would be untrustworthy, but they represent the original bones, like any fossils in which the bone has been replaced by another substance.

The specimens described in this communication are all new to science, and are from the Elgin Sandstone of the one locality known as Cuttie's Hillock Quarry, which has sometimes been called "New Spynie," and they represent, at least, eight distinct skeletons. Three of these belong to the Geological Survey, and the remainder to the Elgin Museum. Seven of the specimens are undoubtedly referable to the Dicynodontia; some being closely allied to the type genus *Dicynodon*, and one nearly related to *Ptychognathus*, while another, having the skull ornamented with many horns, is one of the most extraordinary fossil animals that has come to light for many years, and this seems most nearly related to *Pareiasaurus*.

In the working out of these specimens I have received assistance from many kind friends, and take this opportunity of acknowledging my indebtedness to them. In the first place I am under obligation to the Rev. Dr. GORDON, of Elgin, whose enthusiasm has been the means of rescuing many of the specimens, and who has

spared no trouble to send several hundredweights of stone to London for my examination.

The officers of the British Museum have, with their usual courtesy, afforded me every facility for the study of the fossils under their charge. To my friends, Professor G. B. Howes and Mr. R. Lydekker, as well as to my colleagues, Mr. G. Barrow, Mr. F. W. Rudler, Mr. W. Topley, and Mr. H. B. Woodward, I am indebted for many useful suggestions and valued aid afforded in the course of the work. I am also under obligation to my colleagues, Mr. J. J. H. Teall and Mr. H. A. Allen, for the trouble they have taken in photographing some of the specimens; to Mr. W. M. Redaway for his careful drawings made from the casts; and to Mr. A. T. Hollick for his successful delineation of them on stone.

II.—DESCRIPTION OF SPECIMENS

A. DICYNODONTIA.

Gordonia, *gen. nov.*

1. Gordonia Traquairi, *sp. nov.* (Plates 26 to 28.)

General Remarks.

It is one of the specimens belonging to the Geological Survey that will be first noticed, as it supplies more information concerning the structure of the skull than either of the others, and will be convenient as a standard for comparison. This is the specimen referred to by Dr. Traquair (45) in 1885 as belonging to the Dicynodontia, and it was hoped that a detailed description of it from the pen of so able a palæontologist would, ere this, have been published; unfortunately, however, official duties have prevented his devoting his attention to these interesting remains.

I had already developed and described the remains included in the first consignment of the Elgin Museum specimens, when Sir Archibald Geikie desired me to include with them the description of the Survey examples, at that time in Edinburgh, which proved to be of great service in clearing up certain difficulties, more especially in the interpretation of parts of the skull.

The specimen now to be described (Plate 26) is contained in three slabs of sandstone, and includes, besides the skull, fragments of several ribs, parts of a scapula, and of a humerus, with possibly parts of two or three caudal vertebræ. In common with all the other remains noticed in this paper, the bones are only represented by cavities in the stone, which, having been laid open in the manner above explained, casts have been made, from which the descriptions are for the most part taken.

Description.

Skull.—The skull has been, most fortunately, split vertically from front to back, nearly in the middle line, so that the left half (Plate 26, fig. 2), after clearing away some of the matrix, has allowed a cast to be made representing an entire side of the skull and lower jaw (Plate 27), and the same cast, with a few particulars obtained from the right side, gives the form of the upper surface (Plate 28, fig. 1). The right half of the skull supplies details for the reconstruction of the palate and other central parts (Plate 28, fig. 2).

Although some of the bones have been cracked and broken, the parts are very slightly, if at all, displaced, and the general contour of the skull has suffered very little alteration. The greatest length of the skull (Plate 27) from the premaxillary region to the back of the squamosal is 185 millims.; while its height from the quadrate condyle (*qu.*) to the parieto-squamosal crest (*pa.sq.*) is nearly 110 millims. The greatest width, across the temporal bars (Plate 28, fig. 1), cannot be absolutely measured, but must have been about 110 millims., or perhaps a little more. The most striking features of the skull (Plate 27), in addition to the characteristic tusk, are the great depth at the hinder part, due to the disproportionately large pedicle for the lower jaw, and the wide laterally-directed plate of the squamosal (Plate 28, fig. 1), forming the outer boundary of the temporal fossa, while the anterior part of the skull is much narrower.

Upper Surface of Skull.—Seen from above (Plate 28, fig. 1), the skull is regularly pear-shaped, the broad hinder half being formed by the temporal region, with its wide temporal bars, enclosing on each side a large supratemporal fossa, which is bounded anteriorly by the postorbital bar. The parietal region is narrow, a deep, longitudinal groove occupying the middle line, on each side of which is a prominent crest, that externally slopes downwards and outwards into the temporal fossa, the surface thus formed being concave above and convex lower down; it is narrow anteriorly but widens as it passes backwards. Each crest rises from the hinder margin of the post-orbital bar and passes backwards and inwards, almost meeting its fellow of the opposite side, with which it runs nearly parallel for some distance, then diverging in the occipital region, it sweeps downwards, backwards, and outwards, meeting, at the hindermost extremity of the skull, the outer plate of the temporal bar, with which it is continuous. These crests occupy the parietal region, but do not seem to be formed by the parietal bones alone, for a depressed line, probably indicating a squamous suture, can be traced along their upper and inner edges, the inner lamina apparently belonging to the spindle-shaped area (Plate 28, fig. 1) which encloses the pineal fossa. This suture is best seen in a cast taken from the right half of the specimen. According to Professor SEELEY (43) these temporal plates in *Dicynodon* appear to be formed by bones which overlie the true parietals and are continuous with the squamosals; and certainly in the Elgin specimen there is no sign of any

divisional suture between this plate and the squamosal; it appears therefore that the last-named bone, besides forming the greater part of the temporal bar, extends along the upper border of the temporal fossa, forming the outer plate of the crest; moreover, it appears to extend downwards on the outer side of the quadrate, leaving only a small part of the latter exposed on the outer surface. A line which is seen crossing the quadrate just above the articular condyle (Plate 27, *qu.*) may perhaps mark the lower end of the squamosal.

Between the anterior part of the parietal crests (Plate 28, fig. 1) is the large oval pineal fossa, which, as can be seen in the right half of the skull (Plate 28, *pn.*), forms a very distinct cup, opening below into the brain cavity. The deep cup-like form of the pineal fossa is probably an indication that it lodged a well-developed eye.

The pineal fossa is situated in the hinder half of a spindle-shaped area, marked off by sutures, which is anteriorly in relation to the frontals, and posteriorly is wedged in between the parietal crests. This area seems to correspond with the similarly shaped parietal bones of *Sphenodon*, which likewise enclose the pineal fossa. In the present specimen this spindle-shaped area is not formed by the parietals alone, for a little behind the anterior margin of the fossa a suture passes inwards from each side, thus separating the spindle into an anterior triangular bone, forming the front boundary of the pineal fossa and wedged in between the hinder ends of the frontals, and a posterior triangular area enclosing the greater part of the pineal fossa. The hinder part of the spindle is so shut in by the crests in this skull that its structure cannot be well seen; but in specimen No. 3 (Plate 32, fig. 2), which has a larger spindle, a suture is clearly seen passing backwards from the fossa and dividing the hinder triangle into two portions; this suture doubtless existed in the present specimen. The portion of a Dicynodont skull from India, described by Professor Huxley (15, p. 10), Plate 30, fig. 1, presents a very similar structure of this area, and he regards the two bones forming the hinder half of the area as the parietals, and the anterior one as an intercalary bone. Professor Cope (8, p. 210) notices the same posterior median suture in his *Lystrosaurus*, but judging from his figure the pineal fossa is entirely surrounded by the two anteriorly connate parietals.

The upper surface of the skull (Plate 28, fig. 1) immediately in front of the pineal fossa, and between the postorbital bars, is deeply depressed, and in the middle of this depression is a smaller concavity occupying the anterior part of the spindle-shaped area; extending forwards from this is a median ridge, apparently co-extensive with the frontals which occupy the inter-orbital space and seemingly meet the premaxillæ some little distance in front of the orbits, a deep transverse pit marking the point of junction. The frontal suture is seen as a line running along the median ridge. The form of the front of the muzzle is somewhat uncertain; the figures, however, fairly represent its present condition, that is notched at the extremity, but this appearance may, to some extent, be due to imperfection. The premaxillæ no doubt form the anterior extremity, and extending downwards in the middle line (Plate 27),

divide the anterior nares, which are double and lateral, though very near to the front and to each other.

On the outer side of the frontal process of the premaxilla and extending from the frontal to the anterior nares, is an elongated bone which occupies the position of the nasal. At its hinder end and separating it from the orbit, is a small triangular area which I regard as the prefrontal; this bone forms part of the orbit (Plate 27), and is in relation with the frontal, nasal, and lachrymal bones, the latter being best seen in the side view which we come next to consider. Each of the bones of the front of the skull occupies the same relative position as those described in Dicynodonts by Professors COPE (8) and SEELEY (43), but in the restored plan given by the latter (p. 247) the nasals are not indicated.

Side View of Skull.—The premaxilla, as seen in a side view (Plate 27) forms in front of the nasal opening a peculiar beak-like projection, which may, perhaps, be due to fracture; but is not unlike what is seen in *Dicynodon pardiceps* of OWEN (38, Plate 38). No suture is to be seen between the premaxilla and the maxilla, but it is the latter undoubtedly which carries the tusk and hides the greater part of it, only about 10 millims. being seen projecting downwards, forwards, and inwards, beyond the alveolus; and when perfect, scarcely 5 millims. could have been exposed. The length of this tusk must have been about 50 millims., and its greatest diameter, perhaps, 10 millims. The distance between the points of the two tusks seems to have been about 35 millims., but the right tooth is not seen.

Each nasal opening is directed laterally, and while its anterior border is well defined and stands out sharply, the posterior edge is ill defined, the bone being depressed and shelving inwards and forwards; indeed the true opening is not so large as it appears to be in the outer view (Plate 27), where the matrix obscures the hinder margin. The true opening, as shown on the opposite block of stone, is smaller and is indicated by a line in the figure.

The orbit is large and oval, measuring from front to back 45 millims., and in height 35 millims.; it is directed outwards, forwards, and a little upwards, its lower and hinder boundaries are narrow bars, showing no sutures to indicate the limits of the bones; but judging from the structure in other Dicynodonts, the postfrontals form the postorbital bar, and the jugal bone, in part at least, the lower bar. If the structure indicated by Professor SEELEY holds good in this specimen, the maxilla underlies the jugal and unites with the squamosal for some distance in the temporal region, thus helping to form the temporal bar. A suture is to be seen on the under surface of the temporal bar (Plate 28, fig. 2), but there is nothing to show whether the bone in front of it is part of the maxilla or part of the jugal. The orbit is continuous, below and behind, with the great temporo-palatine vacuity.

Within the front of the orbit is the lachrymal foramen, which passes through into the nasal chamber and may be seen on the inner surface. The sutural boundaries of the lachrymal bone are not very clear, but they may be traced within the orbit

and on the outer surface extending from the orbit to the nasal aperture. Immediately above the lachrymal is the triangular bone above called the prefrontal.

The parieto-squamosal crest arises abruptly behind and above the orbit, increasing in height as it passes backwards, and then curving downwards sweeps backwards and outwards to meet the temporal bar. As we have already seen, the outer plate of the crest seems to be formed by the squamosal, which apparently also includes the downward extension forming the pedicle for the lower jaw. The pedicle has a remarkable form; as it descends from the temporal bar it has a broad surface (45 millims.) directed outwards, which is convex from before backwards; it is then twisted so as to turn the outward face nearly forward, and becomes concave from side to side; its outer margin forms an angle and then curves downwards, inwards, and forwards to the quadrate; the lower end is much constricted and again twisted so that the front face becomes once more directed outwards, a line near the condyle being possibly the suture between the squamosal and the quadrate.

Passing from the inner side of the quadrate, the outer edge of the pterygoid is seen stretching forward to join the maxilla below the orbit; but the form of the palate is hidden in this side view.

Palate.—By clearing away the matrix from above the palatal region of the right half of the skull it has been possible to obtain casts representing the greater part of the palate, and from these, with a partial restoration, the drawing (Plate 28, fig. 2) has been made. The base of the cranium being hidden, its relation to the pterygoids is uncertain, but it is tolerably clear that the united pterygoids were continuous with the basisphenoidal region. The under surface of the palate is concave from side to side throughout its length, but especially so at the extremities; while from front to back along the middle it is convex, a ridge, carrying a suture, occupying the middle line. A strong process is given off from the hinder part of the pterygoids on each side, which passing downwards and backwards joins the inner side of the quadrate well above the articular condyle (Plate 28, fig. 2, *qu.pt.*) as seen also in a side view (Plate 27), thus giving a triradiate character to the hinder end of the palate. Immediately within the bases of these processes, and close to the middle line, is a pair of small holes piercing the pterygoids vertically. About 15 millims. in front of these foramina is the narrowest part of the palate, which widens again more gradually in front of this point. About 30 millims. in front of the pair of foramina there is a median ovoid aperture (*pt.f.*), pointed in front, which passes through the palate and opens into the supra-palatine vacuity, just behind the orbits. This opening, although single on the lower surface of the palate, is double above, being divided by a median ridge or septum, which, although not very clearly seen in this specimen, is much more distinct in the one next to be described (No. 2). Passing forwards from the narrowest part of the pterygoids their outer margins extend downwards and outwards, while the middle part inclines upwards, thus forming a deep wide channel between nearly vertical lateral plates. The outer surfaces of these lateral plates seem to be

extensions of the pterygoids which join the maxillæ in front; but about the middle of the oval foramen (*pt.f.*) a suture is seen on each side curving outwards and then forwards, near the lower edge of this plate. The bone thus separated off on each side within the pterygoid is doubtless the palatine, it appears to join the maxilla, and then to turn inwards again. Although this region is obscured in the present specimen, yet, judging from others as well, there can be little doubt that the palatines extend to the middle line, either meeting each other, or being merely separated by the vomer, and thus form the posterior nares (*pt.na.*); these two passages passing directly upwards and forwards into the nasal chambers, are separated by the ethmo-vomerine septum, the hinder end of which can be traced, but its forward extension is hidden. Judging from the position of this septum in specimen No. 2, where it is well seen (Plate 29, fig. 2, *eth.vo.*), it would in the present specimen extend forward to a point between the external nares (Plate 27, *n.*).

The posterior nares being situated between the front parts of the orbits, the boundary of each nasal passage forms part of the wall of the orbit, and passes just on the inner side of the maxillary cavity, which contained the pulp of the tusk-like tooth. The upper surface of the pterygoid bones had a slight median ridge, but there is no evidence of an ossified interorbital septum. In clearing away the matrix from the interorbital region in the left half of the specimen, fragments of bone were met with, which seemed to correspond with a trough-like bone seen in the same region in specimen No. 2, which is believed to be an orbito-sphenoid.

The roof of the mouth in front of the posterior nares forms a deep concavity, extending so far upwards and forwards as to be in part between the external nasal openings, and it seems highly probable that it received a beak-like prominence of the mandible. The premaxillæ and maxillæ are doubtless the chief elements in the formation of this arched part of the roof of the mouth; but there is no evidence to show whether or not the vomer and palatines were included also.

Brain Case.—Little can be said as to the structure of the cranium proper, for the bones of this region are much broken; all the available information being in the right half of the specimen. The deep cup-like cavity for the pineal eye, already alluded to, is here seen very distinctly, and the manner in which it opens into the brain cavity by a narrowed foramen, which spreads out below into an inverted funnel-shaped space in the roof of the brain case, is also well shown. The pineal opening gives a clue to the position of the brain cavity which would otherwise have been uncertain, for although there are some thin plates of bone in this region, which are doubtless parts of the cranial walls, they are not sufficiently perfect to give any clear idea of the form of the brain case. Although only part of the roof of this cavity is seen, yet it is evident that it was nearly an inch below the highest part of the parietal crest, and that above the brain case there was a cavity on each side, continuous below with the temporal fossa, and covered above by the plates forming the parieto-squamosal crest.

Mandible.—The lower jaw is preserved *in situ* (Plates 26 and 27), and casts of both

the inner and outer surfaces of the left ramus have been made; the bones, however, have been cracked and the limits of the different elements cannot be traced. The hinder extremity is shallow, and is close to the quadrate condyle. Passing forward its depth increases quickly for about one-fourth of its length, and then more gradually for about twice this distance, the anterior fourth maintaining the same depth to near the symphysis. The upper margin is convex in its present condition, but it seems probable that the anterior end was turned somewhat upwards to form a beak. The lower margin is concave from end to end, except where it is interrupted just behind the middle, by a broad thin process directed downwards and inwards. The ramus, as preserved, is nearly straight from back to front, but a little behind its anterior extremity, which seems to be its natural termination, the outer surface curves outwards forming a slight depression, possibly having some relation to the maxillary tusk. Both the inner and outer surfaces present a long oval vacuity at about the middle of their extent; that on the outside being bounded above by a strongly-marked ridge, which curves upwards towards the front. The greater part of the front half of the ramus is formed evidently by a dentary element, and its junction with the hinder half is shown at the upper margin by the two parts being drawn a little apart. A process from the hinder part of the ramus extends nearly to the front below the dentary.

A portion of the narrow symphysis is preserved in front showing that the two rami were perfectly anchylosed. The greatest length of the ramus is 105 millims.; its greatest depth, near the front, 40 millims., while towards the back, excluding the downward process, it is about 30 millims.

Parts of the Trunk.—The parts of the skeleton which are preserved, other than the skull, are in such a broken and fragmentary condition that they supply no satisfactory characters. A portion of what seems to have been a humerus, with the epicondylar foramen and bridge very strongly developed (Plate 28, figs. 3 and 4), gives no idea of the form of the entire bone, although it must have been more ponderous than any of the humeri described farther on.

A portion of a much broken flat bone, seen near the piece of humerus, is no doubt a scapula, probably similar in form to that of No. 2 specimen, and there are fragments of about a dozen ribs, the best exposed being about 9 millims. wide in the middle, and 13 millims. wide near the head. The ribs converge more or less towards the region which the vertebral column would naturally have occupied, but no traces of vertebræ are to be seen in this position. On the outer edge of the block, however, there are some indistinct impressions (Plate 28, fig. 5) which may have been left by three small elongated vertebræ; they are too indefinite to say much about, but their small size prevents their reference to any part of the body except the tail.

Affinities.

Dr. TRAQUAIR'S reference of the specimen just described to the Dicynodontia (45) is fully justified by the detailed study of it now that it has been fully developed. The pair of maxillary tusks in the otherwise edentulous jaws, the large development of the pedicle for the articulation of the lower jaw, the double parieto-squamosal crest, sweeping round to the temporal arcade, and the structure of the palate, leave no room for questioning its close alliance with *Dicynodon*. Although the light build of the skull is quite unlike the ponderous proportions of most of the specimens that have been referred to that genus, yet it presents certain points of resemblance to both *Dicynodon* and *Oudenodon*, in its general outward appearance.

The genera into which Dicynodonts have been divided are not very clearly defined. The characters of the type genus *Dicynodon*, as given by Sir R. OWEN (38, p. 30) and modified by Mr. LYDEKKER (23, p. 1063), are tusk-like teeth in the maxilla growing from persistent pulps, the rest of the jaws being edentulous with trenchant edges. The profile of the skull rounded, the maxillæ not strongly ridged, nares approximated to the muzzle, and the supraoccipital forming a broad bar above the foramen magnum.

Oudenodon, OWEN, resembles *Dicynodon* in most points of its structure, but is distinguished by the total absence of teeth.

Kisticephalus, OWEN, was established for a number of small forms with depressed skulls especially broad in the inter-temporal region, and with no tusks. Mr. LYDEKKER (24, p. 47), however, has pointed out that teeth are sometimes present in this genus.

Ptychognathus, OWEN, has the skull strongly bent upon itself in front of the orbits, the maxillæ are strongly ridged and bear a pair of large tusks, the nasal openings are far from the muzzle.

Lystrosaurus, COPE, and *Dicynodon Murrayi*, HUXLEY, appear to be generically identical with *Ptychognathus*.

Keirognathus, SEELEY, was established for a small Dicynodont from South Africa and characterized as having very small tusks, which project almost directly downwards, and only two phalanges in all the digits except the third. The latter character has been questioned by Mr. LYDEKKER (24, p. 50), and additional characters are desirable to establish the generic distinctness of this form, which seems very closely related to *Dicynodon*.

There can be no doubt that of all these forms the type genus *Dicynodon* is the one to which the present specimen bears the closest resemblance, but at the same time there are differences which to me appear of generic importance. The spindle-shaped area inclosing the pineal fossa, the anterior part of which is formed by a triangular azygos bone, finds its nearest analogue among the Dicynodonts. This structure is not shown in any of Sir R. OWEN'S figures (38), neither does Professor SEELEY (42) give a similar structure in his restoration of the Dicynodont skull. Professor HUXLEY, however

(16, p. 11), as already noticed, has described a similar arrangement of the bones of the parietal region in an Indian Dicynodont, and calls attention to specimens of *Dicynodon* [*Ptychognathus*] *Murrayi*, *D. lacerticeps*, and perhaps *Oudenodon Grayii*, as also possessing a single intercalary bone, interposed between the parietals and frontals, and bounding the parietal foramen. A similar intercalary bone is probably represented by Professor COPE (8, p. 210) as a tuberosity at the back of the frontals in *Lystrosaurus* (*Ptychognathus*).

The plan of structure pointed out by Professor HUXLEY in these Dicynodonts is no doubt in principle the same as that found in the Elgin fossil, and the Indian cranium is so similar that it may well belong to the same genus. In *Ptychognathus* (including *Dicynodon Murrayi* and *Lystrosaurus*) the form of the intercalary bone is different, and apparently distinctive, being more or less quadrate. In *Dicynodon lacerticeps* and *Oudenodon Grayii*, so far as I can see in the British Museum examples, the form of the intercalary is more like that of the Elgin skull, but it is not very clearly shown. The most important character which separates *Gordonia* from most, if not from all, Dicynodonts, namely, the possession of two large post-temporal fossæ on each side, unfortunately is not shown in the present specimen, the occiput of which is hidden; but this character is clearly seen in the allied species of *G. Juddiana* (p. 465, Plate 35, fig. 8). However, it must be noticed that Sir R. OWEN describes three such vacuities in *D. lacerticeps* (38, p. 30, Plate 23, fig. 3).

The comparative slenderness of all the bones of the skull, and the small size of the teeth in all the specimens referred to *Gordonia*, may also be taken as characteristic, and to this may be added the apparently imperfect ossification of the vertebral centra, for in none of the specimens have centra been detected with certainty, and this absence from all the examples seems to indicate something more than accidental imperfection.

There is in the British Museum a specimen of *Kisticephalus*, in which two or three vertebræ have been cut through, and these show remarkably open cancellous tissue. If our Elgin specimens had similarly ossified centra, it is possible that they would be obliterated by the coarse sandy matrix.

The peculiarities presented by this Elgin Dicynodont seem to me amply to justify its generic separation, and I propose to name it *Gordonia Traquairi*, as a mark of respect for the veteran zoologist of Elgin, the Rev. Dr. G. GORDON, and as an acknowledgement of the services rendered to science by that well-known palæontologist, Dr. R. H. TRAQUAIR, who, having recognised the affinities of this Triassic Reptile, was the first to record the occurrence of Dicynodonts in Great Britain.

2. Gordonia Huxleyana, *sp. nov.* (Plates 29 and 30).

General Remarks.

The second specimen belonging to the Geological Survey is contained in several blocks of sandstone which, when placed together, exhibit impressions of a skeleton extending for about 30 inches (760 millims.) over the surfaces of the stone. These include a well preserved skull and lower jaw, with parts of scapulæ, humeri, bones of the forearm, the neural arches of some cervical vertebræ, a number of ribs, partly retaining their natural relations, and at the hinder end a portion of a pelvis with a piece of what may be a femur. The skull is in much the same condition as the first one above described, having been broken through vertically in the middle line. By clearing away some of the matrix from the left half, and by a second horizontal fracture, which exposed the temporal arcade, I have been enabled to prepare casts which reproduce the form almost as perfectly as the first specimen. The right half of the skull shows the structure of the palate in a very satisfactory manner.

Description.

Skull, upper surface (Plate 30, fig. 1).—The general form of this skull is similar to that of No. 1 specimen, but it will be seen in this view, that it is proportionately wider and more regularly oval in outline. The greatest length of the skull, making allowance for the possibly imperfect muzzle, is about 150 millims., and its greatest breadth across the temporal arcade, 100 millims. The interorbital space is about 22 millims., and the narrowest part in the parietal region 17 millims. The parieto-squamosal crest is less strongly marked than in No. 1, and its external surface (squamosal), where it slants down to the temporal fossa is nearly flat. The temporal fossa itself is broader than in No. 1 specimen. The pineal fossa is situated only a little behind a line connecting the hinder margins of the postorbital bars, while the space immediately in front of it, and between the bases of these bars, is only slightly depressed. There are indications of the spindle-shaped area, but the sutures are mostly obliterated, the median one passing backwards from the pineal fossa being alone visible. The frontal and premaxillary regions are only slightly convex from side to side. The connate premaxillæ curve downwards in front over the nasal openings, but the front is broken, and its termination obscured. However, an examination of the right half of the specimen (Plate 29, fig. 2) shows that it must have terminated somewhat as shown in the figure (Plate 30, fig. 1), there being a slight emargination of the extremity. No sutures can be traced in the front part of the skull. As it has not been possible to get a cast of the middle part of the postorbital bar, this has been modelled in the cast and restored in the figure.

Side View.—There is evidence of the premaxillæ having extended in front of the anterior nasal openings, but this is not shown on the left side (Plate 29, fig. 1). The

maxilla supports a tooth very similar to that of *G. Traquairi*, but a smaller proportion of it extends beyond the alveolus. The points of the two tusks are about 20 millims. apart; a natural cast of the pulp cavity of the left one is preserved, and its base is seen immediately below and in front of the orbit. The maxilla extends backwards below the orbit, and seems to pass beyond it to join the squamosal, but these parts are somewhat broken and obscure. The jugal bone may possibly shut out the maxilla from the lower part of the orbit, somewhat as indicated by Professor SEELEY'S restoration (43), but this is uncertain; posteriorly, however, it is seen extending along the upper and inner part of the squamosal (Plate 30, fig. 1, *ju.*) forming a large part of the inner margin of the temporal bar. The squamosal, besides forming the greater part of the temporal bar, extends apparently downwards to support the quadrate and lower jaw, and upwards and forwards to form the upper boundary of the temporal fossa. In this aspect the parieto-squamosal crest is much less conspicuous than in *G. Traquairi.*

The orbit is more elongated than in the last-named species, but this may, to some extent, be due to a slight depression of the specimen.

The side wall of the brain-case is seen in the temporal fossa (Plate 29, fig. 1), but the bones are too much broken to give any definite information. Between the orbits there is a triangular bone (*o.sp.*) which may be the united orbito-sphenoids; the base of the triangle is directed backwards and the point forwards; it is bent upon itself along the middle line, so as to form a trough above and a ridge below. This bone is now towards the left side, but was doubtless a median ossification.

The back of the skull is broken and its form is uncertain.

Palate.—The whole of the upper surface of one-half of the palate is shown by the left moiety of the specimen (Plate 29, fig. 1), while the under surface is shown in the right (fig. 2). Passing back from the maxilla the anterior outer edge of the pterygoid is thickened, while further back it becomes thinner and then gives off the quadrate process. The median part in this hinder region is continued into the base of the skull. The pterygoid rises towards the middle line and forms a median ridge, which near the hinder part of the orbit rises into a thin vertical process, extending upwards very nearly to the orbito-sphenoid (Plate 29, fig. 2). On each side of this process, and somewhat more towards the front, the palate is pierced by two apertures, (*pt.f.*) as in *G. Traquairi*, but in this case the division into two by the median ridge is more clearly seen. In front of this process the pterygoid continues to rise towards the middle line, until it reaches some distance along the inner side of the orbit (Plate 29, fig. 1). This rising is really the roof of one of the posterior nares, as shown by the right half of the specimen (fig. 2), in which is also shown the ethmovomerine septum, beginning just at this point, dividing the posterior nares, and extending forwards above the arched roof of the mouth to a point as nearly as possible opposite the middle of the anterior nasal opening. This bony septum does not altogether separate the nasal cavities, its upper part evidently remained cartilaginous; near its hinder

end there is an upward process which comes into near relation with the orbito-sphenoid.

The palate, as seen from below, is essentially the same as that of *G. Traquairi.* Rather more of the base of the skull is preserved in this instance, but its form is indefinite. The pterygoid gives off a quadrate process on each side, and this is definitely separated from the median part which is continuous with the base of the skull. Passing forwards the pterygoids become concave from side to side, and in the region of the pterygoid foramina the outer edges descend rapidly, then curving inwards and forwards they join the lower part of the ethmo-vomerine septum, thus circumscribing one of the posterior nasal openings. The palato-pterygoid suture is not so well seen in this as it is in *G. Traquairi;* but it is tolerably certain that the palatines surround the posterior nares, and probably form part of the pterygoid foramina.

The roof of the mouth, in front of the posterior nares, is deeply concave, with a median ridge occupying the position of a vomer, but there are no sutures visible to show what bones enter into the formation of this part of the palate.

Lower Jaw.—A large part of the left ramus of the lower jaw is preserved; but it is less perfect than that of *G. Traquairi;* on the outer side more especially the bones are broken and pushed over one another. The articular surface, however, is very well preserved; it is saddle-shaped, being convex from before backwards and concave from side to side; there is a triangular surface just in front of it on the upper aspect of the ramus, which seems to indicate that the articular element was wedged in between an outer plate (supra-angular ?) and an inner plate (splenial ?).

There are indications of a vacuity on both inner and outer surfaces; and from the lower margin a thin plate extends downwards and inwards, as in *G. Traquairi.* The imperfection of the bones prevents any useful comparison with the last-named species but the ramus appears to have rather less depth in proportion to its length.

Vertebræ.—Immediately behind the head the line of the vertebral column may be traced by portions of several vertebræ, which have the appearance of expanded transverse processes; but they are too indistinct to allow much to be said about them. No centra can be definitely made out in this or any other part of the body, although, from the position of the ribs and limbs, it is evident that the skeleton was entire when embedded in the sand.

Ribs.—Numerous ribs, or portions of them, are present, and in one block 17 or 18, more or less imperfect, may be seen lying nearly in their natural relation to each other. The longest of these, which is not complete, is the tenth in front of the ilium; it measures about 140 millims. in length, and at its middle is not more than 6 millims. wide; this, however, increases to 7 millims. at the upper end.

Ilium.—A little behind the last of the ribs there are impressions of two expanded bones, and a cast, taken from the more perfect of these, shows it to be a left ilium (Plate 30, fig. 5); the bone has been somewhat flattened, but the external surface, which

is the most complete, is seen to be concave, with a thickened downward process to form the acetabulum. Only a small part of the inner surface is shown, but this is of interest, its lower part, near the acetabulum, having an articular surface, apparently for the attachment of the ischium. The greater part of the bone is in front of the acetabulum, but there is also a slight posterior extension, which is separated from the articular cavity by a notch. It is not quite certain that the upper margin is complete, but in its present condition it is undulated and nearly parallel with the lower margin. Anteriorly, it curves downwards, and, forming a rounded extremity, is continued into the lower margin, the pre-acetabular portion of which is slightly concave. The posterior extremity is indistinct, but seems to be rounded above the notch. The greatest length of this ilium is 85 to 90 millims., its least height, a little in front of the articular cup, is 35 millims., while its greatest height, including the acetabular process, is not less than 50 millims., and may have been more.

Scapula.—Parts of both scapulæ are preserved, but only one, the left, is sufficiently perfect to give an idea of its form (Plate 30, fig. 2). The lower, or articular, end is tolerably perfect, but the upper extremity is broken; when complete, it probably had more the form shown in fig. 7. Its greatest length is now 85 millims., its width, at the acromion (more correctly coracoid, LYDEKKER, 'Zool. Soc. Proc.,' 1893, p. 174), process, 34 millims., at the widest part above this, as now preserved, about the same, 34 millims., at the narrowest part, midway between these, 23 millims., and the neck of the articular process about 15 millims. The outer surface is convex from end to end; in the acromion region its anterior two-thirds is convex from before backwards, while the hinder third is concave. The upper part of the bone is nearly flat, but the posterior edge is reflected. On the inner aspect, the concavities and convexities are exactly reversed. The greater part of the bone has but little thickness, but the process for articulation with the coracoid and humerus is stout, and on its inner side, near the middle of the bone, there is a slight ridge. This ridge, it will be seen, is on the opposite aspect of the bone and is much smaller than that of the scapulæ figured by Mr. LYDEKKER (24, pp. 16 and 43), which he calls the supra-acromial process, and consequently these scapulæ have quite a different form to that of the Elgin specimen, which also differs from those figured by Sir R. OWEN (38), but seems to be intermediate between that referred by him to *Dicynodon* (Plate 70) and that belonging to *Kisticephalus* (Plate 69). The acromion is more definitely marked in the Elgin form than in the latter, while there is less constriction above it. In *Dicynodon*, on the other hand (38, Plates 69 and 70), both the acromion and articular portions are more definite processes than in the present one, and there is a greater constriction above them.

The scapula of *Keirognathus* (42) is too fragmentary to allow of comparison. The portion of a scapula preserved in the specimen of *G. Traquairi* agrees, so far as can be seen, with the present one.

Clavicle.—Very near to one of the scapulæ is a spatulate bone (Plate 5, fig. 3) with

one extremity produced and rod-like. This I take to be a clavicle; it corresponds in form, to some extent, with the bone of *Kisticephalus* represented by Sir R. OWEN (Plate 69), and called episternum. The broad end of this bone is thin, and the side represented is convex, while the opposite side has the appearance of having been overlapped by another bone, a ridge occupying one side and continuing into the elongated rod, as shown in the example represented by fig. 6, which occurs on specimen No. 5, and presents the opposite side of a similar bone.

Humerus.—Portions of both humeri are present, but unfortunately in a very imperfect condition; the right and more complete one is figured (Plate 30, fig. 4), but both ends are wanting. The portion preserved is the middle of the shaft with part of the deltoid crest, and the entepicondylar foramen. The crest is set at an angle with the distal extremity, and both ends were evidently expanded in the characteristic Anomodont fashion. This humerus may be compared with those figured by Mr. LYDEKKER (22, Part 3) from India, as similar parts are preserved, but nothing very satisfactory can be said about so imperfect a specimen.

Affinities.

There can be no question as to the close resemblance between the skull of this specimen and that of *Gordonia Traquairi*, and without any hesitation it is placed in the same genus. But the question of species is not so easily settled, the two skulls being so much alike and there being so few of the other parts of the skeleton available for comparison. When the skulls, or the drawings of them, are placed side by side, the differences are more apparent, and justify, as I think, their specific separation. Disregarding the difference of size, the skull of the present specimen is proportionately wider in the temporal region, although the broad outer plate of the temporal arch is narrower than in *G. Traquairi*. The fronto-nasal portion is comparatively flat, showing neither the deep depression in front of the pineal fossa nor the strongly arched nasal region. The parieto-squamosal crests also, are far less developed, and their outer surfaces are nearly flat, not rounded as in *G. Traquairi*. The entire skull is more depressed; the extreme depth from the crest to the quadrate, making allowance for imperfections, is about half the length from the hinder end of the squamosal to the point of the tusk; while in *G. Traquairi* the depth is more than three-fifths of the length measured from the same points. The lower jaw also seems to show a correspondingly greater length in proportion to depth. Although the fragment of a humerus preserved with *G. Traquairi* is too little to say much about, yet it is more ponderously developed in proportion to the size of the skull than that of the specimen now under consideration.

These points of difference seem to me to indicate more than mere individual variation, and I propose to name this form specifically after my respected master in science, who has done so much towards the elucidation of the structure and relations of the Elgin Sandstone Reptiles; it will be named, therefore, *Gordonia Huxleyana*.

3. Gordonia Duffiana, *sp. nov.* (Plates 31–33).

General Remarks.

The series of specimens from Cuttie's Hillock, belonging to the Elgin Museum, will now be described, and the first to be noticed is the greater part of a skeleton contained in several blocks of sandstone. Unfortunately most of the blocks were unnumbered when they came into my hands, and it was only by fitting the pieces together that one could tell to which specimen the different pieces belonged; this, however, was satisfactorily accomplished in all cases except with regard to the skull and trunk now to be considered; for although it is almost certain that these belong to the same specimen, yet the corresponding surfaces, by which they fitted together, could not be traced. The skull is contained in two blocks, which had been split apart when I first saw them, one half revealing the impression of part of the upper surface of a skull, about $4\frac{1}{2}$ inches in length, while the other half exhibited the impression of the under side of the same parts. As it was evident that other portions lay hidden in the matrix a careful exploration with the chisel was made, the result being the opening out of both orbits, the palatal region of the left side, with part of the side wall of the brain case, and also much of the back of the skull and quadrate bone on the left side.

The impressions on the remaining three blocks represent the vertebral column, ribs, parts of the pectoral and pelvic arches, with a humerus and certain foot bones.

Description.

Skull, upper surface.—A cast taken from the upper rock-mould shows the structure of a large part of the upper surface of the skull (Plate 32, fig. 2), which is very similar to that of the two skulls above described. The supratemporal fossa is large and occupies a considerable part of this upper surface, its anterior margin being as nearly as possible the middle of the length of the skull. The parieto-squamosal crest is wider than that of *G. Huxleyi*, but does not attain to the height of that of *G. Traquairi*. The crest sweeps backwards and downwards to form the temporal bar and the pedicle for the lower jaw. The temporal bar is a thin plate, convex above and concave below, narrowing as it passes forward to join the postorbital bar, which is preserved on the left side and defines the hinder boundary of the orbit; the upper margin of the orbit is shown on both sides, and its lower limit is tolerably well defined by the remains of the suborbital bar of the right side (Plate 33, fig. 2). The inter-orbital width is 26 millims., and this is rather greater than the inter-parietal width, which is 22 millims.

A spindle-shaped area occupies the median part of the upper surface, and is similar to that mentioned in *G. Traquairi*, but larger than in that species, although the skull of the present specimen is really smaller. The pineal fossa is situated chiefly in the

hinder half of this area, formed doubtless by the two parietals, the median suture passing backwards from the fossa being here well seen. An indented line on the left side near the front of the pineal fossa (but not seen on the right side) is doubtless one of the sutures which separate the anterior half of the spindle as a separate bone; and the sutures which mark its division from the frontals are also clearly indicated. From the anterior end of the spindle a ridge passes forwards to the front of the specimen, so far as the upper surface is preserved, and a median suture dividing the pair of frontals accompanies this ridge. On each side a suture is seen passing from the middle of the spindle obliquely forwards to the orbit, separating the frontal from the bone forming the postorbital bar. The similarity between the parietal region of this specimen and that of the Indian skull, described by Professor HUXLEY (16), has been already alluded to when considering the affinities of *G. Traquairi*.

Side of Skull.—The structure of the side of the skull has to be interpreted, almost entirely, from the impressions of the inner sides of the bones (Plate 33, fig. 1), but the outlines of the upper part and of the supra-temporal bar are defined by the cast of the upper surface, which has just been described, and is shown in profile (Plate 33, fig. 3), in its natural position upon the internal cast, with the missing anterior parts indicated in outline.

At the front of the specimen there is evidence of an oval opening, which has quite the appearance of being a terminal single nasal aperture, and, without the evidence afforded by the other closely allied forms, there was nothing to hinder this interpretation; but, as the premaxillary portions are wanting, it is only reasonable to suppose that, when perfect, this skull also had double anterior nares. What remains of the pre- and sub-orbital regions are best seen on the right side (Plate 33, fig. 2). A portion of the maxilla is shown just below and in front of the orbit, and there is at this point a cast probably representing the pulp-cavity of a tooth; but nothing can be seen of a similar cast on the left side. If there were two of these pulps, the teeth growing from them must have been smaller and nearer the middle line than are those of *G. Huxleyana*.

The impression seen on the right side below the orbit is probably a cast of the under surface of the maxilla; while that on the left side may represent a part of the jugal bone.

The maxillary continuation of the temporal arcade was, no doubt, very similar to that of *G. Huxleyana*, and fig. 3 has been restored on the same lines, so that the parts which are preserved may be more intelligible.

The distal articulation of the quadrate has left a saddle-shaped cavity, which is slightly out of position, and separated from the pedicle formed by the squamosal, on the back of which there is an arched space, that seems to have been for the attachment of the quadrate.

Palate.—At the time when this skull was chiselled out its affinities were entirely unknown, and, in order to ascertain whether it possessed palatal teeth, it was thought

best to work down upon this region from above, so that the impression of the lower surface might be preserved. For this purpose the matrix was removed from the left temporal fossa, and the quadrate process of the pterygoid, which was soon uncovered, was traced inwards, and then the pterygoid was followed backwards and forwards. Not a trace of a tooth could be found, and the thinness of the bones, which were only a little thickened at the edges, made it highly improbable that they ever supported any dentary apparatus. The palate was displayed as far forwards as the internal nares and maxilla, and inwards beyond the middle line. In order to trace the more anterior parts of the palate, an attempt was made to display the right side from below, but without success, the bones of this side not being in place, and had evidently been broken away before the skull was imbedded in the sand; however, some additional information was obtained. The right quadrate process of the pterygoid seems to have been broken and crushed downwards as a thin vertical plate, presenting a very misleading appearance, as if it were an inner projection of the left pterygoid. If this were the correct interpretation, and the right pterygoid were absent, which seemed quite possible, the hinder part of the palate must have been much wider when perfect, with a space between the hinder ends of the pterygoids, much as in *Sphenodon*. The interpretation of this palate was indeed very uncertain until the two Survey specimens (Nos. 1 and 2) were developed; in the light of these, however, there can be little doubt that all three are constructed on the same plan. The concavity of the under surface is similar; there is the same rising in front to form the arch of the posterior nares; the hinder part, also, is evidently continuous with the base of the skull, and there is a similar process to the quadrate. Moreover, there is a corresponding perforation of the pterygoid just behind the posterior nares, but in this case, the left aperture being a little removed from the middle line, it seems clear that the two openings were more distinctly divided than in the other two specimens, and this is in accordance with the greater width of the palate which the present specimen exhibits. The ethmo-vomerine septum is shown on the under surface, but it does not appear in the section of the nasal chambers presented by the truncated muzzle.

The drawing of the palate (Plate 33, fig. 4) has been chiefly made from a cast of the left side, but also in part from measurements of the impression, and the opposite side has been restored so as to give a better idea of its width, which is absolutely greater than that of the larger skull of *G. Traquairi* (Plate 28, fig. 2).

Back of Skull.—The back of the skull in this specimen, although unsatisfactory, gives more information than either of the others, except No. 7 described below. The impression seen on the stone (Plate 32, fig. 1, and Plate 33, fig. 1) above and behind the articular condyle of the quadrate, is really the mould of the greater part of the left half of the occiput, and a cast taken from this exhibits much of its structure (Plate 32, fig. 3). The supraoccipital region can be traced descending almost vertically for perhaps 16 millims., and at this point probably the *foramen*

magnum began, but this cannot be definitely seen. Laterally the supraoccipital region is continuous with the broad squamosal plate. From the lower part of the exoccipital region a broad bar of bone extends outward to abut upon the lower part of the quadrate (or possibly squamosal); it occupies the position of the paroccipital process of *Iguana*, and like it may be in part formed by the exoccipital and in part by the basioccipital. Professor SEELEY (43) regards this process as the homologue of the malleus. Comparing this specimen with No. 7 (Plate 35, fig. 8) it is clear that the aperture above this paroccipital process is the lower post-temporal fossa, which is separated from an upper post-temporal fossa by a process from the side of the foramen magnum, corresponding with that in *Iguana* and other Lizards, which Dr. W. K. PARKER has shown to be chiefly formed by the opisthotic. In the present specimen the upper fossa is obscure, but may still be seen. Between the two processes in *Iguana*, the *columella auris* passes to the deep-seated *foramen ovale*, and it seems tolerably certain that this was also the case in the Elgin *Gordonia*, indeed there is an angular notch at the hinder margin of the squamosal, which seems to indicate the position of the outer end of the columella.

What may be the relations of the supraoccipital, parietal, and squamosal, in *Gordonia*, there is no evidence to show; but in so far as the parts above described are concerned, the occiput of *Gordonia* seems to be constructed on the same plan essentially as that of *Iguana*.

Vertebral Column.—The block of sandstone containing the trunk, having been split open, now forms three slabs, exhibiting the counter parts of various portions of the skeleton. The most interesting slab is that shown on Plate 31, about one-third its natural size, where the vertebral column may be traced from one side to the other, and was evidently continued into the surrounding rock. The entire length of the series of vertebræ preserved being about 18 inches (460 millims.). When first examined the position of the vertebral column was indicated by the direction of the ribs, and by a double series of holes extending for a good part of its length. A closer study showed these pairs of holes to be the moulds left by the sides of the neural arches, the rod of matrix between them being the cast of the neural canal, and the neural spine passed down into the matrix; it seemed tolerably certain, therefore, that the centra of the vertebræ would be found in the opposing slab of sandstone, but this was not the case, for no traces of centra could be found. Near the front part of the specimen some of the ribs were folded across in such a way that it seemed very unlikely indeed that the vertebræ could have been displaced; and on clearing away the matrix, the pairs of holes were found, marking the positions of the neural arches; but there were no traces of centra. A little below the line of the vertebral column, and just behind the lower ribs, there is a ring-like depression, and in the opposing block there is a similar and corresponding depression; it is just possible that these may be the impressions of the ends of a deeply bi-concave vertebra; but I am by no means sure that such is the case. The form of the upper

parts of the neural arches has been ascertained by removing the cast of the neural canal, and some of the surrounding matrix, from two or three of the middle thoracic vertebræ, and then taking a cast of the upper surface thus revealed. Figures of these casts are shown on Plate 32, figs. 3 and 4. The form of the neural spines is not quite certain, as the cavities were too small to allow of casts being made, but measurements were taken, and the form as given is fairly accurate. Seen from above (fig. 4) the vertebra is wide anteriorly (25 millims.) and narrow posteriorly (about 10 millims.), where it articulates with the succeeding vertebra. A side view (fig. 3) shows the anterior part depressed, while the posterior part rises considerably and arches over, as it were, to articulate with the next vertebra. A distinct ridge runs along the middle line, and posteriorly rises into a long and narrow neural spine.

Ribs.—Ribs are seen, more or less in their natural position, on both sides of the vertebral column, and on one side as many as 16 or 17 may be counted in a regular series, those towards the front being the largest. The tenth or eleventh rib from the sacrum is one of the largest and most perfect; in length it measures 180 millims., in the middle it is about 6 millims. wide, increasing to 8 millims. a little before its expansion to form the simple head, which has a diameter of 14 millims. The whole of the rib, including the head, is flattened.

Sacrum and Ilium.—At the hinder part of the specimen (Plate 31) there are three vertebræ which call for special attention, they are indicated by three pairs of holes—casts of their neural arches—from which transverse processes pass outwards for about 12 millims., and meet at an angle a broad plate, the form and position of which, leaves no doubt that it is a left ilium. The cavities left by the transverse processes and ilium are continuous, and the bones, therefore, must have been in close contact, if not firmly fixed, to each other. The ilium is partly hidden, the upper edge being under the vertebræ, but its form is shown by a cast (Plate 32, fig. 7). The greatest length of this bone from before backwards is 63 millims., the depth in front about 28 millims., increasing to 30 millims., and, with the acetabulum, 40 millims. The acetabulum, as preserved, is about 20 millims. across.

There are indications of a fourth vertebra supporting the ilium, and thus forming part of the sacrum, behind which three triangular impressions seem to be the neural spines of caudal vertebra, thrown a little out of place.

The cavity left by a long-bone is seen near the ilium, and from its position might be a femur, but it is not sufficiently perfect for identification.

Pectoral Arch.—At the anterior end of the counterpart of the block which has been figured there are some indistinct and imperfect impressions, seemingly of a scapula and coracoid, but their outlines cannot be traced. Not far from them is a very conspicuous cavity, which has been followed deep into the stone, and a cast from this (Plate 32, fig. 6) shows it to be a bone narrow in the middle, but broad and flattened at the extremities, which, however, are imperfect and set at right angles to

each other. That this bone is a humerus is tolerably certain, and that the lower end in the figure is the distal extremity, wanting its articular portion, is equally certain. The proximal end is evidently imperfect, and the peculiar form shown by the cast may be, and probably is, due to this imperfection. The broad ends of this humerus conform to the Anomodont type, and whatever may be their exact form, this bone differs from the other humeri described in this paper in having its extremities set at right angles to each other, and in its more slender proportions.

Foot Bones.—Near the lower part of the specimen and midway between the extremities there are three toe bones, an ungual and two other phalanges, lying very nearly in their natural relation to each other. The total length of the three bones is 47 millims. There is no evidence to show whether these bones belonged to a fore or hind foot.

Affinities.

The necessity of including the present specimen in the same genus as the two forms already described will be obvious, but there are differences which sufficiently justify a specific separation. Of the anterior part of the muzzle, and of the teeth, one can say little, but the more median position of the teeth, as indicated by the one pulp cavity, deserves to be noticed. The upper surface of the skull is the part of which we have the most certain evidence, and when due allowance is made for possible distortion, the following points of difference between it and those of *Gordonia Traquairi* and *G. Huxleyana*, may be noticed. Although this skull is smaller than either of the other two, yet the spindle-shaped area enclosing the pineal fossa is more strongly marked than in *G. Huxleyana*, and larger than in *G. Traquairi;* its inter-orbital and inter-temporal spaces are as wide as in *G. Traquairi*, and absolutely wider than in *G. Huxleyana*. This greater width of the median parts of the skull is further exemplified by the proportionately wider palate. To these differences in the skulls must be added the slenderness of the humerus in the present specimen, and especially the peculiar manner in which its two extremities are set at right angles to each other. If the outlines of the ilia are correct, then the preacetabular extension of that of *G. Huxleyana* is another point of distinction.

With imperfect specimens to deal with, it is not always easy to give definite characters for the distinction of the species, but it seems to me that the differences just pointed out are quite sufficient for the separation of the present form, and I willingly adopt the suggestion of Dr. Gordon, to associate it with the name of Mr. Patrick Duff, the first discoverer of Reptile remains in these Elgin Sandstones, and call it *Gordonia Duffiana.*

4. Gordonia Traquairi? (Plates 34, 35.)

General Remarks.

This is the second specimen from Cuttie's Hillock, belonging to the Elgin Museum. The whole of the piece of sandstone containing this skeleton has not been preserved; but the one large block, and three or four smaller pieces which have been sent to me (Plate 34), contain impressions of the greater part of the skull, with portions of the vertebral column, ribs, fore limb, and hind limb of an animal smaller than any of those yet noticed. The hinder part of the body being very imperfect, the length of the skeleton is uncertain. Much work with the chisel was necessary before casts could be taken, and, in the case of the skull, the parts being in different blocks, the joining of the casts was troublesome, especially as one side of the skull was pressed out of place.

Description.

Skull, upper surface.—Seen from above this skull is long and narrow (Plate 35, fig. 1), and resembles, in this respect, *G. Traquairi*, although only half its length, rather than either of the other species. The narrowness may be to some extent due to compression in fossilization, but the width between the orbits has not been thus affected. The left temporal bar is not quite perfect at its outer edge, but it has been completed in the figure by reference to the right side, which, although out of place, is entire. The front half of the pineal fossa is preserved, but some of the median parts of the skull behind this are wanting, however, the left parieto-squamosal crest is entire, and this shows how little is really absent. In front of the pineal fossa is a large triangular space, quite as large as that in *G. Traquairi*, but no sutures can be seen. The inter-orbital space is deeply concave, and in front of the premaxillary region curves downwards to the muzzle, which is not quite perfect, being broken away in front of the nasal apertures.

The greatest length of the skull is 93 millims., and was probably 98 millims. when complete; the greatest width across the temporal arches, as nearly as can be measured, is about 55 millims.; the least inter-orbital space is 17 millims. and the inter-temporal space was probably 14 millims. The greatest height of the skull from crest to quadrate is as nearly as possible 50 millims.

Side View (Plate 35, fig. 2).—Excepting in its smaller size, this skull so closely resembles that of *G. Traquairi* that one description would almost serve for both; but it will be seen that the parieto-squamosal crest is flat on the lateral aspect, not rounded, and it is not so high as in *G. Traquairi*, moreover the orbit is more oval in outline, being 27 millims. long and 19 millims. high, otherwise there is the same sweeping round of the crest to form a projection at the back of the skull and then to join the temporal bar and the pedicle for the lower jaw. The temporal arcade is

broad, thin, and concave below; narrowing anteriorly it becomes rod-like where it joins the post-orbital bar, and with the maxilla forms the lower boundary of the orbit. No sutures can be seen to indicate the extent of each of the bones. The squamosal below the temporal arcade is a broad bone similar to that of *G. Traquairi;* curving downwards and forwards it forms a narrow neck, just above the quadrate condyle, but no division between the two is visible. The lower surface of the maxilla is concave, and its outer and lower edge is sharp, terminating anteriorly in a point, but whether this bone supported a tooth or not I am unable to say, there being no evidence of the projection of any such tooth beyond the bone, or any cast of a pulp cavity visible. The direction of the point of the maxilla is, perhaps, more downwards than in any of the forms above described. On the right side about half of the external nasal aperture is preserved, it is 11 millims. in advance of the orbit and about 10 millims. high. The extremity of the muzzle, perhaps 5 millims., is wanting.

Palate.—The outer and part of the upper surface of the palate is shown, and agrees very closely with those previously described. The median hinder part rises somewhat to join the base of the skull, but this part is obscure; the lateral process is seen extending outwards and downwards to the quadrate; the outer border is thickened before reaching the maxilla; the anterior half rises rapidly to form the roof of the posterior nares. I am unable to speak with certainty as to the presence of the aperture which in the other specimens pierces the pterygoid.

Lower Jaw.—One ramus of the lower jaw is seen extending from the quadrate to near the maxilla; but it is very imperfect, and little can be said about it except that there is no reason for thinking it differed materially from those already described.

Vertebræ and Ribs.—Vertebræ and ribs, more or less in position (Plate 34), may be traced for nearly 12 inches (300 millims.), but all are fragmentary. At a distance of about 25 millims. from the skull there is a series of four neural spines, seen from the side, which occupy a space of 40 millims.; each spine being about 10 millims. high and 8 millims. wide. Below there are the displaced neural arches, with apparently the pre- and post-zygapophyses. A long search failed to reveal any evidence of the vertebral centra, either below their neural arches, or anywhere on the specimen. The position of the hinder part of the vertebral column is indicated by fragments of ribs. Towards the anterior end of the specimen there are a few more perfect ribs which seem to be in their natural positions; they have simple rounded heads, and the most perfect one measures about 80 millims. along the outer curve, and at its broadest part is about 4 millims. wide.

Pectoral Arch. Scapula.—The hollow moulds of the bones of the left fore limb are preserved almost in their natural relations, the foot bones alone being displaced. Casts from these cavities, although representing but one side of each bone, give their characters in a very satisfactory manner (Plate 35, figs. 3 to 5).

The *scapula* (fig. 3) exhibits the outer aspect; it is a thin plate with the outer surface convex in the direction of its length, which is 59 millims.; it is widest at its

upper extremity (29 millims.) becoming narrower at about the middle of its length (16 millims.); it expands a little to form the acromion process (17 millims.). Below this the bone is suddenly narrowed to 10 millims., and then more gradually, till it reaches the constriction, 8 millims. wide, above the glenoid articulation, the latter articulation again expanding to 10 millims. The anterior and posterior borders are both concave. The narrow glenoid portion is somewhat thicker than the rest of the bone. It is probable that the upper end of the scapula of *G. Huxleyana* (Plate 30, fig. 2) when perfect had much the same form as this one, which most likely was surmounted by a cartilaginous suprascapula; and it is also probable that the inner surface of the present scapula possessed a similar ridge to that seen in *G. Huxleyana*. This scapula resembles the one referred by Sir R. Owen (38) to *Kisticephalus*.

Humerus.—The cast of this bone represents the outer and hinder surfaces, as well as the proximal and distal terminations (fig. 4). The greatest length of the bone is 56 millims.; the width of the distal extremity, 31 millims.; width from inner edge of shaft to lower angle of deltoid crest, 27 millims.; from inner tuberosity to upper angle of deltoid crest, 29 millims. The most striking peculiarity of this bone is the great width of its extremities, and the large size of its deltoid crest, the latter being directed forwards and outwards at an angle of about 75° to a line drawn across the posterior surface of the distal extremity; and with the same line the long axis of the proximal articular surface forms an angle of about 35°. The inner tuberosity is the proximal termination of the thin inner margin of the bone. The distal half of the hinder surface (fig. 4) is marked by a large triangular depression, while the proximal half is convex; its curvature, sweeping round to the side, is continued into the deltoid crest, there being no line of demarcation between them. The lower part of the crest is distinctly on the front of the bone. Between the crest and the proximal articulation there is a deep notch, but I am not sure that the angle of this notch or those of the crest should be quite so definite as they appear to be in the cast. The distal extremity, which varies from 4 to 6 millims. in thickness (fig. 4, *b*), has no definite condyles for articulation with the radius and ulna, but seems from its roughened surface to have terminated in cartilage.

Radius and Ulna.—The casts present these two bones almost in their natural relation to each other (fig. 5), and it appears to be their posterior surfaces that are preserved. The stouter of these two bones, which is regarded as the ulna, is 47 millims. long, it is narrow in the middle, 7 millims., expanding at the proximal extremity to 13 millims., and at the distal extremity to 12 millims. Its radial margin forms a thin edge, but the opposite side is much thicker. The radius is the same length as the ulna, 47 millims.; it is a stout bone, although less so than the ulna; its narrowest part, near the distal end, is 5 millims., and it enlarges gradually to the extremities, the distal being about 8 millims. and the proximal about 9 millims. wide. The inner side of this bone is marked by a groove, and seems to have a thin edge, while the other side is thickened and rod-like.

Foot Bones.—Near the distal ends of the ulna and radius are the remains of a number of small bones, evidently parts of the foot; but none of them are perfect enough to show their form.

Hind Limb.—Near the hinder extremity of the specimen (Plate 34), low down on the block of stone, is a faint impression, which may be part of the pelvis, and a fragment, about 3 inches in front of this, is probably the distal end of a femur; the surface preserved is marked by a triangular depression, which does not extend quite to the extremity. There are no indications of articular condyles, but the end has more the appearance of having been covered by cartilage.

In front of the femur are two long bones lying side by side (Plate 34); they are imperfect, a fracture of the stone having passed across both of them, but still sufficient is preserved to show their length, and that one is a little stouter than the other; they each measure 60 millims. in length, and, as this is considerably longer than the radius and ulna, they doubtless are the tibia and fibula.

Near the ends of these two bones are some scattered fragments, evidently, from their position, parts of the hind foot.

Affinities.

The structure of the skull of this specimen conforms so precisely to the type of *Gordonia* that it must be included in that genus. And there is so close a resemblance to *G. Traquairi*, except as regards size, that there is great difficulty in pointing out any satisfactory characters for its specific distinction. Unfortunately, *G. Traquairi* has no limb bones sufficiently perfect for comparison. The greatest differences between the two skulls seem to be the more elongated orbit of the present specimen, the larger size of its spindle-shaped area, the less depth of its nasal region, the less development of its parietal crest, and its much smaller size. These differences, with the exception perhaps of the first, may be due to age; and it will be well therefore, in the absence of more definitely distinctive characters, provisionally to refer the present specimen to *Gordonia Traquairi*.

5. Gordonia Huxleyana (Plate 30, figs. 6–9).

General Remarks.

The third specimen from Cuttie's Hillock sent to me from the Elgin Museum is contained in three pieces of sandstone, and consists of the impressions of similar parts of a skeleton to that last described—namely, parts of the skull, vertebral column, ribs, and pectoral arch, but representing a somewhat larger animal.

Description.

The Skull is in a very dilapidated condition, the scattered fragments of it, remaining

near the anterior part of the spinal column, being too indistinct to give any idea of its original form.

The Vertebræ and Ribs are in much the same condition as those of No. 4 specimen. A few neural spines may be seen, and below them crushed fragments of what are most probably neural arches. With regard to the vertebral centra, there is the same uncertainty here as in all the other specimens. Some of the fragments present are undoubtedly neural arches; others may possibly represent parts of deeply biconcave centra; but this is very uncertain. Numerous ribs are to be seen at the sides of the vertebral column, but they present no special characters; they are rather flatter than those of No. 4 specimen, and perhaps resemble more nearly those of No. 3.

Pectoral Arch. Scapula.—Parts of both scapulæ are preserved in this specimen; but the right one is the more perfect (Plate 30, fig. 7). It closely resembles that of specimen No. 4 (Plate 35, fig. 3), and similarly has the outer convex surface best preserved; part of the inner surface, however, is also present, and this shows the same thickening and ridge upon the inner side of the glenoid process that was noticed in *G. Huxleyana* (Plate 30, fig. 2A). In general form it agrees best with the scapula No. 4, but that of *G. Huxleyana* may have had a similar outline when perfect. The greatest length of this scapula is 72 millims.; its width at the upper extremity is 35 millims., and a little above the acromion process 19 millims.; below this process there is a rapid decrease. The glenoid region is incomplete, but no doubt it expanded somewhat as in the other examples.

Clavicle.—A clavicle has been described in *G. Huxleyana*, and a similar bone is lying just in front of the scapula in the present specimen; but in this instance it is the concave side of the bone which is shown (Plate 30, fig. 6). This clavicle is a thin plate, broad at one end and narrowing to a rod at the other, the rod being the continuation of a thickened edge which forms the convex margin of the bone. The greatest length is at least 52 millims.; the broad plate which occupies about half this length is 14 millims. wide.

Humerus.—Impressions of both humeri are preserved, and, as the cavities have been split open, I have been able to get casts of both surfaces, and thus the form of the entire bone is better shown in this specimen (Plate 30, figs. 8 and 9) than in any of the others. The proximal and distal ends have the characteristic Anomodont expansion; the deltoid crest is large, but has not the same proportionate extent as in specimen No. 4, neither has it the same angularity. The articular surfaces seem to have been cartilaginous, and this accounts for the slightly different form of the terminations in the two bones. The greatest length of the humerus is 71 millims., the width of the distal extremity 42 millims., and that of the proximal extremity, including the crest, 36 millims. On the front or palmar aspect (fig. 9) the inner part of the proximal half is rounded, and forms a strong support to the articular head, on the inner side of which there is a distinct tuberosity, while the outer part is concave,

especially near the head, from the outer side of which the well-developed deltoid crest extends forwards and outwards. This crest is not angular, like that of specimen No. 4 (Plate 35, fig. 4); it is widest at its upper part, it then becomes gradually less as it curves downwards and inwards; crossing the front of the bone, it forms the bridge over the entepicondylar foramen, and ends near the inner side of the distal extremity. The distal half of the palmar surface is concave on the outer or radial side, and convex on the inner, just below the entepicondylar foramen. The inner and outer condyles are prominent. The back of the humerus (Plate 30, fig. 8) is strengthened by a stout buttress, which extends from the proximal articulation downwards and outwards to the outer side of the distal extremity; its upper part is continued forwards and outwards to form the deltoid crest, while on the inner side of its lower half there is a triangular concave space. Although the outlines of these humeri are well shown, their thickness is uncertain, the cavities they have left in the stone having been much compressed.

Affinities.

As the skull and vertebral column are too fragmentary to give any characters, it is only the scapula, clavicle, and humerus which are available for comparison; and, in the absence of any opposing characters, these are sufficiently like those of specimens Nos. 2 and 4 to justify their being provisionally included in the same genus, *Gordonia*.

The angular deltoid crest of No. 4 differs so much from the crests of the present humeri that they cannot fairly be included in the same species; on the other hand, the scapula of No. 2, *G. Huxleyana*, in so far as it is preserved, agrees pretty well with that of the present specimen, although it seems to be more stoutly built, and the same may be said of the clavicle and portions of humeri; but these differences may quite well be due to the impressions of the bones in the present instance having been compressed, and thus giving them a less robust appearance. The two forms agree very nearly in size, and it is deemed better provisionally to include the present one in the same species, *G. Huxleyana*, until evidence for its separation is forthcoming.

6. Gordonia? (Plate 33, fig. 5.)

The fourth specimen from Cuttie's Hillock, belonging to the Elgin Museum, is the most imperfect of the series described in this paper. It consists of a series of impressions of the upper surfaces of from eight to ten vertebræ, to which are attached long lateral processes, nearly all in place; and, at the anterior part, some indistinct indications of bones, the interpretation of which remains uncertain. The entire length of the specimen, as preserved, is about 7 inches (180 millims.).

A cast of this specimen exhibits the upper surfaces of the vertebræ, and one or two are sufficiently distinct to show that they have a quadrate form, are rather wider than

long, and a little narrower anteriorly than posteriorly. The neural spine is indicated by a tubercle placed at the hinder part between the bases of the post-zygapophyses. The most anterior vertebra which can be clearly distinguished is tilted a little out of place; it is certainly larger than the one succeeding it, and there is no doubt in my mind that the series gradually decreases in size towards the hinder end, the impressions, however, are too much worn to allow one to speak very positively. The first vertebra measures approximately 12 millims. in length from the pre- to the post-zygapophysis; in width it is 13 millims. at the front and 14 millims. at the back. The corresponding measurements of the second vertebra are—length 10·5 millims., width in front 11·5 millims., at the back 12·5 millims. The remaining vertebræ of the series are crowded together, and partly pushed one over the other.

On each side of the vertebræ are to be seen long slender processes directed backwards, and so regularly arranged as to impress one with the belief that they were processes fixed to the vertebræ, and not loosely attached ribs, which are usually found curving backwards in quite another fashion. I cannot be certain as to the point of attachment of these processes, but it seems to have been near the hinder end of each vertebra. The diminution in size of the posterior vertebræ and the presence of these transverse processes leads to the inference that they belong to the caudal region, and that somewhere in front of them the pelvic girdle would be found. As a matter of fact portions of bones have been uncovered in this region, but, unfortunately, nothing that can be definitely assigned to any part of the pelvis or limbs.

These caudal vertebræ are of Lacertilian type, and the question naturally arises, can they be referred to either of the skeletons above described, or to any of the forms known to occur in the Elgin Sandstone of other localities. They are too small for any known example of *Hyperodapedon* and much too large for *Telerpeton*, but would agree in size with some of the specimens here included in the genus *Gordonia*, and might have belonged to such a form as *G. Duffiana*. It seems quite possible that it may really be part of the specimen so named (Plate 31), but there is no information to justify this supposition, and for the present this specimen is simply referred to *Gordonia*.

7. Gordonia Juddiana, *sp. nov.* (Plate 35, figs. 6 to 8.)

General Remarks.

Among the specimens sent to me from the Elgin Museum were two, to which Dr. Gordon specially called my attention because they contained pebbles similar to those found in the basal "Conglomerate bed," described by Professor Judd (20), and presumably, therefore, were obtained from low down in the quarry near to this basal bed.

The first of these two, which I propose now to describe, consisted of a single block externally resembling in texture most of the others from this quarry; but the inner

portion, immediately surrounding the fossil was, as I subsequently found, composed of much finer and softer sandstone. On one surface of this, irregular impressions and holes could be seen, some of which passed deeply into the block; and partly by cutting away the matrix and partly by splitting open the cavities, I was enabled to ascertain that these impressions represented a nearly perfect skull, slightly distorted by pressure, intermediate in size between that of No. 3 and that of No. 4. The casts taken from these cavities (Plate 35, figs. 6, 7, 8) exhibit, not only the upper and side aspects of the skull; but also the greater part of the palate and occiput; the latter including, for the first time among these Cuttie's Hillock specimens, the basi-occipital and foramen magnum.

Description.

Skull, Upper Surface.—The general structure of this skull is undoubtedly the same as in those already described, and being long and narrow when seen from above (fig. 6) resembles most nearly the skulls of No. 1 and No. 4. The distortion which the specimen has undergone prevents the true proportions being so clearly seen as in previously described specimens; the left orbit, and more especially its hinder boundary, is thrown somewhat backwards, while the right one is pushed forwards. The inter-orbital and inter-temporal regions are narrower and the pineal fossa is smaller than in No. 4 specimen, although the latter is really a much smaller skull. The frontal region is obscured, but it was evidently not depressed between the orbits. The premaxillary region is pointed anteriorly and much thickened between and above the nasal apertures by a greater deposit of bony matter than is seen in any of the other specimens from Cuttie's Hillock, and makes a slight approach to the hyperostosis seen in some of the South African forms of Dicynodonts.

Side View.—The thickness of the premaxilla (fig. 7) accompanied as it is by a similar hyperostosis of the nasal and lachrymal bones, encroaches upon the nasal aperture, which, in consequence, seems sunk in a deep pit. The maxilla bears a tooth that projects perhaps 5 millims. from its alveolus; it is directed more distinctly downward than in No. 4 specimen, and does not reach quite so far forwards as the nasal aperture. The elongation of the orbit is, to some extent, at least, due to distortion. The temporal bar most nearly resembles that of *G. Traquairi*, but differs from it and from all the specimens here noticed in having the broad hinder plate convex below instead of concave. The downward process of the squamosal is large and similar in form to those of specimens 1 and 4.

Palate.—The general structure of the palate is like those previously described; but it is narrow, even for so slender a skull, and this is not altogether due to the compression of the specimen, but seems to be a natural peculiarity, for the various parts, such as the quadrate processes, are remarkably slender. The union of the pterygoid with the base of the skull is clearly shown by this specimen, although it has been necessary to divide them in order to display other parts.

Back of Skull.—The occiput is well shown (fig. 8) and is found to possess two large post-temporal fossæ on each side, thus differing from any Dicynodont skull hitherto described. The occipital plate is, as in other Dicynodonts sunk in the hollow formed by the backwardly directed squamosal bones. No sutures can be traced and the bones can only be spoken of from the position they occupy. The occipital condyle is tripartite, the two segments formed by the exoccipitals being each much larger than the median, basioccipital segment. The lateral segments of the condyles extend upwards on each side of the foramen magnum, and being more prominent than the small median one, at first sight there appears to be a double condyle. The lower surface of the basioccipital in front of the condyle is concave. From the outer side of the condyle and lower part of the foramen magnum the bone extended outwards and downwards, forming a process abutting upon the quadrate, and is pierced by a foramen close to the condyle. In *Iguana* there is a similar process, but it does not reach the quadrate and it is chiefly formed by a process from the basioccipital. In the present specimen the larger size of the exoccipital element of the condyle and the position of the large foramen makes it highly probable that the process in this case is formed chiefly by the exoccipital. From the upper part of the foramen magnum a second process extends outwards and expands after having passed over a ridge formed apparently by the squamosal. This process abuts upon the inner side of the parieto-squamosal crest a little above the level of the temporal bar, but its true relations to the surrounding bones cannot be seen; it occupies precisely the position of the upper lateral process in *Iguana*, and like it, separates the two large post-temporal fossæ; it may still further have resembled this process in *Iguana* by being formed chiefly by opisthotic bone, and doubtless the foramen ovale was situated in the hollow just below it. A careful examination of the impressions and casts of this fossil has convinced me that both these post-temporal fossæ opened freely into the temporal vacuity.

The foramen magnum has the form of a reversed key-hole, being constricted in the middle and wider below than above. Owing to the abrasion of its margins it now appears rather too large. In its present condition it is 14 millims. high, and its greatest width is 7 millims.

Over the foramen magnum there is a depression of the bone succeeded by a prominence, above which there is a notch formed by the diverging parieto-squamosal crests.

The greatest length of this skull is 118 millims., the width across the temporal bars about 70 millims., the least inter-orbital width is 16 millims., and the least inter-temporal width about 14 millims. The pineal fossa is not clearly defined but must have been about 7 millims. long and scarcely 5 millims. wide. The height of the skull from quadrate to crest is 53 millims., but this may have been altered by the distortion of the specimen.

The lower post-temporal fossa is represented in most Dicynodont skulls, by a smaller aperture than in the present specimen, as, for example, in Sir R. Owen's

figures (38, Plate 46, Plate 50, fig. 3, and Plate 64, figs. 6, 9). In *D. lacerticeps* the same authority (38, p. 30, Plate 23, fig. 3) describes three vacuities on each side of the occiput, of these the lower one, marked *o*, seemingly corresponds with the lower one in the present specimen, and probably leads to the auditory foramen; that marked *m* seems to occupy the position of the upper fossa, but it is very indistinct; the one marked *n* finds no counterpart in the present specimen, but may, like the small one figured by Professor COPE in his *Lystrosaurus* (8, p. 209, F.O.), represent a part of the large lower fossa of *Gordonia*, and may lead to the auditory organ, but it can scarcely be the true fenestra ovale as suggested by Professor COPE.

The occiput of No. 3 specimen seems to have the same structure as in the present skull, but the parts are more obscure and the post-temporal fossæ are proportionately a little smaller.

The Lower Jaw is indicated by a cavity to be seen below the palate, but as its anterior extremity is wanting, and the opening of the cavity would probably injure other parts of the specimen, this has not been attempted.

Affinities.

The close resemblance which this specimen bears to the *Gordonia* above described leaves no doubt as to its generic identity with them, and the structure of the occiput is so unlike that of any of the South African Dicynodonts that it affords additional grounds for the generic separation of these Elgin forms.

The distortion of the specimen prevents so close a comparison with others as could be desired, nevertheless, the positive differences seem to me sufficient to prevent its reference to any of them. In its narrowness in proportion to length this skull resembles specimens Nos. 1 and 4, but it differs from both these in the thickening of the bones above the nasal region, in the small external nasal opening, in the canine tusk being further back and more downwardly directed; also, the pineal fossa is proportionately smaller. It further differs from No. 1 in not having the same development of the parieto-squamosal crest, and this can scarcely be due to age, which the much smaller size of the present specimen might seem to indicate, for the excessive development of the bones of the nasal region in the present skull shows that it must have been an adult animal. With the skulls of specimens Nos. 2 and 3 the present one agrees in the form of its parieto-squamosal crest, but it differs from them in all those particulars which separated it from Nos. 1 and 4, and, in addition, it is proportionately narrower.

These differences seem to me amply to justify a specific separation of this form, and I purpose associating it with the name of Professor JUDD, who has done so much for Scottish geology, and was among the first to call attention to these Dicynodonts form Cuttie's Hillock. I propose, therefore, to name this specimen *Gordonia Juddiana*.

Geikia, *gen. nov.*

8. GEIKIA ELGINENSIS, *sp. nov.* (Plate 36.)

General Remarks.

The last of the series of Dicynodont remains from Cuttie's Hillock, belonging to the Elgin Museum, remains to be described. It is the impresssion of a skull in a block of sandstone which, like the specimen No. 7, includes pebbles similar to those of the basal conglomerate, and was probably obtained from low down in the quarry and near the base of these Triassic beds. The sandstone in this case is harder and coarser, making the development of the specimen correspondingly more troublesome. As the block was broken through in two directions, obliquely to the skull, the interpretation of the parts as they were exposed was rendered very uncertain, and it was not until the casts of the several parts were joined together that anything like a correct idea of the outward form was obtained. The specimen proved to be a skull of an altogether different character from that of *Gordonia*, as will be at once seen by a glance at the figures.

Description.

This skull has been a little distorted by oblique pressure, which has given a slightly different appearance to the two sides (Plate 36, fig. 1), but its general form is very obvious, and its proportions are seen to be entirely different from those of *Gordonia*. The greatest length from the tip of the muzzle to the middle of a line drawn across the hinder extremities of the squamosals is 105 millims., while the width across the temporal arches is about 125 millims.; the greatest height of the parieto-squamosal crest above a line joining the lower extremities of the quadrates would be about 80 millims. No sutures are shown, and consequently the relations of the various elements cannot be seen. The surfaces of the bones in the frontal, premaxillary and maxillary regions are rugose, but in other parts they are comparatively smooth.

Seen from above (Plate 36, fig. 1) the temporal fossæ appear almost round, the inter-temporal space is wide, 32 millims., but the inter-orbital area is remarkably so, being nearly 50 millims. at its hinder part and increasing in width towards the front, where it is 60 millims. This inter-orbital area is one of the most striking features of this extraordinary skull; each side of it is raised into a prominent ridge, which passing forwards and outwards from the post-orbital bar, overhangs the orbit, and terminates anteriorly in a thickened horn-like prominence above the nasal opening, and forms the anterior angle of the orbit. The space between these ridges is a wide semiquadrate trough 20 millims. deep. From the hinder end of each ridge the post-orbital bar passes directly outwards, it is flattened from before backwards, and curving

downwards joins the temporal bar. Starting from the same point at the hinder end of the frontal ridge, the parieto-squamosal crest sweeps backwards and outwards very much as in other Dicynodonts; the two crests do not meet in the middle line but leave a space of about 14 millims.; near the front of this space the pineal fossa might be expected to be seen, but unfortunately an oblique fracture crosses this part and renders it obscure.

The premaxillary region forms a small beak-like prominence at the front of the specimen (fig. 1) which is set at an angle of about 55° to the top of the skull, as shown in a side view (fig. 2). It is flattened anteriorly (fig. 3) where it is marked by three ridges, one median and one at each side, the latter separating the front from the lateral aspects of the muzzle.

Side View.—Seen from the side (fig. 2) the pedicle for the lower jaw is very long, but on the whole is very similar to that of *Gordonia*, excepting that throughout its length it is turned more directly forwards. Probably this pedicle is formed as in other Dicynodonts chiefly by the squamosal, which also constitutes a large part of the temporal bar as it passes forwards to the orbit. The sub-orbital bar is directed inwards and a little forwards, its lower margin being continuous with the lower edge of the maxilla, which is directed downwards and forwards to end in a point evidently corresponding with that in *Gordonia* which carries the tooth; but there is no tooth to be seen here, and the thinness of the maxilla at this part makes it unlikely that there was any tooth, but points rather to its having had a horny covering. The orbit looks outwards and forwards, it appears almost triangular when seen from the side (fig. 2); its upper margin is nearly straight and meets the post-orbital bar almost at a right angle. The sub-orbital bar, in this view, seems to form an almost straight margin extending from the lower end of the post-orbital bar to the horn-like anterior end of the frontal ridge. However, when seen more from the front (fig. 3), the lower boundary of the orbit is found to be curved, and to be continued upwards by a sharp edge, probably formed by the maxilla, lachrymal, and prefrontal bones, but no sutures mark the limits of these elements. In front of and below the orbit there is a somewhat quadrate area in which the surfaces of the bones are marked by rugosities; these are best seen on the right side (figs. 2, 3). One angle of this area is directed downwards and forwards, it forms the anterior extremity of the muzzle, and is doubtless the premaxilla. A second angle directed downwards is the tooth-like point of the maxilla. The thickened angle directed upwards, is the horn-like prominence possibly formed by the prefrontal. The hinder angle is that at which the sub-orbital bar joins the maxilla The margin between the points of the maxilla and premaxilla is deeply indented; it forms a sharp cutting edge and was in all probability covered with a horny armature; this edge, with a portion of the maxilla behind its point, formed the upper oral margin. The edge uniting the premaxilla and the prefrontal (?) is likewise indented, and a little behind the angle thus formed there is a deep fossa in relation to the anterior narial opening, but the true aperture seems

to be restricted to a small part near the anterior margin, and cannot be seen very clearly on account of the matrix.

Passing backwards and inwards from the maxilla is the pterygoid, which has much the same form as in *Gordonia*, but is relatively shorter and deeper. This will be alluded to again when describing the palate.

Front view.—Seen from the front (Plate 36, fig. 3), the skull shows some of its peculiarities in a striking manner—the large inter-orbital trough, with its ridges terminating in front and above the orbits, as horn-like prominences, which overhang the widely-separated external nasal openings. The flattened and triple-ridged premaxillary area is also best seen in this aspect. The orbits, as in the side view, appear to be nearly triangular, while below and in front of them the maxillæ extend downwards to form the pair of prominent but toothless projections. The right squamosal and quadrate are seen in this view, those of the left side are partly wanting.

Palate.—The palate has essentially the same structure as it has in *Gordonia* and other Dicynodonts. The hinder part, where it joined the base of the skull, is broken away, but the front part, although somewhat distorted, gives full information as to its general structure.

The roof of the front part of the mouth is deeply vaulted, and forms an arch extending backwards some little way beyond the tooth-like maxillary processes. This arch is formed by inwardly-directed plates from the maxillary and premaxillary regions, and it is highly probable that it was terminated posteriorly by the palatines, which may here, as in *Gordonia*, have formed the greater part of the boundary of the posterior nares. The pterygoids may, perhaps, have taken part in the completion of the hinder boundary of this vault, while the thickened ridge in the middle line of its hinder two-thirds occupies the position of a vomer. Above this ridge there was an ethmovomerine septum dividing the nasal chambers. The form of the posterior narial opening is hidden, but it is pretty clear that its front margin was situated about 10 millims. behind the maxillary tooth-like process, and was divided by the ethmovomerine septum. The pterygoids are deeply arched where they rise to cover over the posterior nares, and at the hinder part of this arch they are pierced by two narrow openings which are separated above by a median septum, and occupy a similar position to the pterygoid foramina of *Gordonia*. The pterygoid is preserved for 45 millims. behind the maxilla, but beyond this the palate and base of the skull is broken away. However, the quadrate processes of the pterygoids were traced on both sides to the neighbourhood of the quadrates.

Back of Skull.—The back of the skull is very wide and flat (Plate 36, fig. 4), the squamosal crests above, and the quadrate pedicles at the sides projecting but little beyond the plane of the occiput. The foramen magnum is large and oval, but its lower part is imperfect, resulting from the breaking away of the articular condyle, and it may be that when perfect, it was not quite so large as it now appears to be. The basioccipital is much broken, but on the right side there is a prominence indi-

cating a downwardly-directed process in the position of the hypapophysis present on each side in most of the South African Dicynodonts. Each exoccipital is pierced by a large foramen just in front of its condylar portion, it extends outwards and downwards as a large process and abuts upon the quadrate region of the pedicle. There is no trace of a suture to separate this process from the exoccipital. Immediately above the process is a large post-temporal fossa, evidently corresponding with the lower one seen in *Gordonia Juddiana* (Plate 35, fig. 8), and to that present in some of the South African specimens figured by Sir R. OWEN (38, Plate 23, figs. 3 and 10, and Plates 46 and 50), and Mr. LYDEKKER (24, pp. 28, 34, 41); it does not correspond with those marked *m* and *n* in Sir R. OWEN'S figure (38, Plate 23, fig. 3), but may in part with that marked F.O. by Professor COPE (8, p. 209).

The upper half of the occiput is formed by a plate of bone confluent with the squamosal ridges on each side and presenting no sutures to indicate what part each element takes in its formation.

Lower Jaw.—The impression of the lower jaw is well preserved, showing parts of both rami, and most of its structure very distinctly (Plate 36, fig. 5); the symphysis and articular end of one ramus being entire. Its greatest length is 88 millims.; the characteristic fossa on the outer surface is 33 millims. long. There is a broad, thin plate of bone passing downwards and inwards from the lower margin, similar to that which has been described in *Gordonia*. This plate seems to be connected with the lower and hinder part of the dentary element, which appears to extend far back, this, however, is by no means certain. The two rami are co-ossified at the symphysis, which is wide, especially below, and oblique as seen from the side. The whole of the symphysial region is rugose, and the upper front part of each ramus is produced into a warty, tooth-like prominence; while the upper margin of each ramus, for some distance behind the prominences, is flattened, leaving however, a groove between the two sides, which may have been connected by bone for 20 millims. from the front. The appearance of the whole symphysial region favours the supposition that it was covered by a horny beak, produced in front into a pair of large horny teeth. The least depth of the jaw, just behind the symphysis, is 20 millims.; from this the upper margin rises to above the middle of the lateral fossa, and then rapidly sinks to its former level and curves backwards to the saddle-shaped articular surface. The angle of the right ramus curves downwards and forwards, that of the left side is not shown.

The vertical extent of this lower jaw is proportionately less than in *Gordonia*, although the height of the skull might lead one to expect that it would be greater.

Affinities.

Although the external form of the skull is unlike any Dicynodont hitherto described, yet the formation of the palate, of the occiput, of the maxilla, and of the

lower jaw, are sufficient to establish its close alliance to the forms which are included in this group. The great width of this skull in proportion to its length, and the angle formed by the meeting of the premaxillary and frontal regions, point to *Ptychognathus* as its nearest ally. The occiput of *P. declivus* of Sir R. Owen (38 Plate 46, fig. 1), is very like that of the present specimen (Plate 36, fig. 4), and the great width between the orbits is likewise very similar in the two forms. The frontal region is somewhat hollowed in some species of *Ptychognathus*, although not to the same extent that it is in this Elgin fossil.

On the other hand, while in *Ptychognathus*, the premaxilla and maxilla are much produced, and the latter bone bears a large tusk, in the present specimen there are no tusks, and these bones are comparatively short. The great size of these bones in the former case is obviously correlated with the largely developed tusk, but this does not altogether account for the differences observable. The similarity between the skulls of some species of *Dicynodon* and *Oudenodon*, excepting the want of tusks in the latter, led Sir R. Owen and others to suggest the possibility of this being merely a sexual character; and the present toothless form seems to hold a somewhat similar relation to *Ptychognathus*. However, the evidence has not been found sufficient to justify the union of the two genera last named, and still less are we in a position to unite this Elgin toothless skull with the large-tusked and long-snouted *Ptychognathus*, more especially as the latter genus has not been found in the Elgin rocks. There will be no question, therefore, as to the desirability of establishing a new genus for the reception of this fossil, and I propose to associate it with the name of Sir Archibald Geikie, the Director-General of the Geological Survey, while specifically it will be convenient to suggest the neighbourhood where the specimen was found; it will therefore be known as *Geikia Elginensis*.

General Remarks on Elgin Dicynodonts.

The very close resemblance in point of structure between the skulls of all the specimens above referred to *Gordonia* is a sufficiently clear indication of their generic identity; while the characters which they possess in common show unmistakably that they belong to the Dicynodontia, and are most nearly related to *Dicynodon* and *Oudenodon*. The small size of the teeth seems to indicate an intermediate position between these two genera, but as the absence of teeth is the chief character by which *Oudenodon* is separated from *Dicynodon*, the Elgin specimens would seem to be most nearly related to the latter. Nevertheless these Elgin forms present, as I think, distinctive characters which justify their being placed in a separate genus, for which I have proposed the name *Gordonia*.

Gordonia is characterized by the presence of two post-temporal fossæ on each side of the occiput, by the comparative slenderness of all the bones of the skull, by the

small size of the maxillary tusk, and probably by the elongated spindle-shaped parietal area enclosing the pineal fossa.

The scapula of *Gordonia* is very similar to the one referred by Sir R. OWEN (38, Plate 69, fig. 9) to *Kisticephalus*—that is to say, it is a flattened bone with a constricted neck above the glenoid cavity, and a distinct acromion process; the skull of the latter genus, however, is quite unlike that of *Gordonia*, more especially in the greater width of its parietal region.

The humerus of *Gordonia* has the characteristic wide extremities and narrow median portion, with a large deltoid crest and entepicondylar foramen.

The ilium is a broad flattened plate which thickens in the region of the acetabular cavity, and has the greater part of its mass in front of that cavity. Its extension behind the acetabulum differs somewhat in the two forms in which it is preserved, being greater in *Gordonia Huxleyana* than in *G. Duffiana*, unless in the latter it has suffered mutilation. The sacrum, shown only in one specimen, included not less than three or perhaps four vertebræ.

We have yet to learn the character of the vertebral centra, as none of the specimens give any definite evidence on this point, and the seeming absence of the centra, although the neural arches are present, is, to say the least, remarkable.

The fragment of a skull described and figured by Professor HUXLEY (16) from the Panchet stage of the Gondwana beds of Central India as *Dicynodon orientalis*, very closely resembles *Gordonia*, more especially *G. Duffiana*, and it seems far from unlikely that they may prove to be generically identical. Mr. LYDEKKER (23 and 25) has referred this Indian specimen, with others from the same locality, to the genus *Ptychognathus*, but in so far as this particular fragment of a skull is concerned I am unable to accept this allocation.

Professors COPE (8) and SEELEY (43) have discussed very fully the structure of the Dicynodont skull, and the Elgin specimens are not in a condition to contribute much to a knowledge of its more intimate structure; still a few points may be noticed upon which they seem to throw some additional light. The structure of the frontal and parietal regions of the skull in *Ptychognathus* (*Lystrosaurus*), as described by Professor COPE, and the form of these parts in *Dicynodon*, as restored by Professor SEELEY, are quite unlike the arrangement found in *Gordonia*, while the fragment of a skull from India, above alluded to, agrees very well with the Elgin genus. Although I am disposed to think some modification of Professor SEELEY's restoration of *Dicynodon* will be found to be necessary, yet it seems to me probable that the different genera of Dicynodontia will be found each to present a peculiar modification of the bones of the fronto-parietal region. These Elgin specimens give no information which would support the idea that the bone, extending between the exoccipital and quadrate regions, is the homologue of the malleus, but rather point to this bone being merely an extension of the exoccipital, and possibly of the basioccipital, such as is seen in the skull of the *Iguana*, and the presence of a second post-temporal fossa, as shown

in *Gordonia Juddiana* (Plate 35, fig. 8) corresponds so well with the structure of this region in *Iguana* and other Lacertilia that I am constrained to believe they are constructed on the same plan. And, further, that in most, if not in all, Dicynodonts hitherto described, the upper post-temporal fossa is closed in by bone, while the lower one, being that which leads to the foramen ovale, is always found open.

The arrangement of the bones forming the posterior nares in *Gordonia*, and probably in all other Dicynodonts, is exceedingly like that found in the Turtle, the palatine bones forming tubular passages which open upwards and forwards into the nasal chambers. The pterygoid foramen, present apparently in all *Dicynodonts*, just behind the posterior nares is not found in the Turtle.

All the lower jaws of *Gordonia* which have been found are characterized by the broad thin plate projecting downwards from the lower margin; this does not appear to have been noticed hitherto in Dicynodonts, which is the more remarkable, as it occurs also in *Geikia*, the ally of *Ptychognathus;* it seems likely, therefore, to be a characteristic of Dicynodonts generally.

Before proceeding with the description of a specimen belonging to a very different group of Reptiles, it may be well to give briefly the specific characters of the Cuttie's Hillock Dicynodonts.

Gordonia Traquairi.—Specimen No. 1, will be the type species of the genus; it is characterized by its narrowness in proportion to its length, by its great height from quadrate to crest, which is three-fifths of the length from the back of the squamosal to the point of the tusk. The parieto-squamosal crest is strongly developed, the spindle-shaped area is small, and the inter-orbital space forms a deep concavity especially towards its hinder part.

The small specimen, No. 4, is provisionally referred to *G. Traquairi*, and if this association prove correct, the humerus of this species will be distinguished by its angular deltoid crest.

Gordonia Huxleyana.—Specimen No. 2, for which I propose this name, is distinguished by the greater proportionate width of the skull, not only across the temporal arcades, but also between the orbits. The skull is likewise more depressed, its height from quadrate to crest being about half the length from the back of the squamosal to the point of the tusk. The upper surface is flatter than in *G. Traquairi* and does not exhibit the same inter-orbital concavity.

To *G. Huxleyana*, specimen No. 5 is provisionally referred; the humerus of this specimen having a rounded crest, is quite unlike that of the smaller form referred to *G. Traquairi.*

Gordonia Duffiana.—The type of this species is specimen No. 3. The skull is proportionally wider at all parts than that of *G. Huxleyana*, and consequently differs still more in this particular from *G. Traquairi;* it also differs from the latter species in the large size of the spindle-shaped area and the flatness of the upper surface.

The two extremities of the humerus being at right angles to each other, is an important distinction between this species and *G. Huxleyana*.

Gordonia Juddiana.—The specimen for which I have suggested this name is a skull which agrees with that of *G. Traquairi* in being proportionally narrow, but it differs in having only a slight parietal crest; the bones of the nasal region are so thickened that they encroach upon the small nasal aperture; the tusk is placed a little further back and points more directly downwards. The pineal fossa is smaller than in any of the other specimens. This skull seems to be as much depressed as in *G. Huxleyana*, but this may be owing to distortion.

Geikia is established for the reception of a skull presenting most of the characters which distinguish *Ptychognathus* from *Dicynodon*; the inter-orbital and inter-temporal spaces are very wide, the premaxillary region bears three ridges on its upper surface, which is set at a considerable angle to the frontal, or inter-orbital region, and the wide, flattened occiput shows only the lower post-temporal fossæ. On the other hand *Geikia* differs from *Ptychognathus* in having a comparatively small development of the premaxillæ and maxillæ, so that the prenasal portion is as small as in *Dicynodon*, but there are no teeth.

Until other species of this genus are discovered, the above characters will suffice for the distinction of this genus and species.

B. PAREIASAURIA.

Elginia, *gen. nov.*

9. Elginia mirabilis, *sp. nov.* (Plates 37–40).

General Remarks.

The Reptilian skull now to be described is one of the most remarkable fossils which have come to light for many years, and reminds one more of *bizarre* Reptiles discovered in North America than of anything which has been found on this side of the Atlantic. The specimen, in common with the others described in this paper, was obtained from the Elgin Sandstone of Cuttie's Hillock Quarry, and, thanks to the foresight and energy of Mr. Linn and Mr. B. N. Peach, of the Geological Survey, is now the property of the Survey. Unfortunately, only the skull of this creature has been recovered; it is about 6 inches in length, and, like all the remains found in this quarry, is in the condition of a hollow mould, all the bone having disappeared.

The most striking peculiarity of this skull is the extraordinary development of bony horns or spines with which the surface is ornamented. There are sixteen of these horns on each side, varying in length from one-fourth of an inch to nearly three inches, besides three small bosses on each side of the parietal region; also in the middle of the forehead there is a rounded spine, and near the bases of the two nasal

horns a small median protuberance, making in all forty of these bony outgrowths, which, although comparatively smooth, exhibit longitudinal grooves and striations indicative of their having been invested with horn. The surface of the bones between the horns is deeply pitted as in the skull of a Crocodile.

The block of stone containing this specimen has been split open in such a way as to peel off, as it were, the greater part of the outer surface of the upper and side walls, leaving, like a kernel, a nearly perfect cast of the inner surface of the bones, which reproduces the general form of the skull; but it is, of course, the pieces that have been peeled off which contain the impressions of the true outer surface, and these, with one or two exceptions, have been preserved. Parts of the right parietal region, and of the left cheek, are wanting; but fortunately, with one exception, what is wanting on one side is preserved on the other.

The first step in working out this specimen consisted in fitting together the fragments which made up the outer surface, and some of the parts, still attached to the main block, had to be cut away and cemented in their proper places on the outer shell. The preparation of casts from these impressions proved to be a more tedious process than with previous specimens, on account of the many separate pieces which had to be made before the whole could be fitted together. The outcome of this first part of the work was the reproduction of the external form of the skull, as shown in Plates 37 and 38.

The front part of the internal cast, or kernel, had been broken through in such a way as to expose the impression of much of the palate, but in order to trace the hinder part of this region, and the base of the skull, it was necessary to cut away, piece by piece, the left cheek with the underlying parts, and although these pieces did not always come away so satisfactorily as could be wished, they have now been cemented together and can be replaced, very little having been lost in the process. The time bestowed upon the development of the deeper parts of this skull has been fully repaid, as the casts made from them reveal the structure of the palate, the base of the skull, and the occiput, together with a large part of the brain-case. A knowledge of these parts, and of the dentition, which was afterwards exposed, was very necessary for the elucidation of the affinities of this new Reptile.

Description.

The Skull.—The right side of the skull retains very nearly its natural form, while the left side has been distorted by the pressing forwards and outwards of the large horn, with the cheek and sub-orbital region; the general contour of the head, however, is but little interfered with. The only vacuities seen on the outer surface are the orbits, the pair of nasal apertures, and the pineal fossa. The bony continuation from the maxilla to the inferior quadrate region shows that the lower temporal arcade is complete, but both the lower and upper temporal fossæ are as entirely

covered in by bone as in the Green Turtle. The outer surface of all the bones, except the premaxillæ, are deeply sculptured with rounded pits, similar to those of the Crocodile, which seem for the most part to radiate irregularly from the spines and bosses. The spines, as already noticed, are longitudinally striated, and this comparatively smooth surface ends abruptly at the lower part and forms a definite edge where it joins the deeply-pitted general surface of the bones. In both upper and side views the skull is, roughly speaking, triangular; in the former view (Plate 38) the posterior margin forms the base, the angles of which are produced into the largest pair of horns, while in the latter view (Plate 37) the apex of the triangle is truncated by the deep and almost vertical muzzle.

The sutures are difficult to trace, but on the cheek and nasal regions they are indicated by deeply serrated lines, corresponding with the meeting of the radiating pittings; in other places they are indistinct. A careful examination of the inner as well as the outer surfaces, however, has led me to indicate by lines what I believe to be the general direction of many of the sutures.

As the skull of the South African *Pareiasaurus* seemed to resemble this fossil more nearly than any other form, I endeavoured to trace a similar arrangement of the bones to that described by Professor SEELEY (41, 44), but in this I have been only partially successful, although on the whole it is tolerably certain that the two skulls are constructed upon the same plan.

A front view of this skull shows the pair of large nasal apertures looking almost directly forwards, and completely separated by the upward processes of the two premaxillæ, which are seen to be separated throughout their vertical extent, a distance, from the dental margin to the bases of the nasal horns, of about 40 millims. The external surface of each premaxilla is comparatively smooth, and as this smoothness ceases suddenly on each side near the hinder part of the nasal opening, this point probably marks the junction with the maxilla, but no suture can be seen. The nasal apertures are nearly round, and each is about 22 millims. in diameter, the upper and inner part alone being angular, and here they are surmounted by a pair of coarsely striated horns probably outgrowths of the nasal bones. Another pair of horns is seen, one on the outer side of each nasal opening, and these seem to be formed by the maxillæ.

An examination of the natural cast of the nasal chambers shows that, at about 5 millims. within the outer margin of the external aperture, a thin plate of bone extends inwards for a little distance from the circumference, thus constricting the cavity and partly separating off a shallow anterior chamber.

The lower margin of each premaxilla supported four or five teeth, but these will be alluded to when the entire dentition is described.

When the *skull* is *viewed from above* (Plate 38) the two nasal horns are seen to be at the most anterior part of an area, which is separated from the frontal region by a jagged suture arising from the middle of each nasal orifice. This area must certainly

enclose the two nasal bones, although no suture is traceable between them; but on the median line there is an oval raised spot, with a concave surface, which may be the remains of a small median spine. The next landmark on the upper surface is the pineal fossa, part of which is preserved, and this is situated exactly in the middle of the skull and opposite the hinder edges of the orbits. When perfect, this fossa must have been about 13 millims. long and 9 millims. wide, and between it and the fronto-nasal suture is a distance of about 50 millims. while at about 30 millims. in advance of it is a pair of horns, doubtless marking the centres of the frontal bones, but no median suture is visible; and with the exception of the fronto-nasal suture there is nothing to mark them off from the surrounding bones. Above each orbit there are three spines, the hindermost of which is the largest and is probably formed by the postfrontal, while the anterior may be the prefrontal; the middle one of the three possibly being a separate ossification. The large extent of surface behind the pineal fossa makes it probable that this fossa was placed near the front of the parietals; but to what extent these bones entered into the roof of the skull cannot be seen, and, indeed, the want of definite sutures makes the interpretation of this region difficult. The pineal fossa communicated directly with the brain cavity by a large opening; and behind this the outer bones of the skull do not form the roof of the brain case, but a large temporal fossa, open at the back of the skull, intervenes on each side, separating the true cranial roof from these outer plates. A vertical and longitudinal plate connects the inner cranial roof with the outer bony covering and, rising as it does above the foramen magnum (Plate 40), occupies the position of the supraoccipital. This bone is in relation above with the bone supporting the median horn of the forehead, which might, therefore, be part of the supraoccipital. But behind this bone, and seemingly separated from it by a suture, is a pair of bones, forming the back part of the upper surface of the skull, each of which bears a well-developed horn. These two bones are likewise in relation with the vertical median plate and, it seems to me, are much more likely to be the supraoccipital elements, while the more anterior one with the median horn is in all probability an interparietal or intercalary bone. If the median plate is the supraoccipital, what are the two hindermost ones? They can scarcely be epiotics, for two reasons; in the first place, epiotics do not meet in the middle line, and secondly, they should be in relation to the brain case and auditory region, while the two bones in question are separated from the brain case by the post-temporal fossæ, the only connection being the vertical supraoccipital plate. Externally these two bones are separated by sutures (shown on the left side) from those forming the outermost angles of the hinder border which bear the large pair of horns, and it is these which hold the position of epiotics, each being inferiorly in relation with the buttress extending from the exoccipital, which is in all probability formed, to some extent, at least, by the opisthotics. It seems to me to be most in accordance with the known relations of these bony elements, to regard the outermost pair with the large horns as

the epiotics, the inner pair with the smaller horns as the supraoccipitals, and the median rounded plate with the single horn as an intercalary bone.

The internal cast in the parietal region shows, on each side of the pineal fossa, a line passing outwards and backwards, which again curving inwards circumscribes an oval area, directed towards the large horn. The position of this line is indicated on the figure of the exterior of the skull (Plate 38, *pa.*). These two areas are separated by the vertical supraoccipital plate, and the intercalary bone on the outer surface must have overlapped the inner edges of the bones indicated by these two areas, which almost certainly indicate the position and extent of the parietals. It is not certain whether the pineal fossa was entirely surrounded by the parietals.

In a side view (Plate 37) the anterior end of the skull is deep and truncated. The nasal apertures are close to the extremity, and being directed nearly forwards would be very little seen in a side view; the distortion of the skull, however, although slight, has pushed the right one a little outwards, and consequently rather more of it is seen in the figure than would naturally have been the case. The nasal bone and horn are seen above this aperture, while in front and below it is the premaxilla; immediately behind it is a spine, doubtless supported by the maxilla, which probably extended only a little way in front of the spine, but certainly reached as far backwards as the middle of the orbit, there being evidence of teeth at this point. The maxilla appears to be united above with the nasal and prefrontal bones, and posteriorly to form the front and lower boundaries of the orbit, but it is possible that a lachrymal bone may be wedged in between it and the prefrontal. The internal cast shows a very distinct canal running from the orbit to the nasal chamber, which there is little doubt is a lachrymal canal, and as it is placed rather deep in the orbit, it is quite possible that the lachrymal bone was overlapped externally by the maxilla. Professor SEELEY found no lachrymal bone in *Pareiasaurus*. The sub-orbital bar is broken near the union of the maxilla and jugal bones. The outline of the orbit is quadrate with rounded corners, and narrower in front than at the back; its upper margin is nearly straight and formed by the bases of the three spines by which it is overhung. The length of the orbit is 35 millims., the height is, anteriorly about 25 millims., and posteriorly about 35 millims.

The cheek behind the orbit is nearly square, and two deeply serrated sutures may be traced across it, one nearly vertical and the other nearly horizontal; besides these there is another at the base of the large horn which was probably continued along the upper margin of the cheek and separated it from the parietal region, but this latter part, as we have already seen, is wanting. On the internal cast there is a deep groove corresponding with the vertical cheek suture, but double at its upper part, which shows that the two hindermost cheek bones turned inwards, and formed the outer boundary of the lower post-temporal fossa (Plate 40, *st.* and *qu.*). The internal cast also shows some slight irregular lines corresponding with the horizontal cheek suture. The cheek is thus divided into four areas; the upper and anterior one (*pt.o.*) forms

half the hinder border of the orbit, and may be a part of the bone supporting the spine at the corner of the orbit, which I have called the postfrontal; but it seems much more likely to be a separate ossification, and if so, occupies the position of a post-orbital. The lower anterior area also forms part of the orbit, and is doubtless the jugal bone (*ju.*); it bears a large outwardly directed spine close to the lower corner of the orbit. The lower and hinder cheek area supports two large and two small spines, its position is that of the quadrato-jugal and quadrate; but how much of the latter bone is seen on the outer surface is uncertain. The articulation for the lower jaw, and therefore the quadrate, is close to and within the two smaller spines, which may be parts of that bone, but no sutures can be seen; or it may be that the quadrato-jugal entirely overlaps its outer surface. It is quite possible that the lower bone seen on the inner surface may be the quadrate, and that it extends backwards to form the posterior horn (Plate 40, *qu.* ?). The upper and hinder cheek area carries a large backwardly directed spine, and is separated by suture from the bone bearing the large horn, which I have referred to as the epiotic. This cheek area must be either the squamosal or the supra-temporal bone; it certainly occupies a similar position to the squamosal of the Turtle, and I am unable to point to any definite area as the squamosal, because the region immediately above this is lost on one side and obscured on the other; but it seems to me much more probable that this skull is formed on the plan of *Pareiasaurus* and that this upper cheek bone is a supra-temporal, while the squamosal will have to be sought in the region marked *sq.* in the figure; that is to say, it will probably be found as a small ossification wedged in between the supraoccipital, parietal, supra-temporal and epiotic, and possibly the small horn at the base of the large epiotic horn will prove to be a part of this squamosal. The markings on the internal cast lend some support to the latter interpretation.

Allusion has already been made to the double groove on the internal cast, corresponding to the upper part of the vertical cheek-suture. This double groove encloses an oval area, situated at the front of the bone I have called supra-temporal (Plate 37, *st.*), and would partly take in the spine seen at the upper part of this bone. These grooves, originally occupied by bone, I have traced inwards on the left side of the skull, and find that they are continuous with the buttress (opisthotic), passing outwards from the exoccipital region to the region of the squamosal; this bone, therefore, occupies the position of the *prootic*, and it is tolerably clear that the auditory organ must have been in this region. It is not certain that this bone reached the exterior, but it seems likely that it formed the spine seen just above and behind it on the outer surface.

The *Palate* of this specimen has been thrown over to one side by the distortion which the skull has undergone, and the median parts seem to have suffered by lateral pressure; but with the exception that little can be seen of the sutures, its structure is well shown (Plate 39), and appears to me to be formed on the Lacertilian plan. This palate is short and wide in proportion to the length of the skull, and its greatest

peculiarity is the relation of its hinder parts to the elongated base of the skull. The front is rounded and margined by the deep edges of the premaxillæ and maxillæ, which are continued posteriorly by the jugals and quadrato-jugals. Near the front there are two large apertures, the internal nares as I think, the more perfect one measuring 30 millims. in length by 9 millims. in width at the rounded hinder part, while anteriorly it narrows almost to a point, and the two are separated by a bony division, from 12 millims. to 15 millims. wide. These apertures open directly upwards into the nasal cavities, and they are not mere vacuities which might be due to non-ossification of membrane or cartilage, but are definitely margined openings, the inner edge of each being on a different plane from that of the outer margin and tending anteriorly to overlap it, in a manner similar to that seen in Lizards. The hinder part of the palate has been uncovered on the left side, and is found to give off a long and stout process outwards and backwards to the quadrate region. The inner end of this process is seen to arise from the side of a median aperture, behind which is the extremely elongated base of the skull. This median aperture of the palate occupies precisely the position of the interpterygoid vacuity in *Iguana* and *Sphenodon*, and corresponds with that seen behind the posterior nares of Dicynodonts; it cannot be homologous with the posterior nares of Dicynodonts or of Turtles, for in these the posterior nares are surrounded by the palatines, whereas this opening seems to be chiefly formed by the pterygoids. There is a great resemblance between the position of this opening and the posterior nares of Mammals, and Professor SEELEY regards them as such (44, p. 316), but with this I cannot agree, for reasons given below (p. 488). The quadrate process of the pterygoid bounds, posteriorly, a large triangular space, which has the quadrato-jugal arch on its outer side and terminates anteriorly close to the hindermost teeth of the maxilla. A similar vacuity is present in *Sphenodon*, and also in *Iguana;* but in the latter, there being no ossified quadrato-jugal arch in the dry skull, there is no outer boundary. And further, in the present specimen, there is a process which projects into this space from its inner side, and a similar projection is seen in both *Sphenodon* and *Iguana*, and as in both these it marks the junction of the transverse and pterygoid bones, it seems highly probable that the same is the case here also, but no suture can be traced.

That the elongated anterior palatal apertures are the posterior nares, opening directly upwards into the nasal chambers, as in Lizards, there seems to me no reasonable doubt. It is also tolerably certain that some part of the horizontal plate of the palate is formed by inwardly directed laminæ of the maxillæ and premaxillæ; very little of the latter, however, is to be seen. On the left side, there is a line which seems to be the junction between the maxilla and the palatine, and if this be so, then both these elements take part in the formation of the outer wall of the nasal opening. The space between these apertures is probably occupied by the vomers, and if the oblique lines seen on the floor of the nasal chambers, and also more faintly on the palate, are sutures, then the palatine bones are almost excluded from the inner walls

of the posterior nares. No sutures can be seen, which would allow one to separate the palatines, pterygoids, and transverse bones, and it is uncertain whether the palatines or pterygoids occupy the middle part between the hinder ends of the vomers. There can be little doubt that the processes to the quadrate bones are formed by the pterygoids, and that the anterior boundary of the pterygoid foramen is formed by the same bones; but it is uncertain whether they also form the hinder boundary of that aperture by extending round it, as in *Sphenodon*, or whether basipterygoid processes of the basisphenoid complete it posteriorly, as in certain Lizards. Four longitudinal ridges run along the palate; two of these, near the middle line, start from the front of the pterygoid foramen and, passing almost directly forwards, extend between the narial openings, possibly on to the vomers, but their anterior terminations are indistinct. About 15 millims. of the anterior part of the right ridge widens somewhat and is deeply pitted, leading to the conclusion that it supported one or more rows of teeth; but there is nothing to show that the hinder part of this ridge was provided with a dental armature. The left ridge does not show these parts so distinctly. The other two palatal ridges are seen outside the first pair, and starting from very nearly the same point; they curve outwards and forwards, terminating a little behind the nasal openings: it is uncertain whether they supported teeth.

The Base of the Cranium is extremely long and narrow, and is one of the striking peculiarities of the skull. I have succeeded in exposing it throughout its length, but the result is not altogether satisfactory, for the occipital articulation is not shown, and there are no indications of subdivisions. Its greatest length from the hinder end to the truncation of the presphenoid is about 70 millims.; its greatest width appears to have been in the region of the condyle, and could not have been more than 12 millims. The hinder third, which I regard as the basioccipital, is deeply grooved longitudinally on the under surface, the sides of the groove forming each a lateral phalange, with a rounded thickening anteriorly and posteriorly. The sides of the bone are also deeply concave, and the upper surface, which forms the floor of the brain-case, is likewise concave from end to end, but V-shaped from side to side. The hinder end of the basioccipital is deeper than it is wide, but unfortunately the articular surface is destroyed. The absence of thickening at the sides of the foramen magnum shows that the articular surface was altogether below the foramen, and I conclude, therefore, that it was single and median; and, further, if the vertebræ with only slightly ossified centra, described at p. 489, belonged to this type of Reptile, then in all probability this occipital articulation was similarly deeply hollowed, and more so than in *Pareiasaurus*, which would possibly account for its imperfect preservation. On the middle third of the cranial base, or basisphenoid region, the groove of the lower surface is gradually lost as it approaches the pterygoid foramen; a ridge on each side runs obliquely downwards and forwards, and is continuous with the bone forming the side wall of the pterygoid foramen. These two ridges doubtless form the basipterygoid processes of the sphenoid; and, seeing that the quadrate processes of the

pterygoids arise from the sides of the pterygoid foramen, the basipterygoid processes could not have been long, and may have been entirely excluded from the foramen by the meeting of the pterygoids behind it. Above the lateral ridge the basisphenoid passes upwards and forwards on each side, but the extent of these lateral wings is not seen, and it is uncertain whether they are continuous with the cranial roof. From their position these wings would appear to be alisphenoids, and this seems to be confirmed by the occurrence of a large foramen on each side, just in front of their upper ends, which probably gave exit to the optic nerves. A short distance in front of these foramina the base of the skull is much reduced in size, and is truncated anteriorly; this appears to be the presphenoid, and above it is a trough-like bone, occupying the position of a pair of orbitosphenoids, which joins the frontals above, and for part of its length is grooved below. A cartilaginous ethmo-vomerine septum doubtless extended forwards from the presphenoid, with its upper edge lodged in the groove below the cranial floor. The lower part of this septum was ossified for some distance above the floor of the nasal chambers, but to what extent cannot be seen.

Immediately above the front of the presphenoid is the pineal fossa, and directly below it the pterygoid foramen. In the basioccipital region the side walls of the brain-case are continuous with the base and roof, but to what extent they are formed by the exoccipitals cannot be seen, neither is it certain to what extent the supra-occipital enters into the formation of the roof. The brain cavity is high and long, but in all probability only a small part of it was occupied by the brain.

The Back of the Skull (Plate 40) is remarkable for its extreme width in proportion to the size of the head, for, without the horns or spines, it measures more than 6 inches (155 millims.) across the quadrate region, the height being only $3\frac{1}{2}$ inches (90 millims.). The hinder end of the basioccipital being mutilated, its form is unknown; but it is certain that, with the exception of the slightly enlarged ends of the lateral phalanges mentioned above, there are no paroccipital processes. The foramen magnum is wider than it is high, only half of it being shown in the figure, and it is broader above than below; indeed, it forms nearly a semicircle, with the curve downwards. Attention has already been directed to the supraoccipital crest connecting the roof of the brain-case with the outer plates of the skull, and to the probability that the two median outer plates (*s.o.*) are expanded portions of the same bone. The uncertainty as to what bones roof over the brain-case, and surround the foramen magnum, has also been alluded to; there can be no doubt, however, that the side wall of the foramen is formed by the ex-occipital, which at the upper angle gives off the broad horizontal buttress, and this, arching very slightly upwards and outwards, abuts upon the outer wall, or cheek, at the junction of the bones I have referred to as supra-temporal and epiotic. This buttress is doubtless in part formed by the opisthotic, although the extent of the latter is uncertain; there is, however, an oblique ridge on the under side, a little way from the brain-case, which may indicate the junction of the exoccipital and opisthotic, in which case the latter bone would form by far the greater part of the buttress, as it does in Lizards.

As a consequence of the great length of the base of the skull, the origin of the quadrate process of the pterygoid is placed far underneath, and, although it passes somewhat backwards to the quadrate, it is necessary to look at the occiput, partly from below, in order to see these parts at all satisfactorily (Plate 40). In this view, the pterygoid is seen to have a considerable vertical extent, and its process, after curving outwards and backwards for about 30 millims., is united with the cheek bones, but its lower part may be followed until close to the quadrate articulation (*qu.*), which is very near the lower and outer angle of the occiput, and the strong spine, here situated, may be part of that bone, as may also a portion of the inner wall of the cheek (*qu.* ?) below the supra-temporal. The last-named bone bears a large spine on its hinder margin, and above is in close relation with the epiotic, which bears one of the largest horns of the skull, just where it joins the opisthotic buttress. Above this buttress is the upper post-temporal fossa, roofed over by the supra-occipital. There being no process extending from the basi or exoccipital bone to the quadrate, as there is in Dicynodonts, the lower post-temporal fossa is widely open below, as it is in most Lizards.

The space above the quadrate process of the pterygoid (*pt.*) opens freely into the orbit, but it is partly separated by a broad thin vertical bar of bone, which extends upwards from the pterygoid and joins the prootic or parietal, or perhaps both, and about its middle gives off a broad process, tapering inwards to a point. This vertical bar occupies much the same position as the columella of the Lizard skull, but whether it is the homologue of that bone or a part of the otic capsule, I am unable to say. The *foramen ovale* was probably situated a little above the point of the inward process.

The *Horns* of this Reptile are developed to such a remarkable extent as to call for a more detailed description than has yet been accorded them. In their present condition many of the horns are imperfect, but it is evident that when complete, most of them were somewhat flattened and sharp pointed, the exceptions being the rounded interparietal boss, and the two or three small knobs on each side of the parietal region. The lateral maxillary horns, also, are rounder than most of the others.

The largest pair of horns, or horn-cores as they should be more properly termed, are those at the hinder and outer angle of the upper surface (Plate 38), which are supported by the epiotics, and, being curved outwards and backwards, give quite a bovine appearance to the head. The right horn is a little longer than the left, and, with the pedicle which supports it, is rather more than 3 inches (60 millims.) in length. In section, this horn is nearly semicircular at the base, but becomes round towards the extremity. The rounded surface looks downwards and forwards, while the flattened side looks upwards and backwards, the two surfaces meeting so as to form a distinct anterior and posterior edge. The surface of this horn is marked by indistinct longitudinal ridges and striations forming a comparatively smooth surface, which ceases suddenly at the base, and is at once succeeded by the deeply-pitted

surface of the pedicle. All the horns and bosses have a similar smoothness ending abruptly at the base. The upper edge of the pedicle bears a short spine (12 millims.) which may be an outgrowth of the squamosal bone. Two spines extend backwards from the hinder margin of the cheek (Plate 37), each about an inch long (25 millims.). The upper one is much flattened, and is supported by the supra-temporal bone, which also bears a smaller spine upon the outer surface, unless, as is quite possible, this spine is part of the prootic element. The lower spine of the hinder margin is thick, curved, and triangular in section, the angles being keen; it may belong to the quadrate or to the quadrato-jugal. The last-named bone bears an outwardly-directed spine, about the same length as the two just described, but more sharply pointed and flattened, with two sharp edges. Below this there are two small prominences close to the articulation for the lower jaw, which may be part of this bone or of the quadrate. The jugal and maxilla each bear an outwardly-projecting spine, which, when perfect, was probably not so long as that of the quadrato-jugal. The jugal spine is flattened and situated near the hinder and lower corner of the orbit, while that of the maxilla is rounded and placed just behind the nasal aperture.

The nasal bones carry each a stout but flattened horn, which, when perfect, could have been but little less than that of the quadrato-jugal. Of the three spines overhanging the orbit, the hinder one is the largest, and probably belongs to the post-frontal bone, while the anterior one most likely represents the prefrontal.

On the upper surface of the skull (Plate 38), commencing at the back, we find the supraoccipitals carrying a pair of prominent horns near their hinder margin; these are somewhat flattened and curved forwards, when perfect they must have been nearly an inch in length. Each of the supraoccipitals also bears one or two small bosses in front of the larger horns. On each side of the pineal fossa there is a spine, evidently upon the parietal bone, and behind this a small boss. More anteriorly the frontals carry a pair of spines. In the interparietal region there is a rounded prominence occupying the middle of the area which I have called an intercalary bone, and evidently carried a median horn.

The small raised and flattened space between and behind the bases of the nasal horns may also be the remains of a small median spine, and with this the total number of horns, spines, and bosses on the outer surface of this skull is forty.

The character of the surface of these horns, and the sharp line of demarcation between it and the pitted bone at the base, even in the case of the small bosses, makes it tolerably certain that they were ensheathed in a special horny covering, distinct from the epidermis which covered the general surface of the bones.

With the exception of the premaxillaries and post-orbitals, every bone of the exterior of this skull bears, at least, one horn, and this is so marked a character that, it seems at first sight, every horn must represent a distinct bone; but, besides the extra small bosses seen upon the supraoccipitals and parietals, there are two small extra spines which seem to belong to the quadrato-jugal. The smooth surface of the

premaxillary bones may be an indication of their covering having been of a more horny nature than the general epidermal covering of the pitted bones.

Dentition.—The teeth being small, there was at first some difficulty in knowing whether the creature possessed any; however, little by little, portions of the dental margin were uncovered, so that now, although teeth are only seen on one side, the entire dentition of the upper jaws is well known, and the close resemblance, in nearly every particular, to the form and arrangement of the teeth in the living *Iguana* is very striking.

The margin of the jaw when seen from below (Plate 39) must, before its distortion, have been nearly semicircular, and short in comparison with the size of the skull. The measurement around the arc of the semicircle is about 110 millims., and the chord of the arc at the hindermost teeth about 70 millims. The edges of the premaxillæ and maxillæ are thin, and on the inner side slant outwards and form a parapet with a ledge raised a little above the general level of the palate. The inner aspect of this parapet is marked by slight vertical depressions corresponding to each tooth, shown best on the left side, but not visible in the figure. The teeth are set on this parapet in a thoroughly typical pleurodont fashion. There are spaces for about twelve teeth on each side, and on the right eight can be traced still in place (Plate 37, fig. 2); spaces for the other four are left, the teeth having fallen out, possibly during the life of the animal, in the natural process of renewing the dentition, or the loss may have been due to post-mortem injury. The hindermost teeth are a little smaller than the others. In the side view of the skull (Plate 37, fig. 1) the whole dentition of the right side has been restored in outline.

Each tooth consists of a long fang surmounted by an enlarged somewhat spatulate crown. This crown is flattened on the inner side (Plate 37, fig. 4), and marked by a series of seven or eight slightly radiating ridges which extend over a large part of this surface to the outer edge. The outer part of the crown (fig. 3) is rounded and marked towards the edges by crenulations which, meeting those of the inner side, form the serration with which the edges of these teeth are provided. The exact form of the crowns of these teeth is not easy to make out, owing to the coarse matrix; but there is really more detail to be seen than might have been expected, and the enlarged and restored figures on Plate 37 (figs. 3, 4) give a fairly correct idea of the form of one of the middle teeth of the left side. The crown is seen to be subpentagonal in outline, the base being its attachment to the fang, from this the slightly curved and non-serrated sides rise a little more than half way towards the apex where the two serrated edges meet at an obtuse angle. The outer surface has a more oval appearance than the inner owing to its being more inflated. Some of the teeth have shorter crowns, possibly due to wearing.

A study of the different parts of the parapet and dental series shows that each tooth lay against the parapet in a slight depression, the base resting on the step, and became fixed to the parapet by a bony deposit, so that at the margin the bone is seen

passing a little way inwards between the teeth. In some places the teeth have been forcibly broken away, leaving a portion of the fang still cemented to the parapet. One of the fangs shows a slight depression at the lower part, apparently indicating absorption by the pressure of a young tooth, such as takes place in *Iguana* and other Lizards. As a matter of fact the dentition of this specimen agrees so closely with that of *Iguana* that the above description would answer equally well for the one or the other, the only differences between the two being that the teeth of the present specimen are proportionately larger and fewer in number, there being only twelve on each side, while *Iguana* has double that number, and the crowns are less pointed and have no median ridge. Allusion has already been made to the ridges along the palate, and to the probability of some of them at least having supported teeth. There will be occasion to speak of this again when considering the affinities of this unique Reptile.

Affinities.

The extreme development of horns on this Elgin skull reminds one forcibly of the Australian *Moloch* and the American *Phrynosoma*, but although the Elgin Reptile undoubtedly possesses several important Lacertilian characters, and apparently finds its nearest living allies in that group, yet it presents peculiarities of structure which prevents its being referred to the Lacertilia. The anterior position of the posterior nares, which open directly upwards into the nasal chambers; the character of the opisthotic and exoccipital process, forming a strong buttress extending to the base of the pedicle for the lower jaw, as well as the mode of dentition, are characteristically Lacertilian. On the other hand, the meeting of the pterygoids on the palate in front of the pterygoid foramen and base of the skull, as well as the presence of a lower temporal bar, are characters not met with among the true Lacertilia; nevertheless, the pterygoids come very near together in *Iguana*, and in *Sphenodon* they are close together both before and behind the foramen, but are said not to unite. *Sphenodon* also has a complete lower temporal bar. Certain Lacertilia have the supra-temporal fossa covered in by bone, but there being no lower arcade the cheeks are uncovered.

The complete covering in of the upper and side walls of the Elgin skull gives it some resemblance to that of a Chelonian, more especially as they both have the lower arcade complete; but the epiotics and paired supraoccipitals, which form part of the outer wall in this fossil, are not present on the surface of the Chelonian skull; and further, although the pterygoids meet in front of the base of the skull in Chelonians, they have no pterygoid foramen or distinct quadrate process; besides this the Chelonian posterior nares are thrown farther back by the arching over of the palatines, as we have seen they are in Dicynodonts.

The pitting of the exterior of this skull is very like that of a Crocodile, but in matters of structure the two are wide apart.

I am not aware of any recent form that makes a near approach to this Elgin skull,

although I believe it presents very strong Lacertilian affinities. It is quite unlike any of the Reptiles which have hitherto been described from the Elgin sandstone; indeed, with the exception of the *Pareiasaurus* to be presently noticed, I know of no fossil that it at all resembles.

The Amphibians (Stegocephala) and lowly Reptiles (Proganosauria) recently described by Dr. CREDNER (9), from the Permian of Saxony, have only a very distant relationship to this Elgin Reptile.

When seeking for allies of this fossil among extinct forms, one is naturally led to examine such as have been found elsewhere similarly associated with Dicynodont remains. With the Dicynodonts and Theriodonts described by Sir R. OWEN in his classical work on the South African Reptiles (38), occurs the very aberrant form named *Pareiasaurus*, two species of which were described, *P. bombidens* and *P. serridens*. The two skulls of these are unfortunately in a bad state of preservation, but the uniform series of teeth, so unlike those of the Theriodonts, seemed to indicate a possible affinity with the Elgin fossil, and this was rendered more probable when comparison was made with another example, described by Professor SEELEY (41), showing a sculptured exterior to the skull, in which also the arrangement of the bones agreed fairly well with the Elgin specimen, although there were no horns. The palate of Professor SEELEY'S specimen, which he referred to *P. bombidens*, is not sufficiently exposed for comparison (41, Plate 15), and on turning to the palate of *P. serridens*, which he also figures (41, Plate 16), the differences between it and the Elgin form appeared to be too great for any possibility of affinity. Whether these differences are due to the imperfections of this example of *P. serridens*, or to its belonging to another genus of Reptiles, has yet to be decided; but another South African skeleton, obtained by Professor SEELEY, and named by him *Pareiasaurus Bainii* (44), has the palate well exposed, and it agrees very closely indeed with that of the Elgin skull, and is quite unlike that of *P. serridens*. This latest acquisition from South Africa has been described by Professor SEELEY before the Royal Society (44). The skull is about 18 inches long, and, therefore, nearly three times the length of that from Elgin, and is proportionately flatter; there are no indications of horns, but the outer surface of the bones is similarly ornamented, and their general arrangement seems to be very much the same, while the structure of the palate and the mode of dentition, are so far alike, that I am convinced the two are allied forms, although the differences between them may be of more than generic importance. Seen from behind the two skulls are found to have similar post-temporal fossæ divided in each by a plate arising from the roof of the brain-case, and supporting the outer plates of the skull; there is a similar exoccipital and opisthotic buttress arising from the upper part of the foramen magnum; but in *Pareiasaurus* this buttress is more ponderous and turns more downwards than it does in the Elgin skull. The quadrate process of the pterygoid is similarly placed far forwards and consequently there is a similar deep recess where the foramen ovale seems to

have been placed. The basioccipital has a pair of tubercles on the lower part, but, like the Elgin specimen, has no process extending towards the quadrate. Seen from below the palates are remarkably alike, the teeth form a similarly uniform series, and so far as I can see, in both are of the pleurodont type. The anterior palatal apertures are in both placed near the front and open directly upwards; there are similar triangular spaces in front of the quadrate process of the pterygoid with a like projection from the inner side. *Pareiasaurus* has six ridges on the palate, each apparently carrying a double row of teeth. Two of these rows seem to be on the vomers and are far forwards between the fore part of the inner nasal openings; in the Elgin skull this part is obscured, and it is therefore uncertain whether any such vomerine ridges were present. A second pair runs backwards in *Pareiasaurus*, from between the palatal openings to end close to the pterygoid foramen, corresponding with the median ridges in the Elgin fossils, which in part at least appear to have carried teeth. The third pair in *Pareiasaurus* starting from the outer side of the nasal opening extends backwards and inwards to end very near the inner pair, and corresponds with the outer pair in the Elgin skull which are placed behind the nasal apertures, but show no signs of having had teeth. There is a pterygoid foramen just behind the palatal ridges, in both specimens, which has much the appearance of the posterior nares of a Mammal, but cannot, I think, be in any way of an homologous nature. Behind this foramen the bases of the two skulls have a different appearance on account of the extreme length of the base in the Elgin specimen, and its shortness and stoutness in *Pareiasaurus*.

When we turn to the upper part of the skulls, there is again a close resemblance between them. In both the nostrils are double; there is a lower temporal arcade, the lateral temporal fossæ are covered in by bone, the surfaces of the bones are deeply sculptured, and the arrangement of the bones of the exterior seems to be the same in principle. It is very evident, from their close resemblance in so many important points of structure, that these two forms are related; but, at the same time, there are differences which suffice to separate them, at least generically. In the first place, there is the remarkable development of horns in the Elgin fossil, which is not found in *Pareiasaurus*, although there are one or two protuberances on the hinder border; and there is also the extreme proportionate length of the base of the skull, and possibly the presence of an interparietal bone is peculiar to the former. Although the teeth of *Pareiasaurus* are said to be implanted in sockets, while those of the Elgin skull are distinctly pleurodont, yet I venture to think that the section figured by Professor SEELEY (41, Plate 16), showing bony matter between the teeth, is not conclusive evidence of distinct sockets. *Pareiasaurus* is not only much larger than the Elgin reptile, but its skull is broader proportionately and more depressed.

Having come to the conclusion that the nearest ally of this Elgin reptile is *Pareiasaurus*, it remains to be seen what the relationship of these forms may be to other groups of Reptiles. This has been considered by Professor SEELEY, with regard to

Pareiasaurus, and he has had a very large part of the skeleton besides the skull to deal with. In the present instance we have only the skull as a guide, but it may be well to see how far it confirms the opinions expressed by Professor SEELEY, who, speaking of the exterior of the skull of *Pareiasaurus*, says it agrees with Labyrinthodonts in five points, which, put briefly, are:—(1) in form; (2) sculpture of cranial bones; (3) arrangement of these bones; (4) presence of mucous canals; (5) absence of lachrymal bone from the corner of the orbit. The first three of these points are likewise found in the Elgin skull, but there is no evidence of mucous canals, and the fact that there is an opening from the orbit to the nasal chamber, makes it hazardous to say there was no lachrymal bone. The development of the epiotics to form prominent angles at the back of the skull, is another Labyrinthodont character, found in both forms, which should be noticed.

The large size and approximation of the external nares are regarded by Professor SEELEY as a reptilian character of *Pareiasaurus*, and this peculiarity is found also in the Elgin skull.

In so far, then, as regards the exterior of the skull, both these fossils show an affinity with Labyrinthodonts rather than with Reptiles.

We now come to consider the palate, and, from what has been said above, it will be agreed, I think, that the later specimen described by Professor SEELEY (44), is constructed upon precisely the same plan as that of our Elgin fossil, and the Professor's account of its constituent bones, so far as they can be traced, in no way invalidates this agreement; but, although we are agreed as to the probable arrangement of the bones, I find myself unable to accept his interpretation of the apertures of the palate. He regards the interpterygoid vacuity, or foramen, as the true posterior nares, while the anterior openings of the palate, he speaks of as merely "palatal vacuities," and, at p. 317, says, "This structure of palate is best compared to the condition in Mammals, though approximated to in Rhynchocephalia, Teleosauria, &c.," although, on p. 332, the palate is said to be "better compared with that in Lizards and *Sphenodon*."

I have already expressed the opinion that this form of palate has the very closest resemblance to that of a Lizard, and, if compared with that of *Iguana* or *Sphenodon*, there will be found to be a most striking similarity, part for part. It is true that in the former, the pterygoids do not meet in the middle line, but they approximate very closely; and, in the latter, they meet in the middle, although they are said not to unite. The union of the pterygoids in the middle line, however, is a common Reptilian character, but one that is rare among the Mammalia, for in the latter, with few exceptions, the palatines form the front boundary of the posterior nares.

I see no more reason for regarding the pterygoid vacuities of *Pareiasaurus* as posterior nares, than for giving a similar interpretation to the corresponding vacuities of *Iguana* or *Sphenodon*. In mammals, the posterior nares certainly communicate with the space above the palate, which forms the nasal chambers, and in the Elgin

skull these apertures also open directly into the orbito-temporal spaces above the palate, but there is no evidence of any bony passages leading to the nasal chambers. It is true the connection may have been by membranous or cartilaginous channels, but this is only begging the question; and in the absence of more definite evidence than is at present forthcoming, I feel compelled to regard the anterior palatine apertures as the posterior nares, and, consequently, the palates of *Pareiasaurus* and of the Elgin fossil present, to me, Lacertilian rather than Mammalian affinities.

I fail to find anything in the structure of this Elgin skull showing affinities with either Dicynodonts or Theriodonts; but Professor SEELEY sees in certain parts of the skeleton of *Pareiasaurus* a resemblance to the Anomodontia, and thinks the genus more nearly related to that group than to any other order of the animal kingdom.

There can be no doubt that in whatever group the new specimen of *Pareiasaurus* finds its resting place, thither this Elgin fossil will have to follow, and, for the present, will remain in the same family as an aberrant group of the Reptilia, possibly allied by its trunk skeleton to the order Anomodontia, understood in its wider sense. The necessity for the establishment of a new genus and species for the reception of this Reptile is obvious; it will be distinguished from *Pareiasaurus* by the large development of horns and spines, by the elongated base of the skull, by the different form of the teeth, apparently by the absence of mucous canals, and probably by the presence of an interparietal or intercalary bone. It is proposed to name this specimen, after the district where it was found, and in allusion to its remarkable form, *Elginia mirabilis*.

10. NOTE ON A SACRUM AND SOME VERTEBRÆ (Plate 41).

The Elgin Museum and the Geological Survey possess, each a specimen from the Elgin Sandstone containing impressions of vertebræ, which are believed to come from Cuttie's Hillock Quarry, but on this point there is a little uncertainty. A cast taken from the Elgin Museum example shows six consecutive vertebræ, four of which are sacral, and two presacral, while the Survey specimen, which may be part of the same skeleton, contains the impressions of two late dorsal, or lumbar, vertebræ. The last-named vertebræ show the left side, as well as the anterior and posterior faces; but the neural spines are only represented by the impression of an anterior and of a posterior extremity (figs. 1–3).

These vertebræ are a little distorted: each centrum is about 28 millims. long and 18 millims. wide at its expanded extremities, but in the middle it is pinched in, being only about 8 millims. wide at this part. That these centra were formed by a mere film of bone surrounding the persistent notochord was amply testified by the fact that one of them, when it came to me, had the notochordal space completely filled with the sandy matrix, and the space left by the dissolving away of the bone was not thicker

than a stout piece of paper. Unfortunately, it was found necessary to remove this mould of the notochord before a cast could be taken. The pre- and post-zygapophyses are large, strong, and widely expanded, being at least 58 millims. across (fig. 2), they are supported by buttresses rising from the neural arches, and almost wholly above the neural canal. The neural spines are incomplete, but the greatest height of the most complete vertebra, in its present condition, is about 55 millims. The posterior end of the centrum is nearly circular and 17 millims. in diameter; the oval neural canal is 8 millims. high; from the neural canal to the base of the spine is about 13 millims., and about 17 millims. of the spine are preserved, but, judging from the other specimens, this must have been about 22 or 24 millims. when perfect. Immediately above the neural canal is a lenticular area, the middle of which forms an elongated projection with the under surface marked by strong antero-posterior grooves, as if for the attachment of ligaments. This projection may have been received into a corresponding depression in the succeeding vertebra, but in neither of the specimens is the anterior face of a vertebra sufficiently well preserved to show this clearly. In a side view the post-zygapophysis is seen to extend beyond the centrum, and to form a flattened articular surface looking almost directly downwards; it reaches upwards to the base of the neural spine, and as a prominent arched bar passes nearly to the front of the vertebra.

From the front part of the neural arch a process passes upwards, outwards, and a little forwards to form the pre-zygapophysis, the articular face of which looks almost directly upwards. This process also is supported by a buttress rising from the neural arch in front of and below the post-zygapophysial bar, which, passing forwards, lies below, and is connate with the pre-zygapophysis; it is a transverse process with only the extremity free, and this, a little enlarged, terminates in a slightly depressed surface which looks somewhat forwards, and may possibly have supported a small rib. It is quite possible that these two vertebræ may have belonged to the same individual as those to be next described, and, if so, could not have occupied a position much in advance of the two pre-sacral vertebræ at the front of that specimen, the anterior vertebra of which has the transverse process in almost the same position.

The Elgin Museum specimen (figs. 4, 5) has the left side of the vertebræ deep in the matrix, but the casts prepared from this, and from the pieces of stone which have been broken off, show the right side nearly complete, with parts of the left side. All the vertebræ are somewhat distorted, but fortunately the exposed right side is the most perfect, and allows their forms to be very well made out. The right side of the centrum of the most anterior vertebra, and parts of the neural arches of both presacral vertebræ, are wanting, but the form of these parts is, to a large extent, supplied by the left side. The two presacral vertebræ closely resemble the two more anterior ones above described, and the centra are likewise about 28 millims. long. The neural spines are preserved, and the anterior one stands 36 millims. above the neural canal; it is flattened from side to side, and at its summit seems to have been about 15 millims.

from front to back, while below it reaches further backwards. The second vertebra has the summit of the spine extended laterally. The post-zygapophyses of these two vertebræ have the same arched form as in the more anterior vertebræ of the other specimen, but the pre-zygapophyses and their connate transverse processes are becoming modified. In the front one the difference is only slight; the articular surface remains much the same, but the transverse process is more prominent, and has receded somewhat. The hindmost of the pre-sacral vertebræ has the pre-zygapophysis enlarged, and extending further down upon the side of the vertebra, while the transverse process is also much stouter, has receded still further, and its termination has become expanded to form a heart-shaped cup, directed backwards, apparently for the attachment of a rib.

The four hindermost vertebræ of this series are very different from those in front of them, and evidently form the sacrum; they all seem to be firmly ankylosed together, although the centrum of the anterior one is more clearly defined from the one which follows it than the hinder three are from each other. The neural arches are not well shown on either side, and the obliteration of the zygapophysial articulations may be more apparent than real, but it is quite certain they were unlike those of the pre-sacral vertebræ.

The anterior sacral vertebra has a very peculiar form; the under surface of the centrum, which is about 28 millims. long, instead of being keeled, like those preceding it, is concave from side to side as well as from back to front; it is slightly expanded anteriorly, where it articulates with the next vertebra, but widens out posteriorly, so as to form a broad triangle, each hinder angle of which extends outwards into the large buttress-like sacral rib, and this, curving backwards, becomes expanded vertically, and reaches beyond the middle of the fourth sacral centrum, thus enclosing a deep semi-oval space, widest posteriorly. The junction of this sacral rib with the vertebra is, probably, indicated by the oblique ridge passing forwards and outwards from the hinder margin of this centrum. Viewed somewhat more from the side, the pre-zygapophysis is seen to be much expanded, and, extending backwards, is apparently continuous with the transverse process and large sacral rib, no division between it and the transverse process being visible, but together they form a wide slightly concave surface. A side view shows the articular surface of the pre-zygapophysis to be directed somewhat forwards as well as upwards. Opposite the space between the first and second sacral ribs, as seen on the upper surface, there is a wedge-shaped prominence, probably marking the proximal end of the sacral rib, which is seen to form a deep trough, with a wide but thin inner and upper side, evidently for the reception and support of the ilium. The neural spine of this vertebra has a greater antero-posterior extent than those which succeed it, and resembles in this respect the two immediately in front of it, but is directed a little backwards.

The three hinder sacral vertebræ are much alike in form (fig. 4) but very different from the anterior one. In the first place they are much shorter than the front one,

and decrease in size towards the hinder extremity; the centra are respectively 20 millims., 18 millims., and 17 millims. in length. One side of these centra being crushed, the form of their under surfaces is not very clearly shown, but they were evidently narrow below, and seemingly almost keeled. Their sides are a little concave from before backwards, and convex from above downwards, the union of their articular faces being marked by roughened ridges. From each centrum a transverse process passes upwards as a flying buttress, and is continuous with one of the irregular processes, which are seen, on the upper surface, extending outwards and backwards from the region of the apparently fused neural arches. Each of these processes terminates in an expanded and roughened end, and this, as well as the gradual increase in length of the hinder processes, makes it evident that they came in contact with the ilium and thus fulfilled the function of true sacral vertebræ. The neural spines of these vertebræ are expanded laterally at their extremities and the hinder ones are closer together.

Can these vertebræ be referred to any one of the genera which have been found in the Elgin sandstone? This is a question which will naturally be asked, but cannot be so easily answered. In the first place, *Stagonolepis*, *Hyperodapedon*, and *Telerpeton*, may be dismissed, as their vertebræ are quite unlike, and we have therefore only to consider the forms from Cuttie's Hillock. The remains of vertebræ on specimen No. 3, *Gordonia Duffiana*, do not allow a close comparison to be made; but certainly, unless the forms of those of the dorsal region, as shown by the casts (Plate 32, figs. 4, 5), are very deceptive, they are quite unlike any of those now under consideration. The circular impression seen in the same slab (Plate 31), which may be the cast of the end of a vertebral centrum, is just such as would be made by one of the centra of the present specimens, and possibly indicates a similar condition of ossification, but there are no sufficient grounds for referring them to the same genus.

The caudal vertebræ (specimen No. 6, Plate 33, fig. 5) have their anterior and posterior end about equally wide and thus resemble the present vertebræ, but the utmost that can be said is that they might possibly have belonged to a similar but much smaller animal.

None of the vertebræ referred to Dicynodonts by Sir R. Owen (38), Professor Huxley (16), Mr. Lydekker (21), or Professor Seeley (43) at all resemble these specimens in form, and in none of them does there appear to be a similar condition of ossification of the centra.

The sacrum referred by Sir R. Owen to *Dicynodon tigriceps* (38, Plate 36) has a large sacral rib somewhat like that now described, but the sacral centra are all similar in form, and therefore quite unlike those of the present specimen.

In so far as the vertebræ of Dicynodonts are known, they differ so much from the present specimens as to prevent the reference of the latter to the Dicynodontia.

The genus from Cuttie's Hillock remaining to be considered is *Elginia*, of which only the skull is known, but as its nearest ally *Pareiasaurus* has much of the skeleton

preserved, including sacral and other vertebræ, a comparison of these with the Elgin vertebræ may show what probability there is of these vertebræ belonging to *Elginia*. *Pareiasaurus* has a large sacral rib (43, Plate 12) very similar to that in the sacrum referred by Sir R. OWEN to *Dicynodon tigriceps*, and supporting the ilium in much the same way as must have been the case in the present specimen. The vertebræ of *Pareiasaurus*, when seen from above, show a somewhat similar arching of the post-zygapophysial bars, but in other respects there are great differences between the two. In *Pareiasaurus* the vertebral centra are shorter and broader, the neural spines are rounded and knob-like, the sacrum is said to be formed of two ankylosed vertebræ only, and these are not unlike those before and behind them. It is possible that some of the vertebræ behind these two sacrals may have had transverse processes reaching to the ilium, but their centra were not ankylosed to each other. It will at once be seen that in the present specimen, the widened anterior sacral vertebra and the three narrow posterior ones all fixed together, constitute a sacrum quite unlike that of *Pareiasaurus*. It would be very hazardous, therefore, in the absence of definite evidence, to refer the present sacrum and vertebræ to *Elginia*; nevertheless, it is possible that they may have belonged to a form related to *Pareiasaurus*, such as *Elginia*; and the differences between this sacrum and that of *Pareiasaurus* may be consistent with the distant relationship, which seems to be indicated by the similarities and differences observable in the skulls of these two genera.

III.—THE STRATIGRAPHICAL POSITION OF THE ELGIN SANDSTONES.

When Reptiles of Mesozoic character were found in the sandstones at certain localities near Elgin, these rocks, which had previously all been referred to the Old Red Sandstone, were acknowledged to be of two distinct ages; but the relation of the reptiliferous beds to those containing undoubted Old Red Sandstone Fishes was left uncertain, no section being known in which both series of beds were seen. The opening of the quarry at Cuttie's Hillock exposed the section already noticed (p. 434), wherein the age of the rocks is satisfactorily proved by fossil evidence, Reptilian remains occurring above a pebbly layer, while below that band a large Fish has been obtained, which has been determined by Dr. TRAQUAIR to be the characteristic Upper Old Red Sandstone form, *Holoptychius nobilissimus*.

The opinion expressed by Professor HUXLEY in 1859 (12) that the palæontological evidence showed the reptiliferous sandstones of Elgin to be of Mesozoic rather than of Palæozoic age, has been abundantly confirmed by more recent discoveries, the chief of which have been made known by the Professor himself; and in his paper on *Hyperodapedon*, published in 1869 (15), he fully discussed the significance of the Elgin Reptiles, as pointing to the Mesozoic age of the strata in which they were found.

Until the discovery of Dicynodont remains near Elgin this group of Reptiles was

only known from the Beaufort and Stormberg group, of the Karoo formation, in South Africa, and in strata of approximately the same age in India, the Panchet beds of the Gondwanas. M. TRAUTSCHOLD (46) has described specimens from Permian beds at Kasan, which he refers to the genus *Oudenodon*, but it seems somewhat doubtful whether such fragmentary specimens, as are represented by his figures, can be identified with certainty.

It is worthy of notice that the Reptiles found at Cuttie's Hillock are altogether different from those which have been met with at other localities near Elgin; thus, from Lossiemouth, we have *Stagonolepis*, *Hyperodapedon*, and *Telerpeton*; from Spynie, *Hyperodapedon*, *Telerpeton*, and a *Ceratodus*-like Fish tooth allied to *Sagenodus*; and from Findrassie, *Stagonolepis* and *Dasygnathus*. From Cuttie's Hillock, on the other hand, have been obtained two forms of Dicynodonts, *Gordonia* and *Geikia*, accompanied by *Elginia*, an extreme type of Reptile allied to the South African *Pareiasaurus*.

The Elgin Reptiles, it will be seen, form a very similar series to those which occur in the Gondwana beds of India (3 and 21), where *Hyperodapedon*, *Parasuchus* (allied to *Stagonolepis*), Dicynodonts, and Labyrinthodonts have been found; and there also the Dicynodonts do not occur at the same locality as *Hyperodapedon* and *Parasuchus*, the former being found in the Panchet rocks, which are referred by Dr. BLANDFORD (3) to a lower horizon than the Kota Maleri beds, where the *Hyperodapedon* and *Parasuchus* have been met with.

If the Elgin Reptiles be compared with those from the South African Karoo beds, we see that it is those from the Cuttie's Hillock Sandstone which find their counterparts in the Beaufort and Stormberg beds. The two types of Dicynodonts, *Gordonia* and *Geikia*, from Cuttie's Hillock are very similar to the *Dicynodon* and *Ptychognathus* of South Africa, while *Elginia*, as we have seen, finds its nearest ally in *Pareiasaurus*.

The correspondence which is found to exist between the Reptiles of the Elgin Sandstones and those from the Indian Gondwanas, and the South African Karoo beds, as well as the absence from each of these localities of types which might be expected to occur, leads to the inference that in each country new forms of Reptiles await discovery. The Karoo beds of South Africa may yield Crocodilia; the discovery of Pareiasauria and Theriodontia may be anticipated in the Gondwanas of India; while Labyrinthodontia and Theriodontia may be expected from the reptiliferous Elgin Sandstones.

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V.—EXPLANATION OF PLATES.

All the specimens are from the Elgin Sandstone of Cuttie's Hillock Quarry, near Elgin, and the drawings, unless otherwise stated, have been made from casts of the original hollow cavities.

PLATE 26.

Gordonia Traquairi, gen. et sp. nov.

From a photograph of specimen in the possession of the Geological Survey, about one-third natural size.

Fig. 1. Block of stone showing right half of specimen.
Fig. 2. Left half of skull of same specimen.

PLATE 27.

Gordonia Traquairi.

Cast from same specimen as Plate 26, fig. 2. Left side of skull and lower jaw. Natural size.

PLATE 28.

Gordonia Traquairi.

Casts from same specimen as Plate 26. All the figures natural size.

Fig. 1. Skull seen from above, with right half restored in outline. The median portions are in part drawn from the right half of the specimen.
Fig. 2. View of palate, partly restored.
Fig. 3. Fragment of humerus showing entepicondylar foramen.
Fig. 4. Same specimen, back view.
Fig. 5. Parts of three caudal vertebræ (?).

PLATE 29.

Gordonia Huxleyana, sp. nov.

Specimen belonging to the Geological Survey. Both figures natural size.

Fig. 1. Left half of skull and lower jaw.
Fig. 2. Right half of skull and lower jaw, drawn from the actual specimen, showing the cavities left by the bones and especially the palate.

PLATE 30.

Gordonia Huxleyana.

Same specimen as Plate 29. All figures natural size.

Fig. 1. Skull seen from above, right side restored in outline.
Fig. 2. Left scapula, outer surface.
Fig. 2*a*. ,, ,, inner surface.
Fig. 3. Clavicle.
Fig. 4. Right humerus wanting both extremities.
Fig. 5. Left ilium.

Gordonia Huxleyana?

The following figures, 6 to 9, are drawn natural size, from casts of a specimen preserved in the Elgin Museum, which is provisionally referred to this species.

Fig. 6. Clavicle.
Fig. 7. Right scapula, outer surface.
Fig. 8. Left humerus, hinder aspect.
Fig. 9. Right humerus, front aspect.

PLATE 31.

Gordonia Duffiana, sp. nov.

From a photograph of two blocks of stone, about one-third natural size, containing a large part of a skeleton, with a skull. Preserved in the Elgin Museum. There is every reason to believe that this skull was found with and belongs to the trunk, but there is no positive proof that such is the case.

PLATE 32.

Gordonia Duffiana.

Same specimen as Plate 31. All the figures natural size.

Fig. 1. Natural cast of the inner parts of the skull. The external surface is shown in fig. 2.

Fig. 2. Upper surface of skull, drawn from a cast of the counterpart of fig. 1. Some of the under parts are seen below this, and the right side and muzzle are completed in outline.

Fig. 3. Occiput.

Fig. 4. Parts of neural arches of three dorsal vertebræ seen from the side.

Fig. 5. Same seen from above.

Fig. 6. Humerus, side view.

Fig. 7. Left ilium, outer surface

PLATE 33.

Gordonia Duffiana.

Figs. 1 to 4. Same specimen as Plate 31. All figures natural size.

Fig. 1. Skull, side view of natural impression of inner parts; same specimen as Plate 31, fig. 1.

Fig. 2. Same specimen, right orbit.

Fig. 3. Same as fig. 1, with cast of upper surface in its natural position, and outline of muzzle restored.

Fig. 4. Restored view of palate. Drawn partly from casts and partly from measurements.

Gordonia?

Fig. 5. Caudal vertebræ with transverse processes, provisionally referred to *Gordonia*. Preserved in the Elgin Museum.

PLATE 34.

Gordonia Traquairi?

From a photograph of a block of sandstone containing a nearly entire skeleton provisionally referred to this species. About half natural size. Preserved in the Elgin Museum.

PLATE 35.

Gordonia Traquairi?

Figs. 1 to 5. Same specimen as Plate 34. All figures natural size.

Fig. 1. Skull seen from above, right side partly restored in outline.
Fig. 2. Same, side view of skull and lower jaw. The post-orbital bar and tip of muzzle partly restored.
Fig. 3. Left scapula, outer surface.
Fig. 4. Left humerus, oblique view of hinder and outer surfaces.
Fig. 4*a*. Same, from outer side.
Fig. 4*b*. Same, outline of distal extremity.
Fig. 5. Left radius and ulna.

Gordonia Juddiana, sp. nov.

Figs. 6 to 8. All the figures natural size. Preserved in the Elgin Museum.

Fig. 6. Skull seen from above, right temporal arcade restored in outline.
Fig. 7. Same specimen, left side.
Fig. 8. Same specimen, occiput with part of right side restored.

PLATE 36.

Geikia Elginensis, gen. et sp. nov.

All the figures natural size. Specimen preserved in the Elgin Museum.

Fig. 1. Skull seen from above.
Fig. 2. Same, right side.
Fig. 3. Same, front view.
Fig. 4. Same, occiput.
Fig. 5. Lower jaw, left ramus.

PLATE 37.

Elginia mirabilis, gen. et sp. nov.

In the possession of the Geological Survey.

Fig. 1. Skull seen from right side. Natural size. The upper part of the temporal region has been drawn from the opposite side (see Plate 38), and the teeth

have been restored in outline. The positions of some of the sutures are indicated by fine lines.

Fig. 2. Portion of left maxilla and premaxilla with teeth *in situ*. Natural size.

Fig. 3. Outer view of tooth enlarged two diameters.

Fig. 4. Tooth from inner side enlarged two diameters.

PLATE 38.

Elginia mirabilis.

Same specimen as Plate 37, natural size. Skull seen directly from above. The portion represented without ornament is wanting in the original, and has been restored from the opposite side.

PLATE 39.

Elginia mirabilis.

Same specimen as Plates 37 and 38, seen from below. Natural size. Showing palate and base of skull.

PLATE 40.

Elginia mirabilis.

Same specimens as Plates 37 to 39, seen from behind and partly from below. Natural size.

PLATE 41.

Sacrum and Vertebræ.

Both the specimens figured on this Plate are from the Elgin Sandstone, but it is not quite certain that they are from Cuttie's Hillock Quarry. Their affinities are uncertain. They are represented natural size.

Fig. 1. Two late dorsal or lumbar vertebræ belonging to the Geological Survey, seen from the left side with the neural spines restored in outline. These two vertebræ are said to have been found with the skull of *Elginia*.

Fig. 2. Posterior end of the hindermost vertebra of fig. 1.

Fig. 3. Diagrammatic section through the two vertebral centra to show the thin bone which covered the notochord.

Fig. 4. Sacrum, with two presacral vertebræ, seen from below, and showing the large sacral rib. The three hinder vertebræ (to the left of the Plate) show

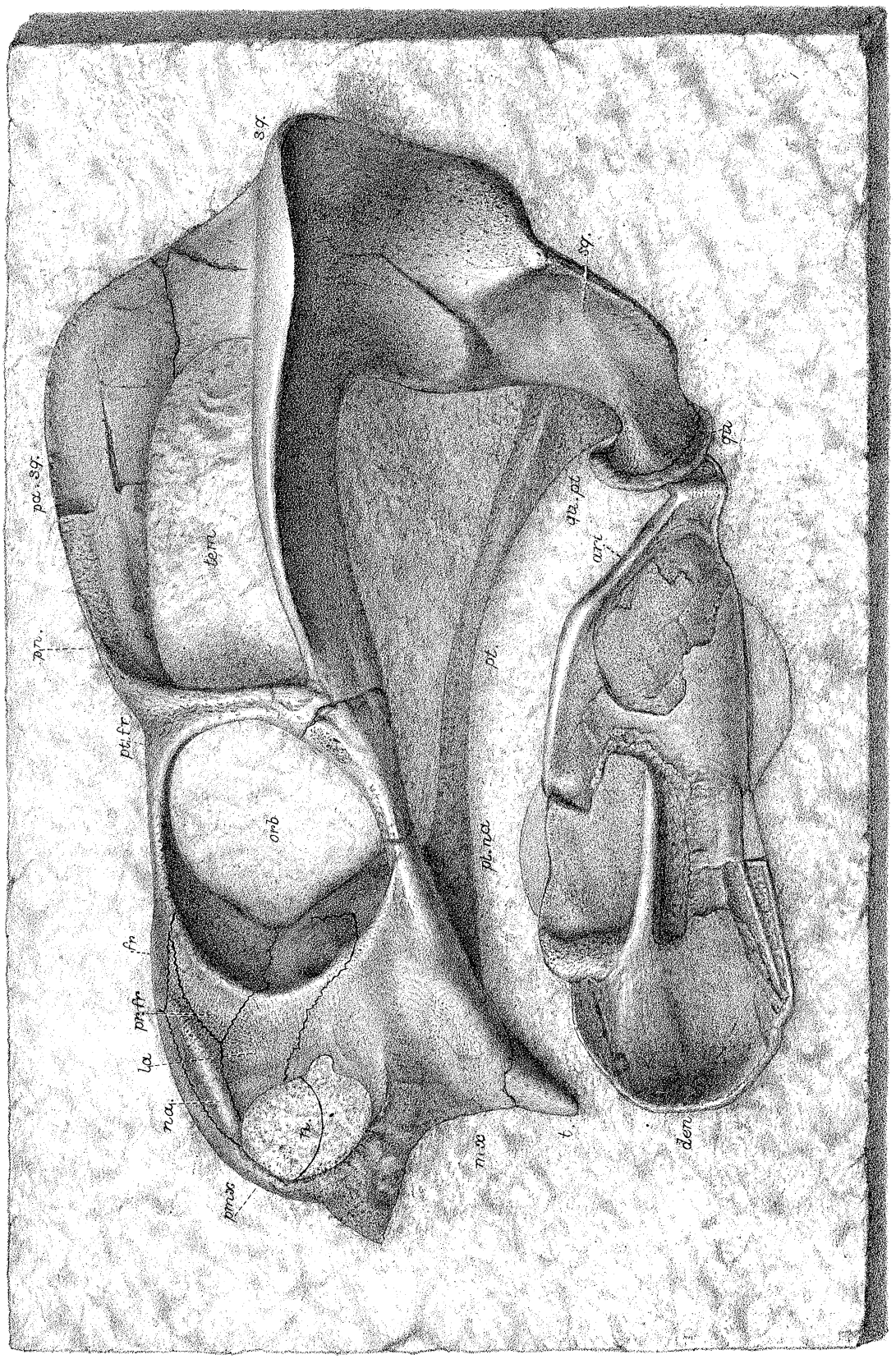
little more than half of each centrum, the left side having been crushed. The left sides of the other vertebræ are also imperfect. Preserved in the Elgin Museum.

Fig. 5. Same specimen seen from right side.

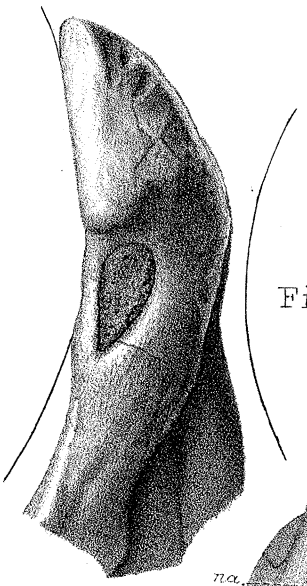
LETTERING USED IN FIGURES.

art. Articular bone of lower jaw.
den. Dentary „ „
eo. Exoccipital.
ep.o. Epiotic.
eth.vo. Ethmo-vomerine septum.
fm. Foramen magnum.
fr. Frontal.
i.pa. Interparietal.
i.pt. Infra post-temporal fossa.
ju. Jugal.
la. Lachrymal.
mx. Maxilla.
n. External nasal aperture.
na. Nasal bone.
orb. Orbit.
o.sp. Orbito-sphenoid.
pa. Parietal.
pa.sq. Parieto-squamosal crest.
p.fr. Prefrontal.
pl. Palatine.
p.mx. Premaxilla.
pn. Pineal fossa.
pt. Pterygoid.
pt.f. Pterygoid foramen.
pt.fr. Postfrontal.
pt.o. Postorbital.
pt.na. Posterior nares.
qu. Quadrate.
qu.pt. Quadrate process of pterygoid.
s.pt. Supra post-temporal fossa.
sq. Squamosal.
st. Supratemporal.
t. Tusk.
tem. Temporal fossa.

GORDONIA TRAQUAIRI, gen. et sp. nov.



Gordonia Traquari. *sp. nov.*



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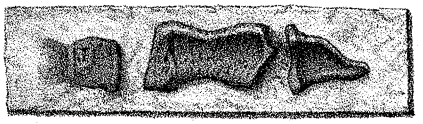

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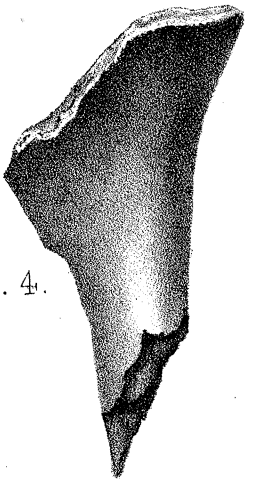
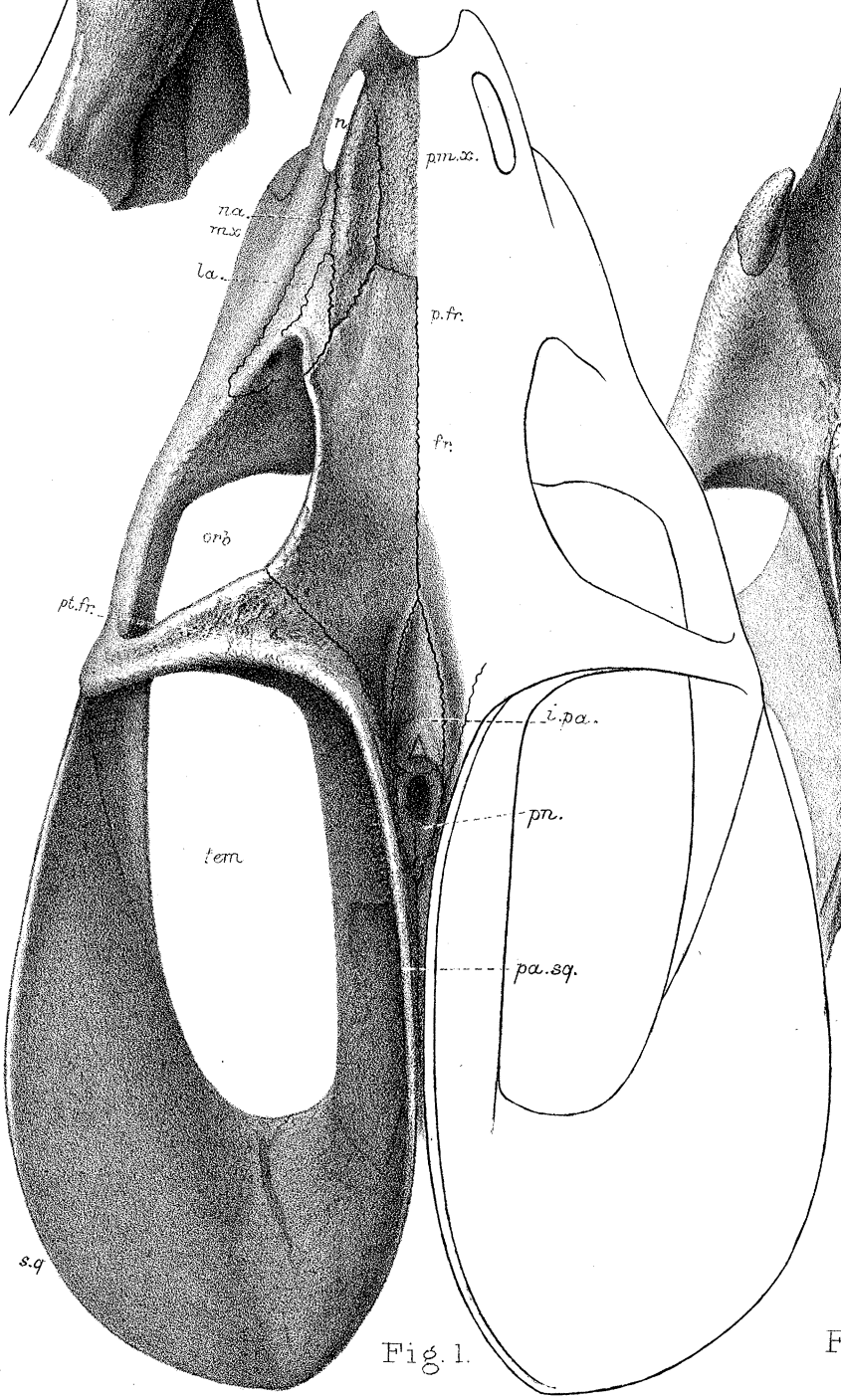


Fig. 4.



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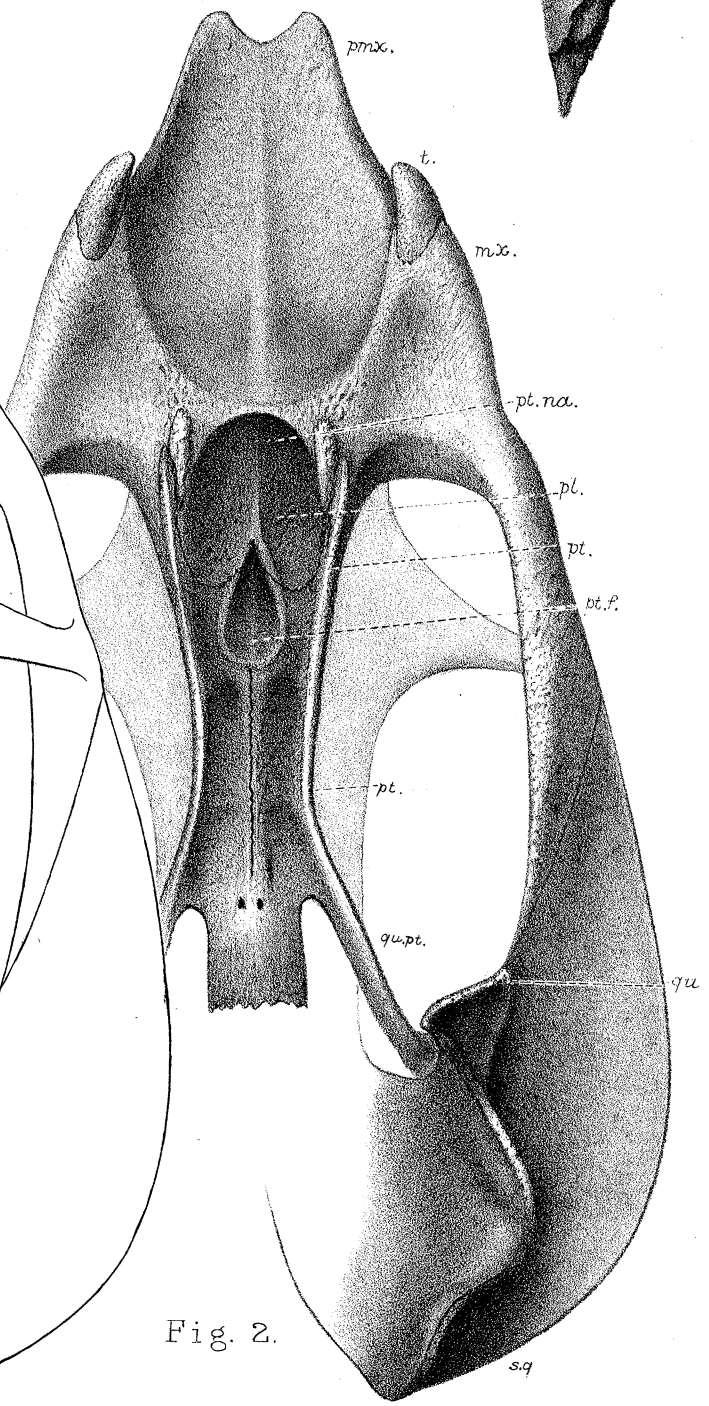


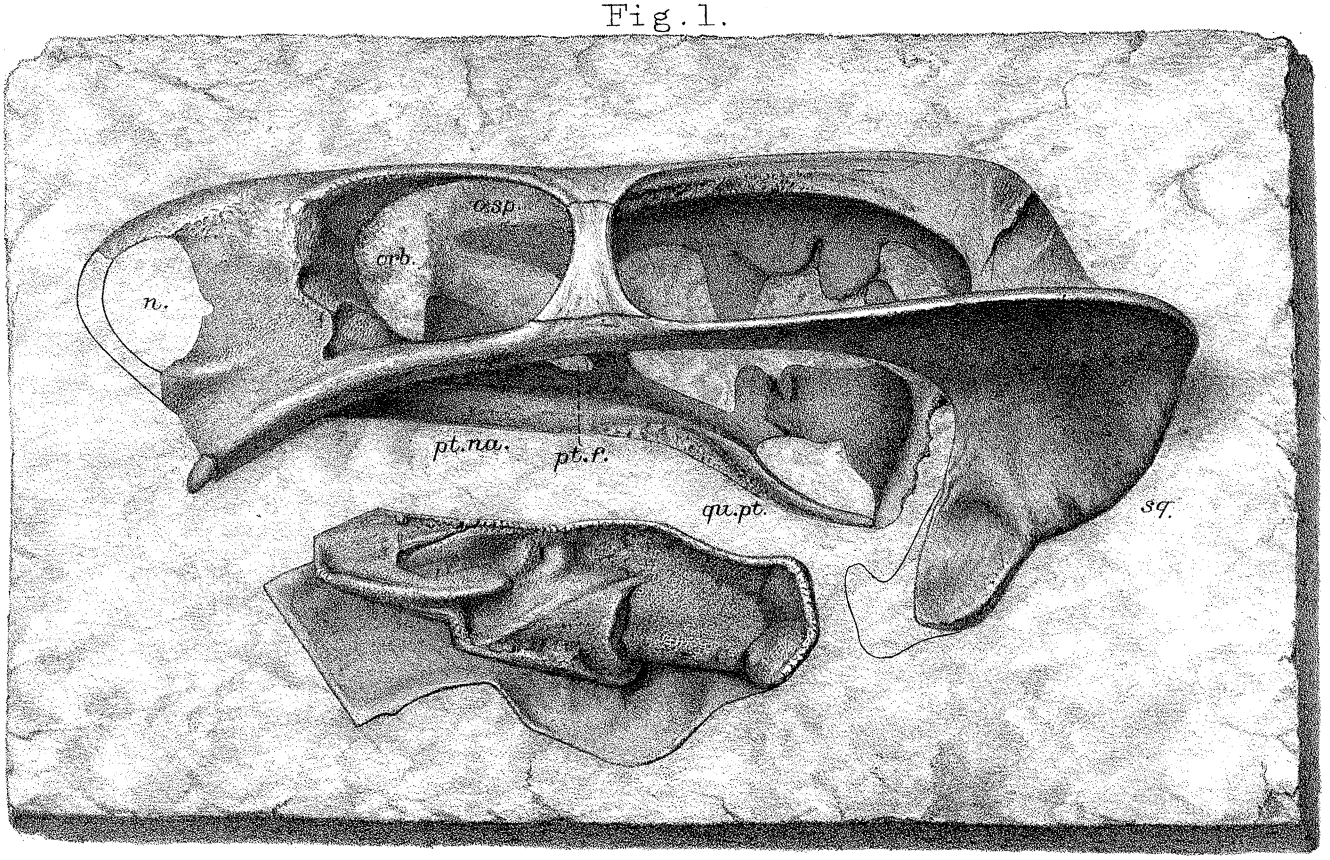
Fig. 2.

A. T. Hollick, lith.

Gordonia Traquairi, *sp. nov.*

West, Newman, imp

Fig. 1.



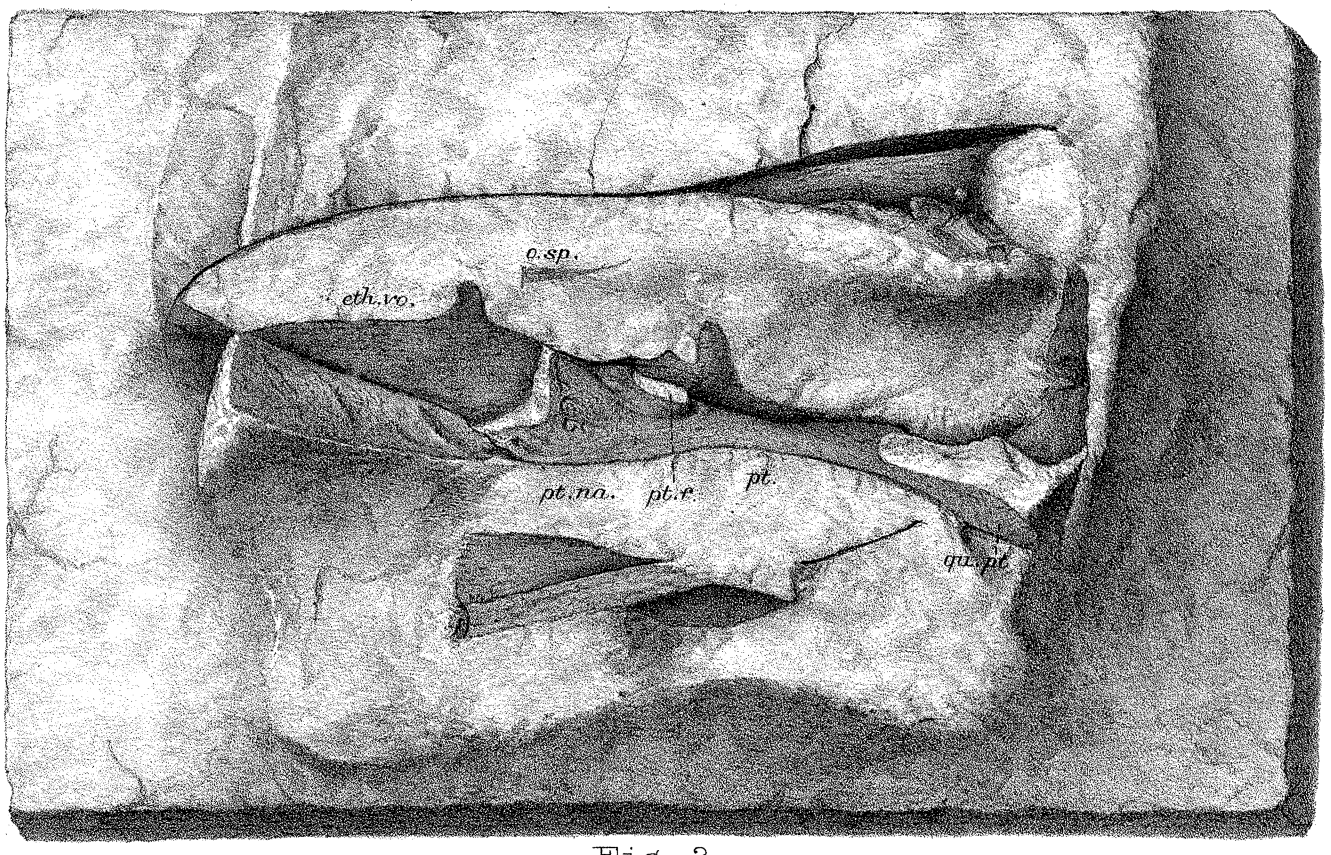


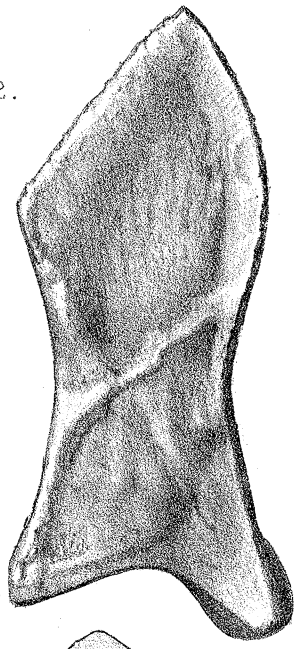
Fig. 2.

A. T. Hollick lith.

West, Newman imp.

Gordonia Huxleyana, *sp. nov.*

Fig. 2.



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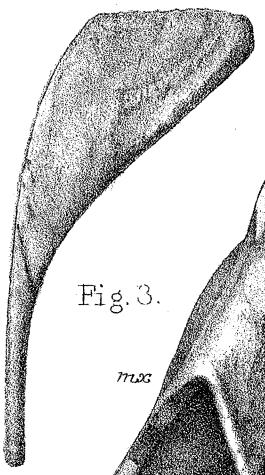

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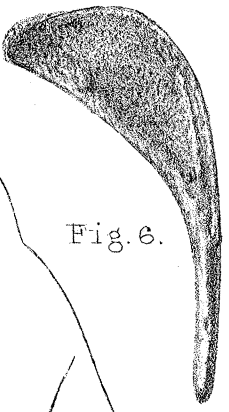

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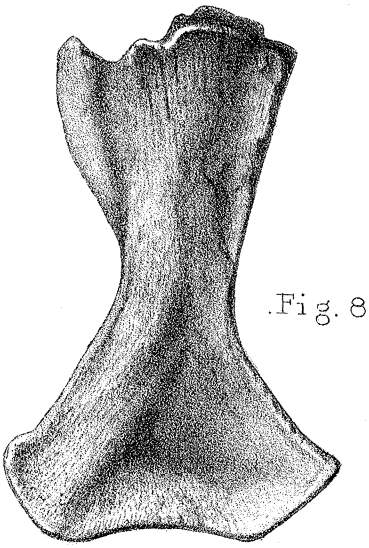
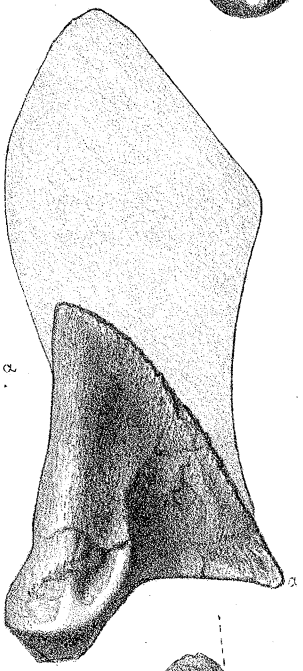


Fig. 1.

Fig. 2.a



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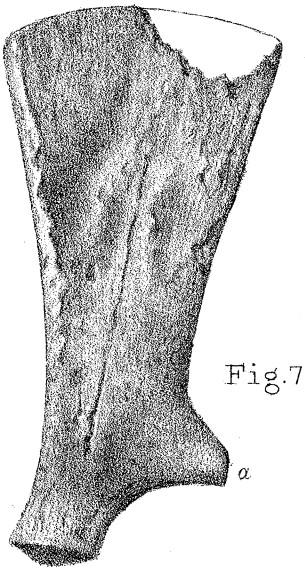

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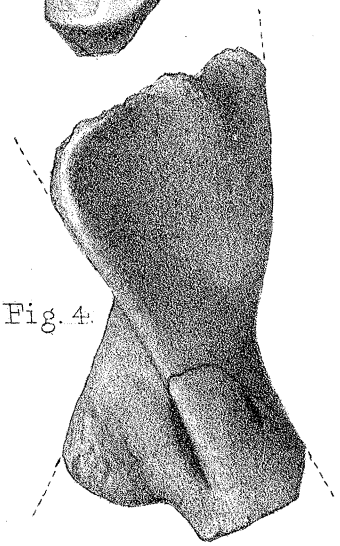
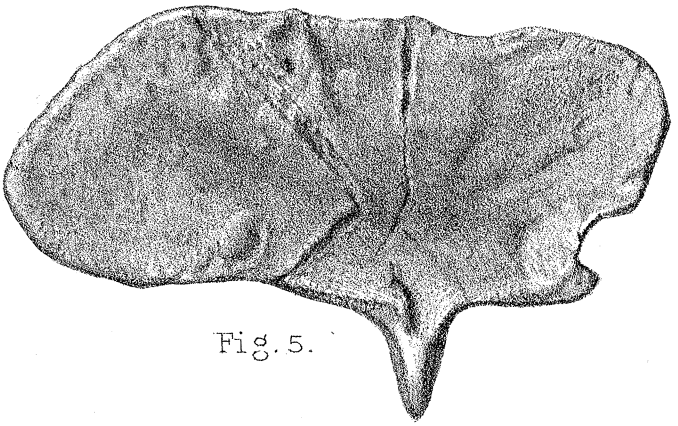


Fig. 5.



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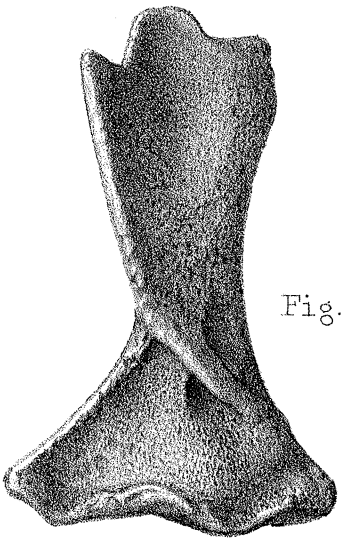


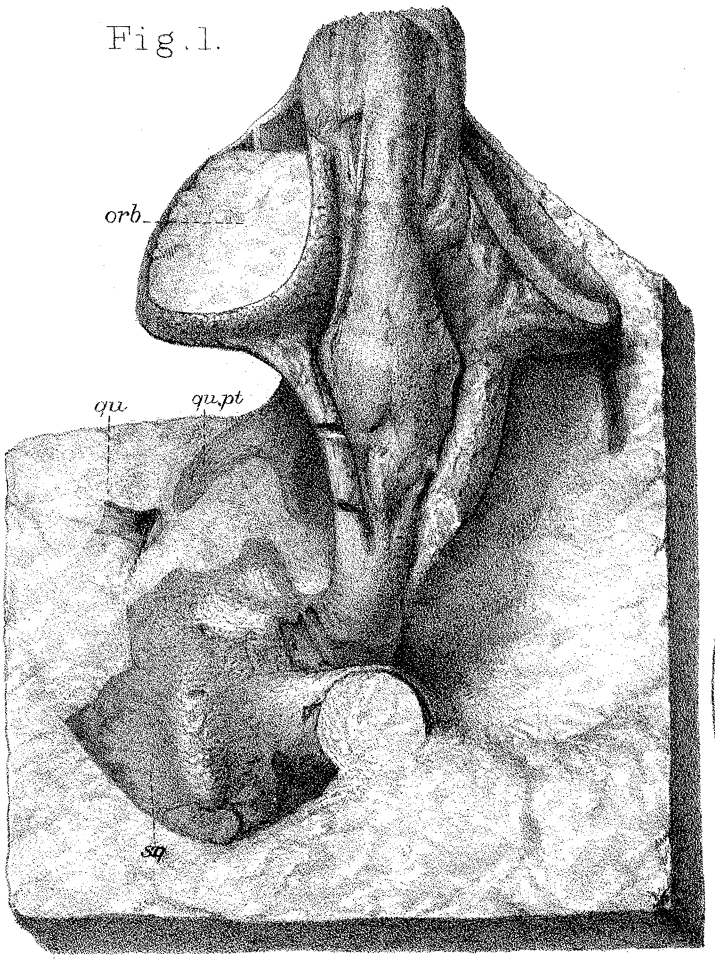
A.T. Hollick lith.

Gordonia Huxleyana, *sp. nov.*

West, Newman imp.

GORDONIA DUFFIANA, sp. nov.

Fig. 1.



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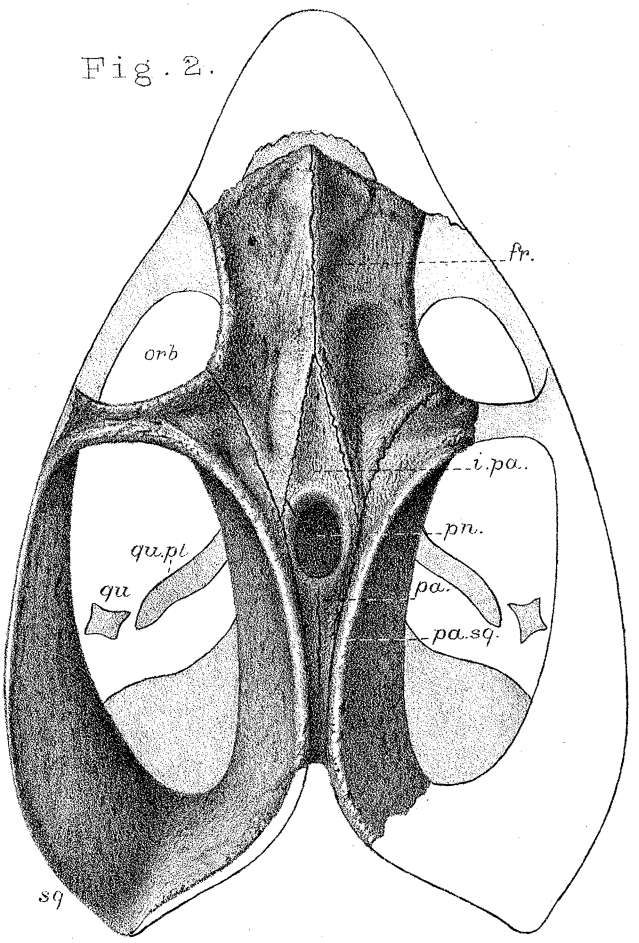

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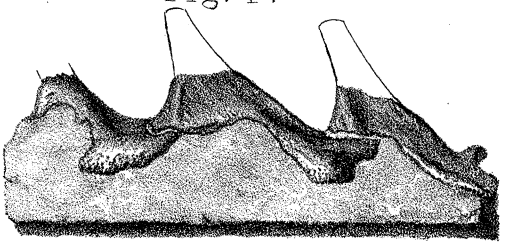

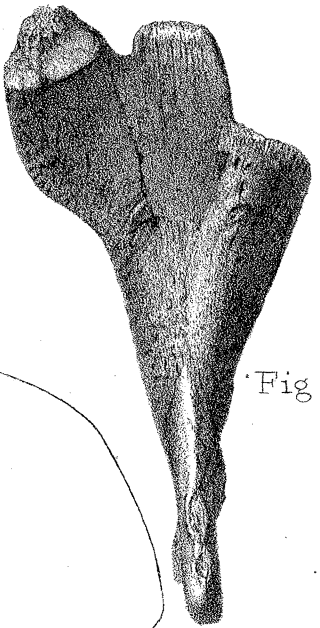

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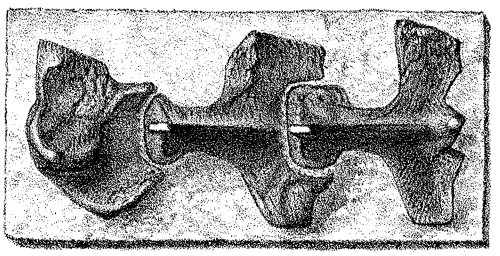

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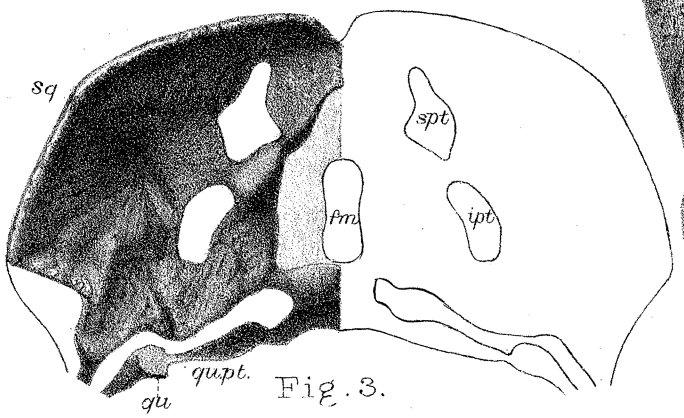

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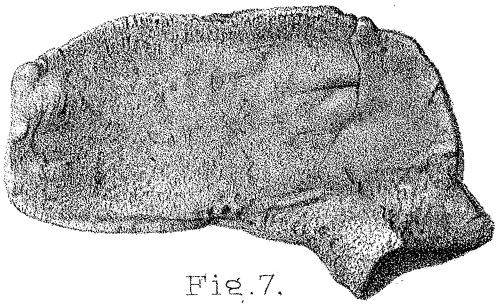


Fig. 7.

A. T. Hollick, lith.

West, Newman imp.

Gordonia Duffiana, *sp. nov.*

Fig. 2.

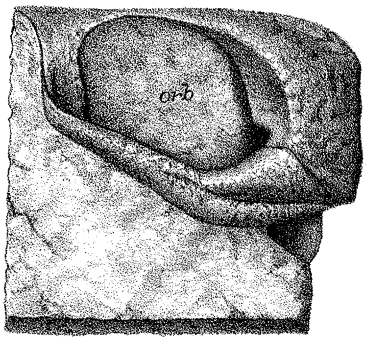
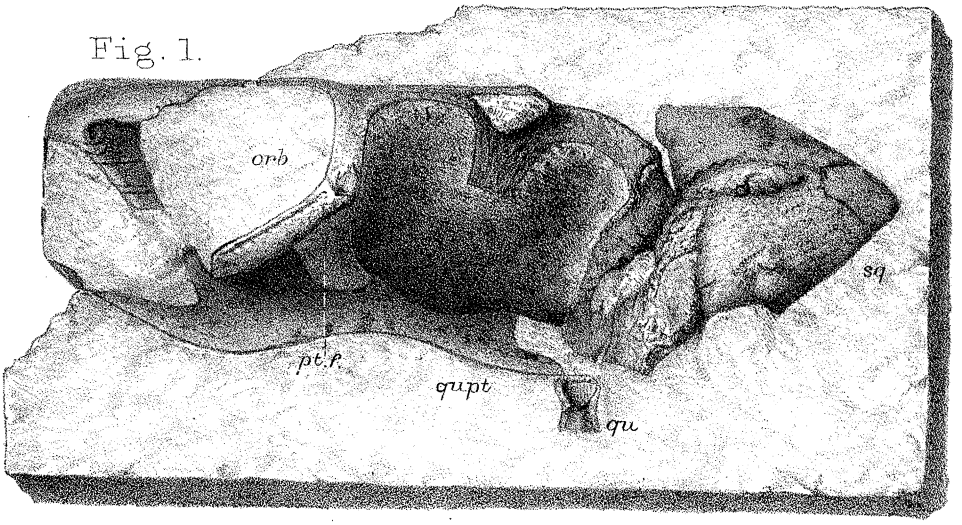


Fig. 1.



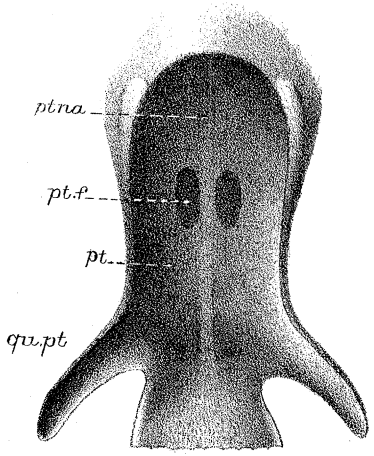


Fig. 4.

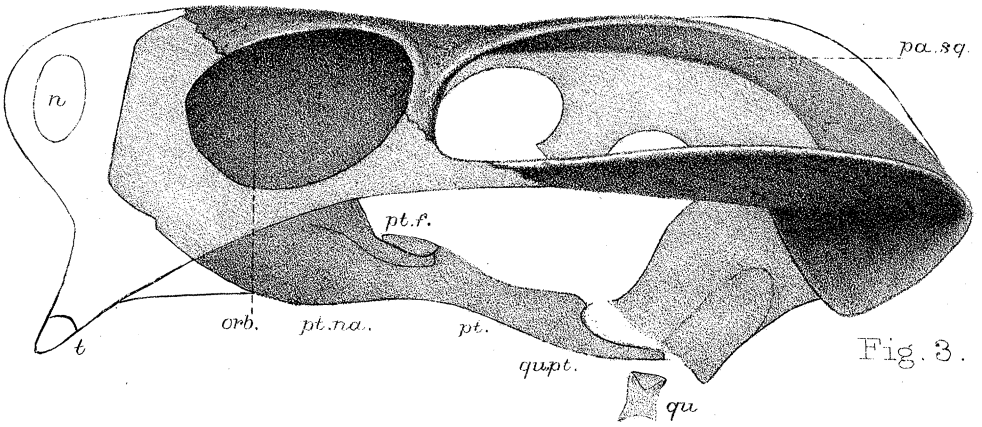


Fig. 3.

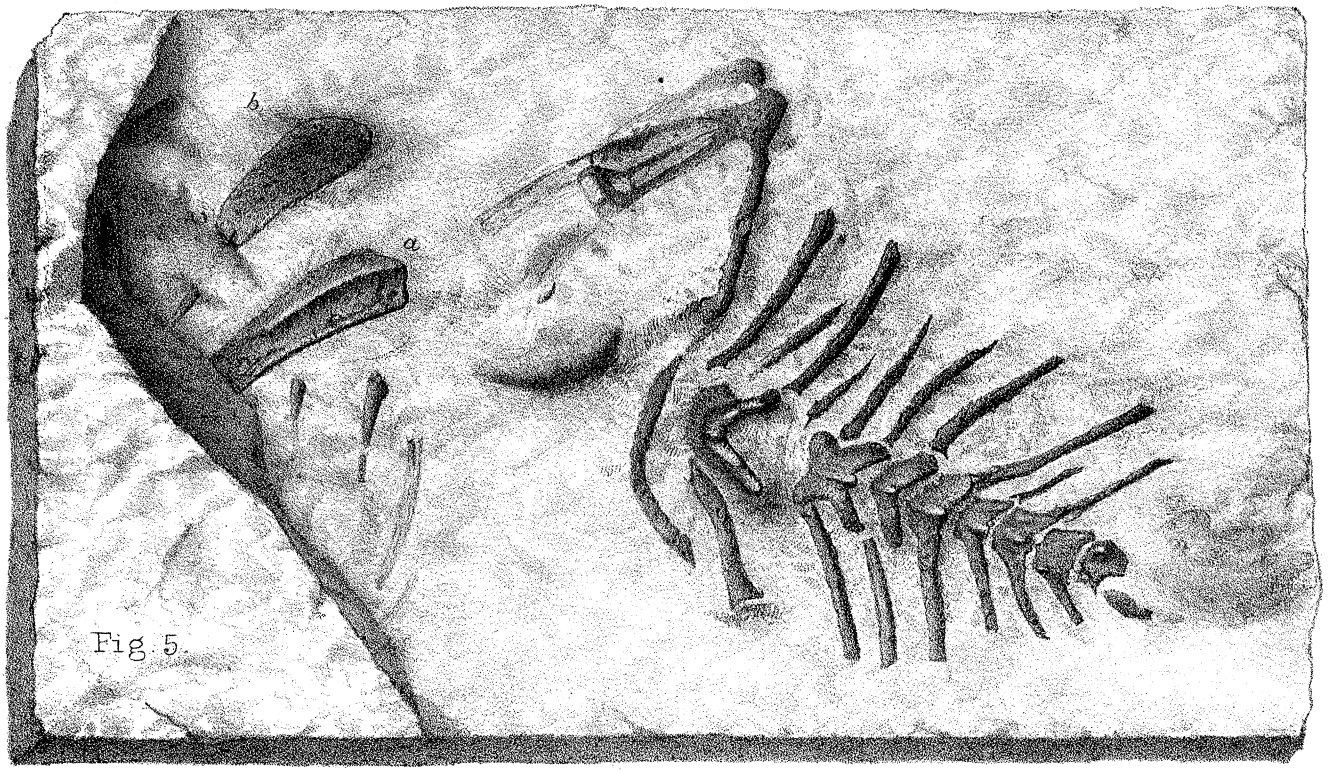


Fig. 5.

A.T.Hollick, lith. West, Newman imp.

1-4 Gordonia Duffiana *sp. nov.*
5 Gordonia ?

GORDONIA TRAQUAIRI, sp. nov.

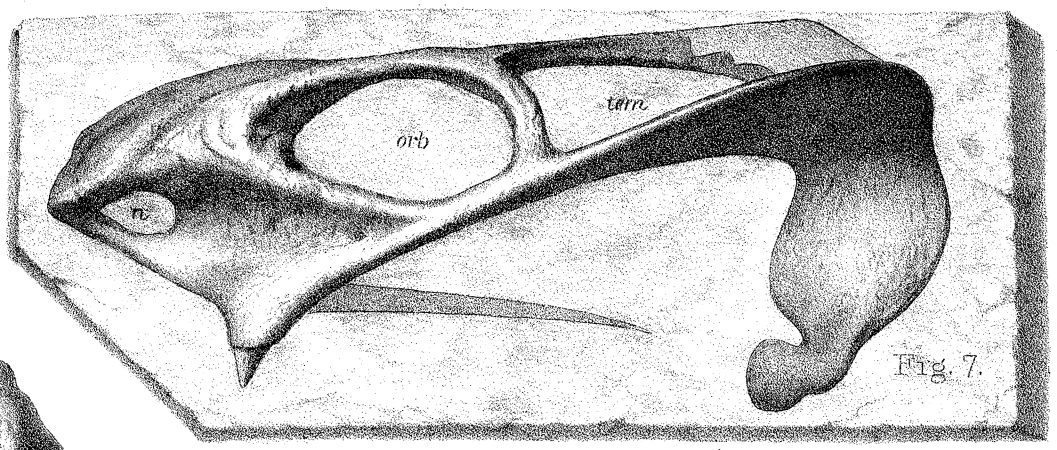


Fig. 7.

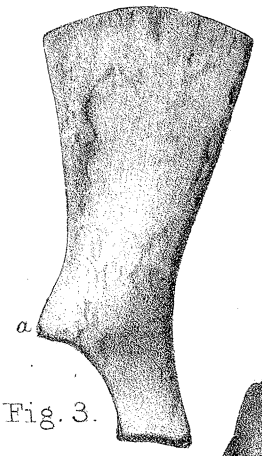


Fig. 3.

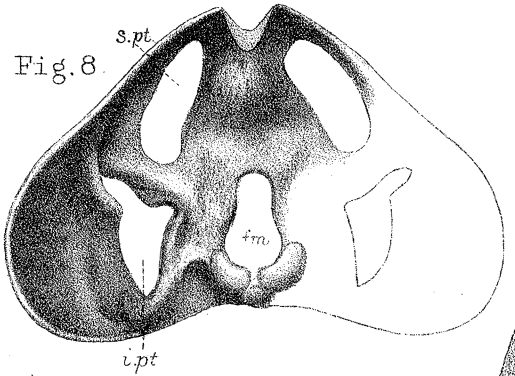


Fig. 8.

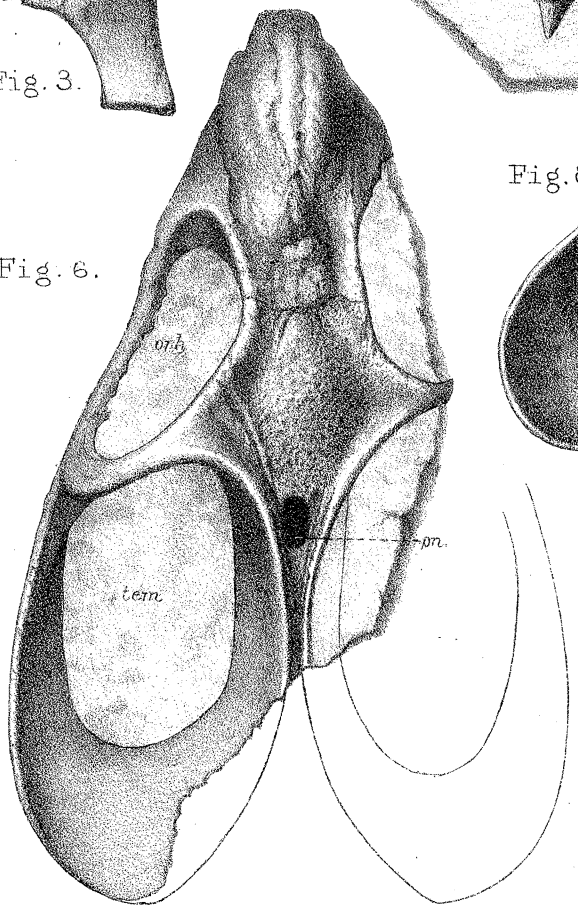


Fig. 6.

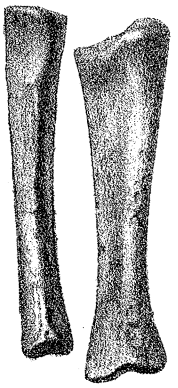


Fig. 5.

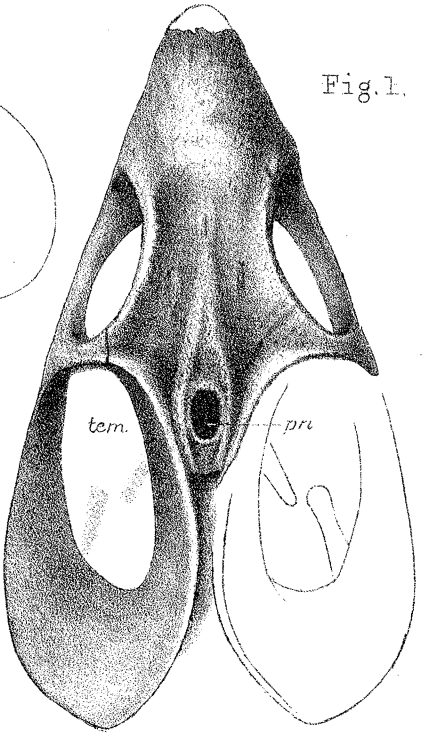


Fig. 1.

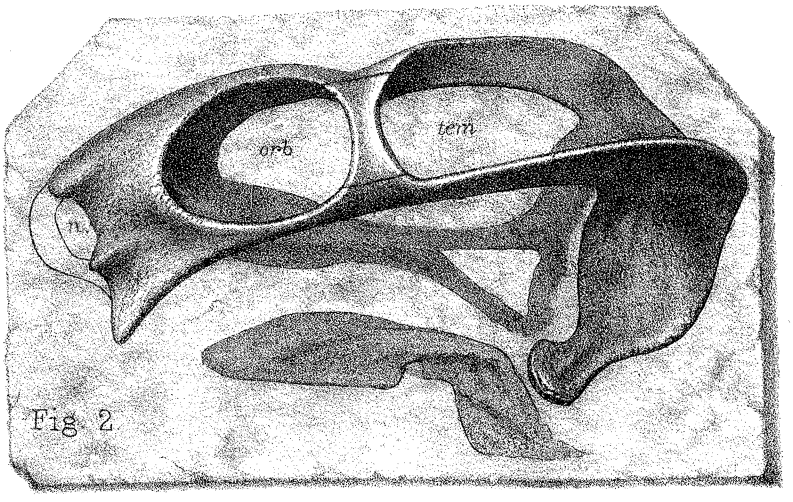


Fig. 2.

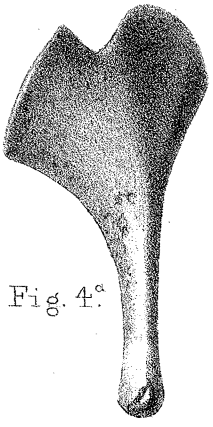


Fig. 4.ª

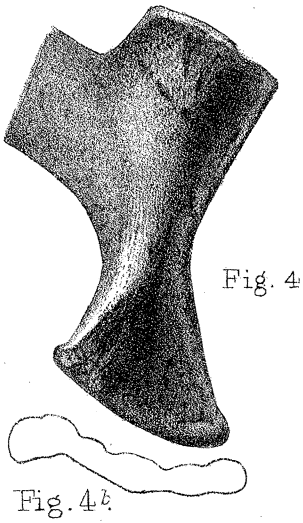


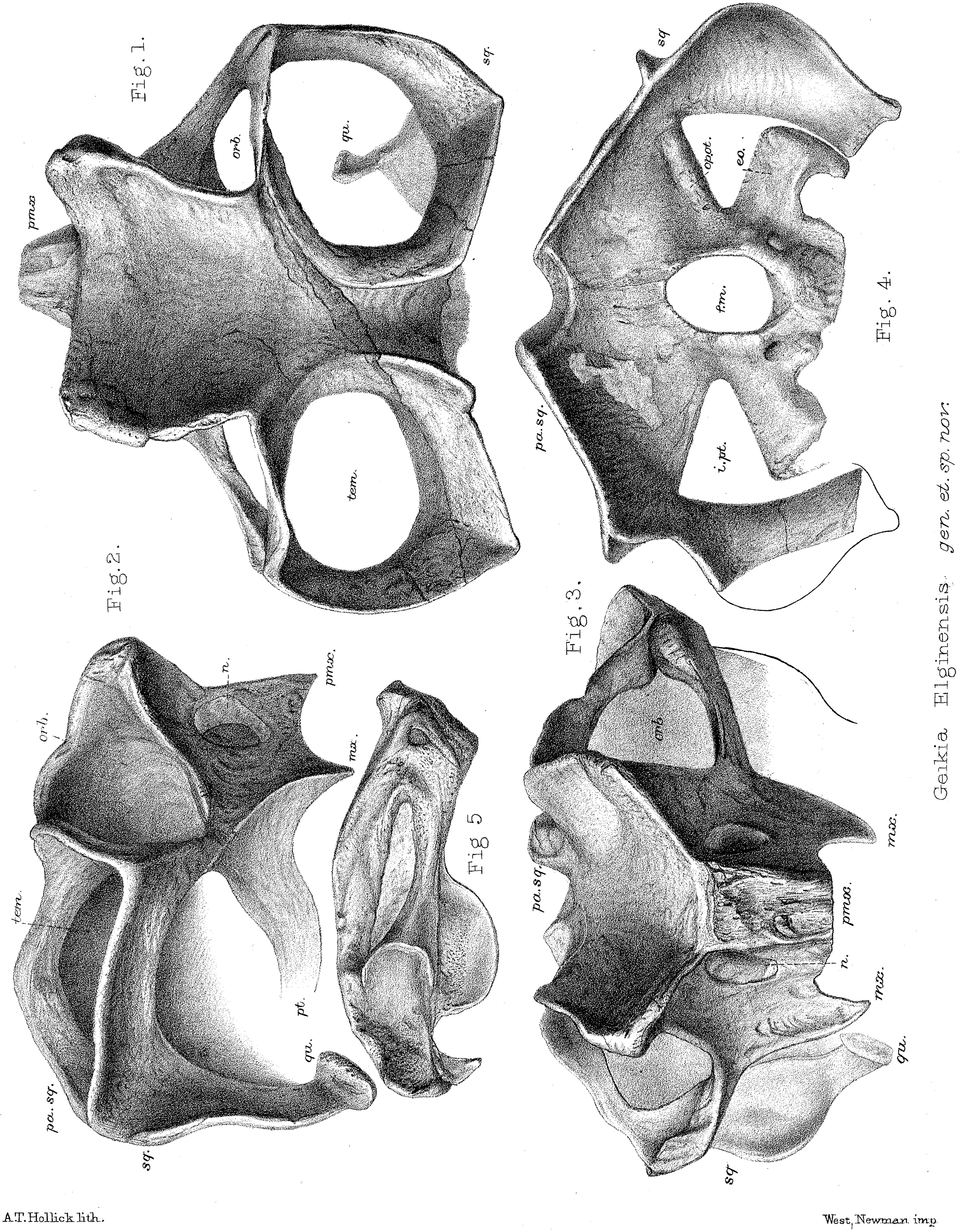
Fig. 4.

Fig. 4.ᵇ

A.T.Hollick lith.

West, Newman imp.

1-5 Gordonia Traquairi, ? *sp. nov.*
6-8 Gordonia Juddiana *sp. nov.*



Geikia Elginensis *gen. et. sp. nov.*

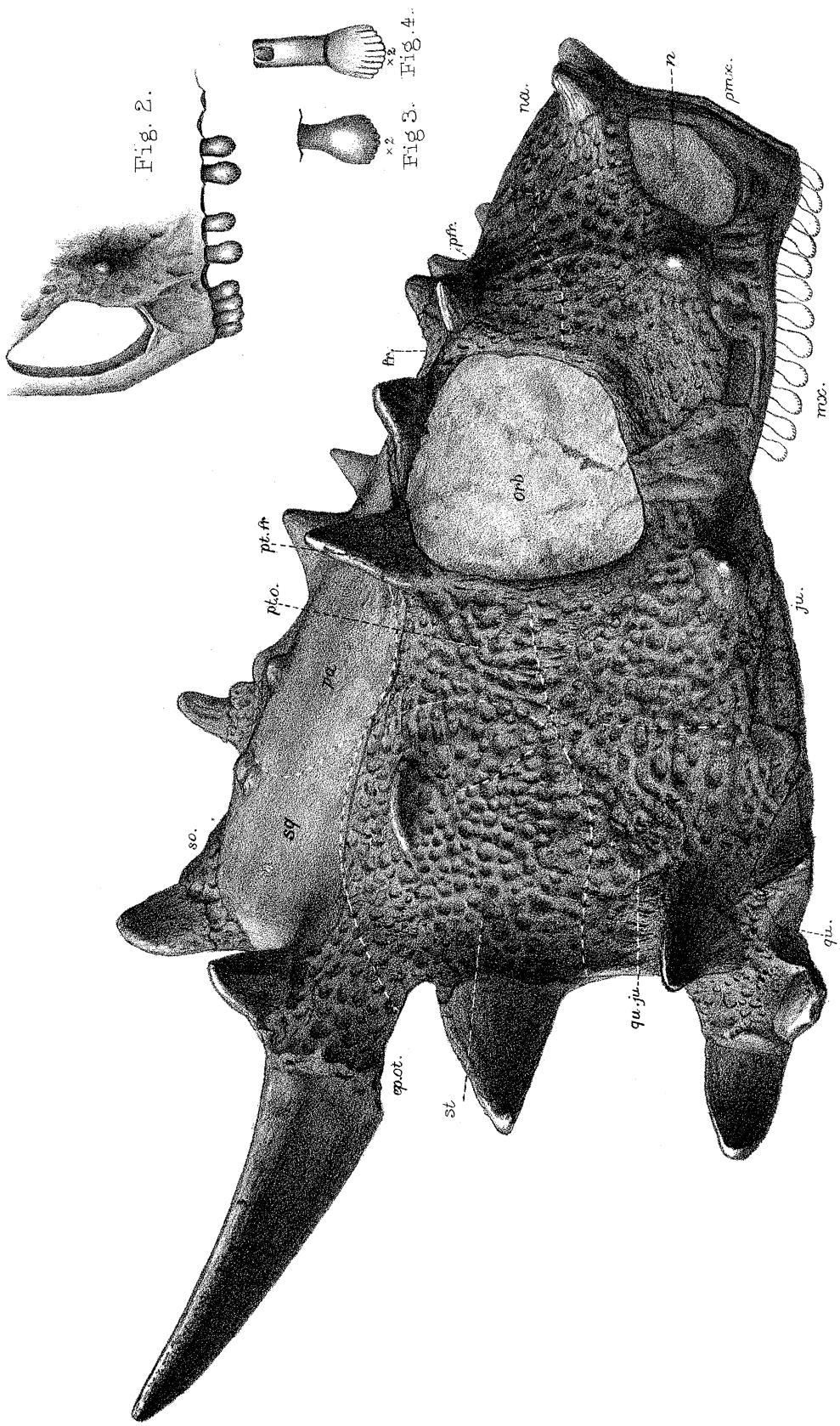
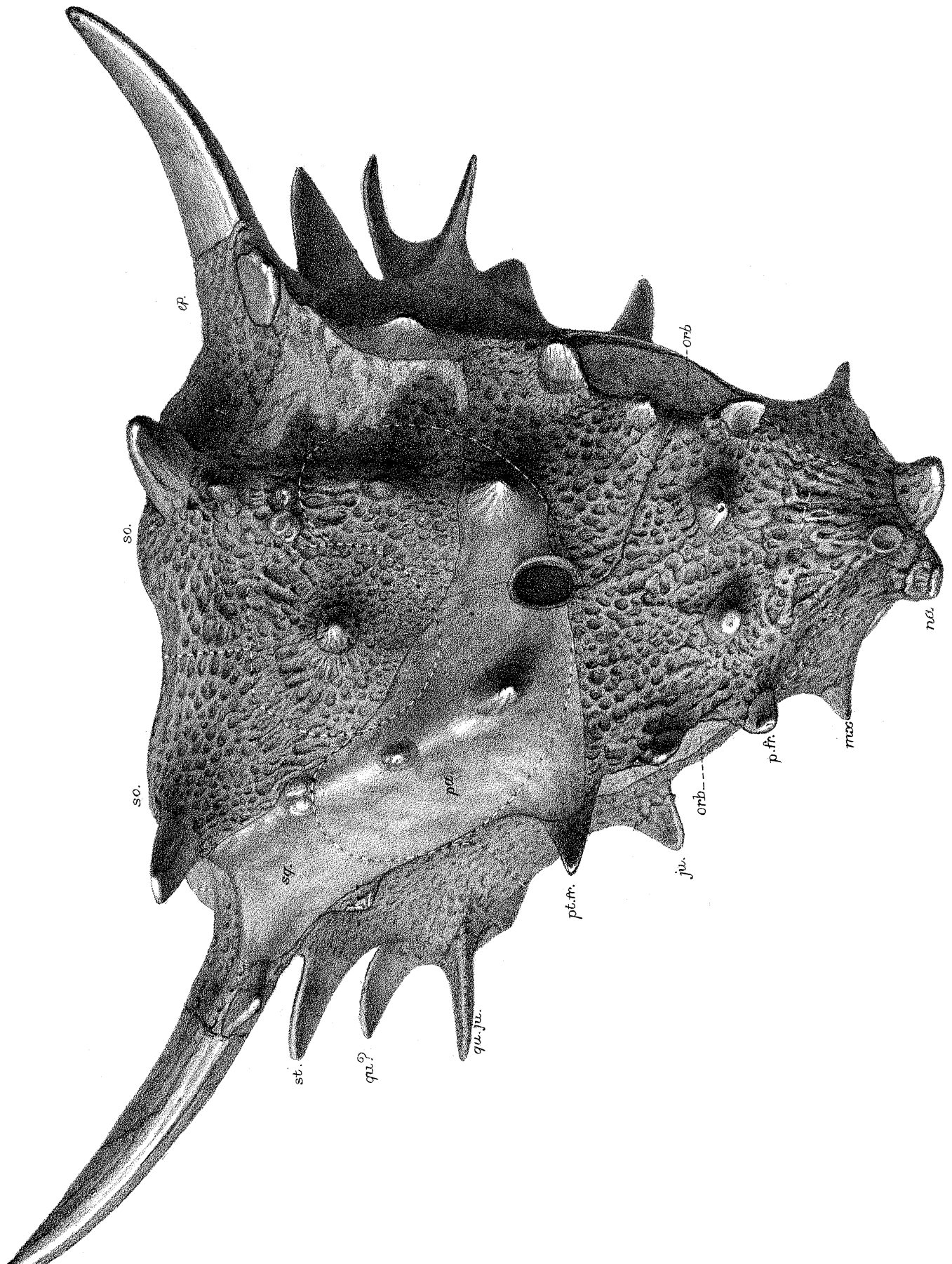
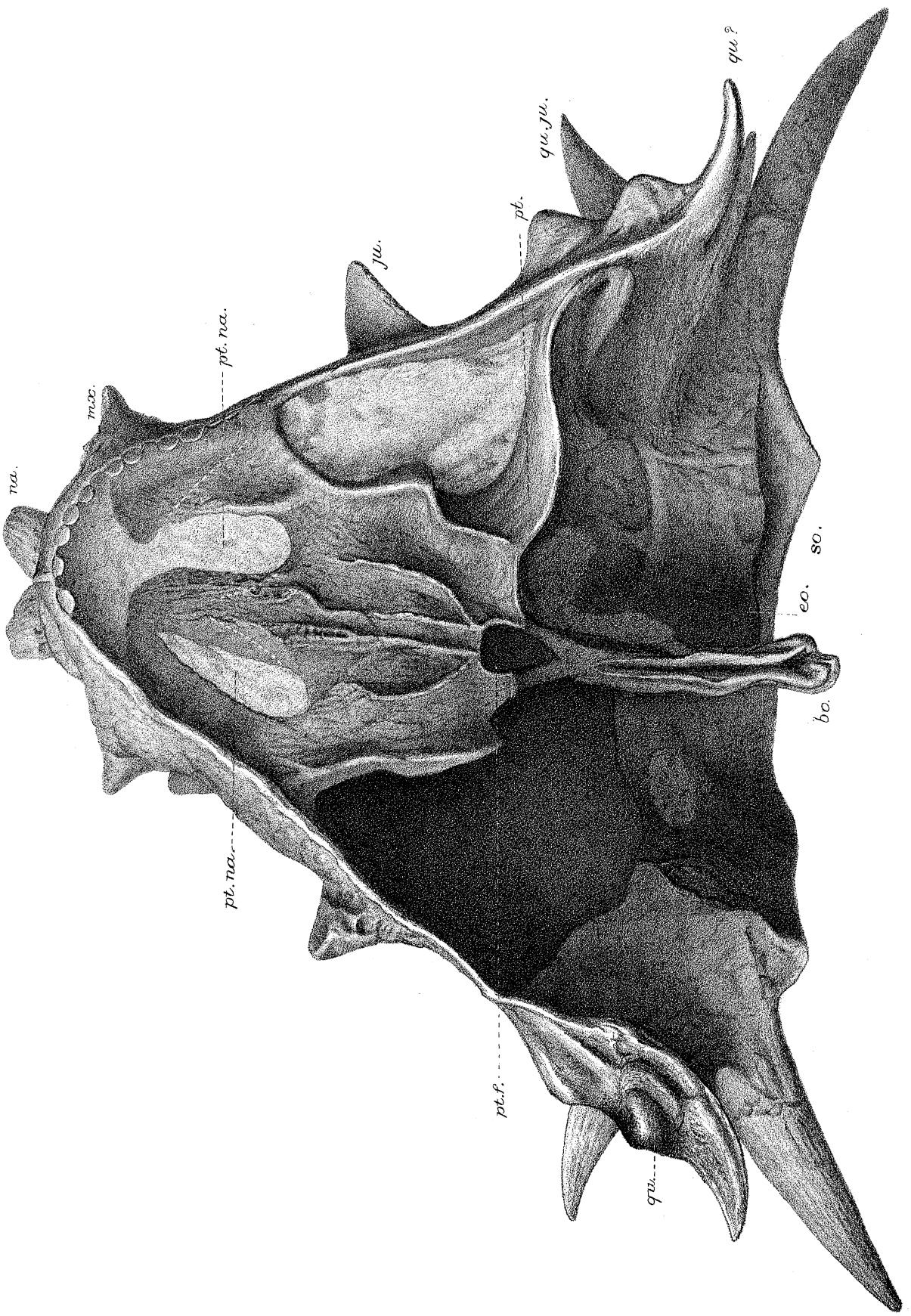


Fig. 1.

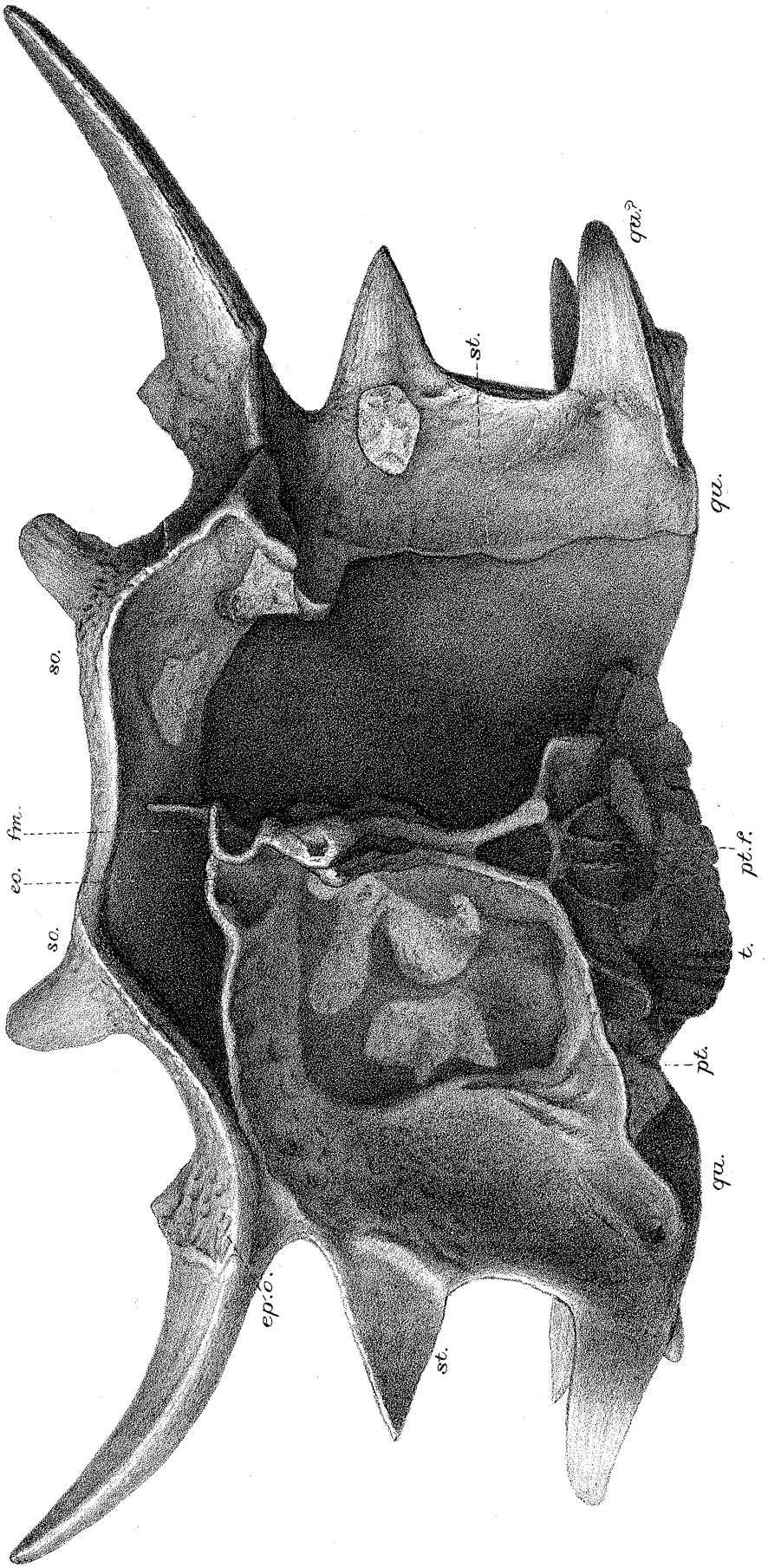
Elginia mirabilis, *gen. et sp. nov.*



Elginia mirabilis, *gen. et sp. nov.*



Elginia mirabilis, *gen. et sp. nov.*



Elginia mirabilis, *gen. et sp. nov.*

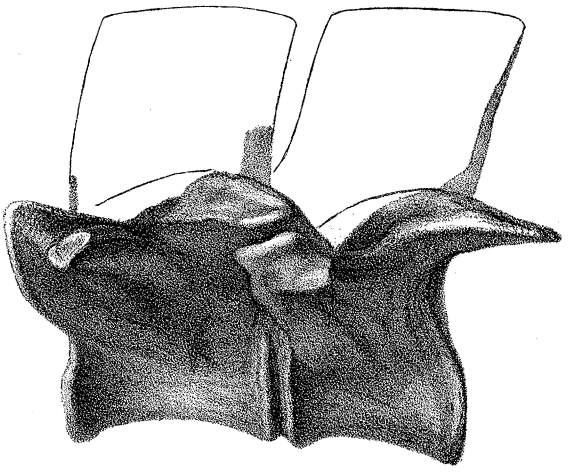


Fig. 1.

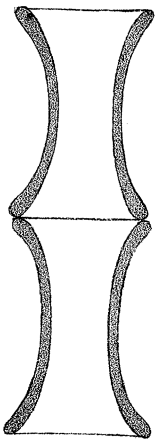


Fig. 3.

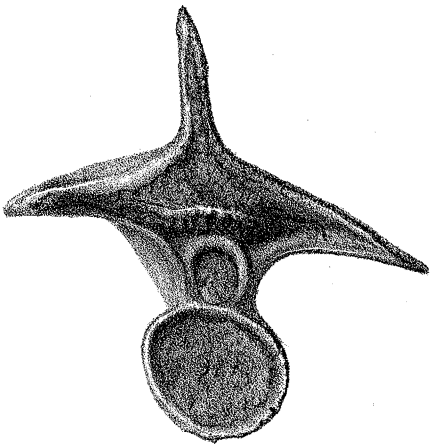


Fig. 2.

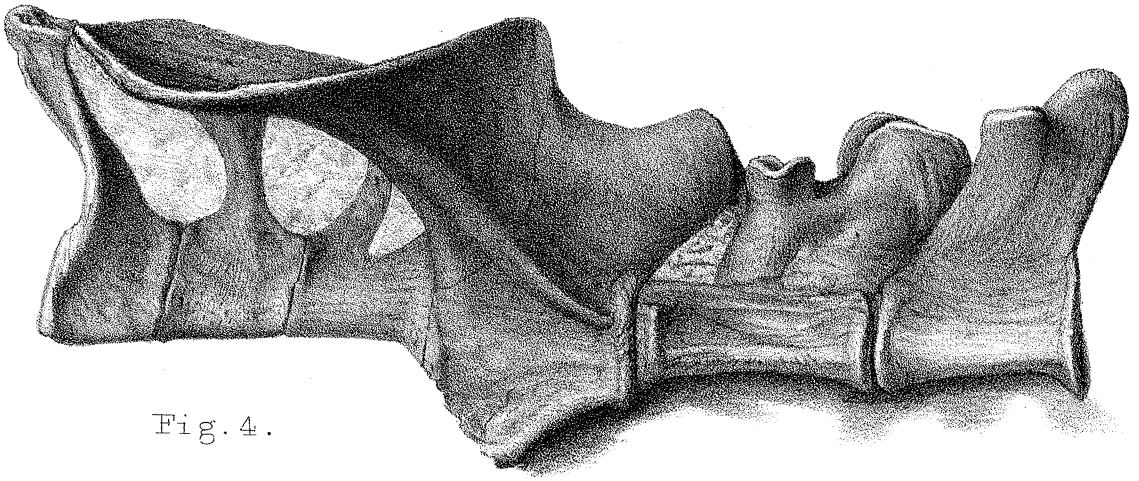


Fig. 4.

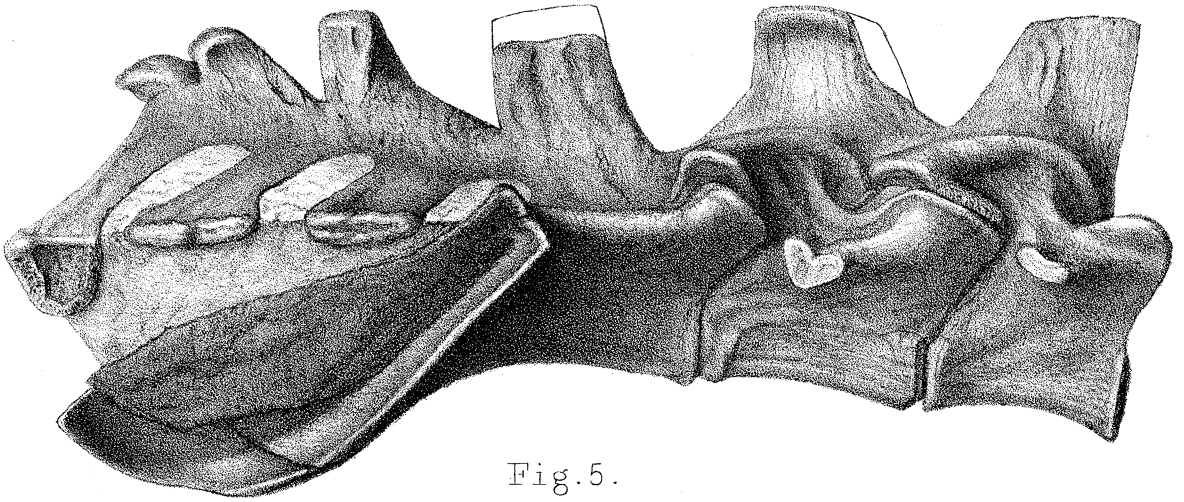


Fig. 5.

A.T.Hollick lith. West, Newman imp.

Sacrum and Vertebræ, *gen.?*

PLATE 26.

Gordonia Traquairi, gen. et sp. nov.

From a photograph of specimen in the possession of the Geological Survey, about one-third natural size.

Fig. 1. Block of stone showing right half of specimen.
Fig. 2. Left half of skull of same specimen.

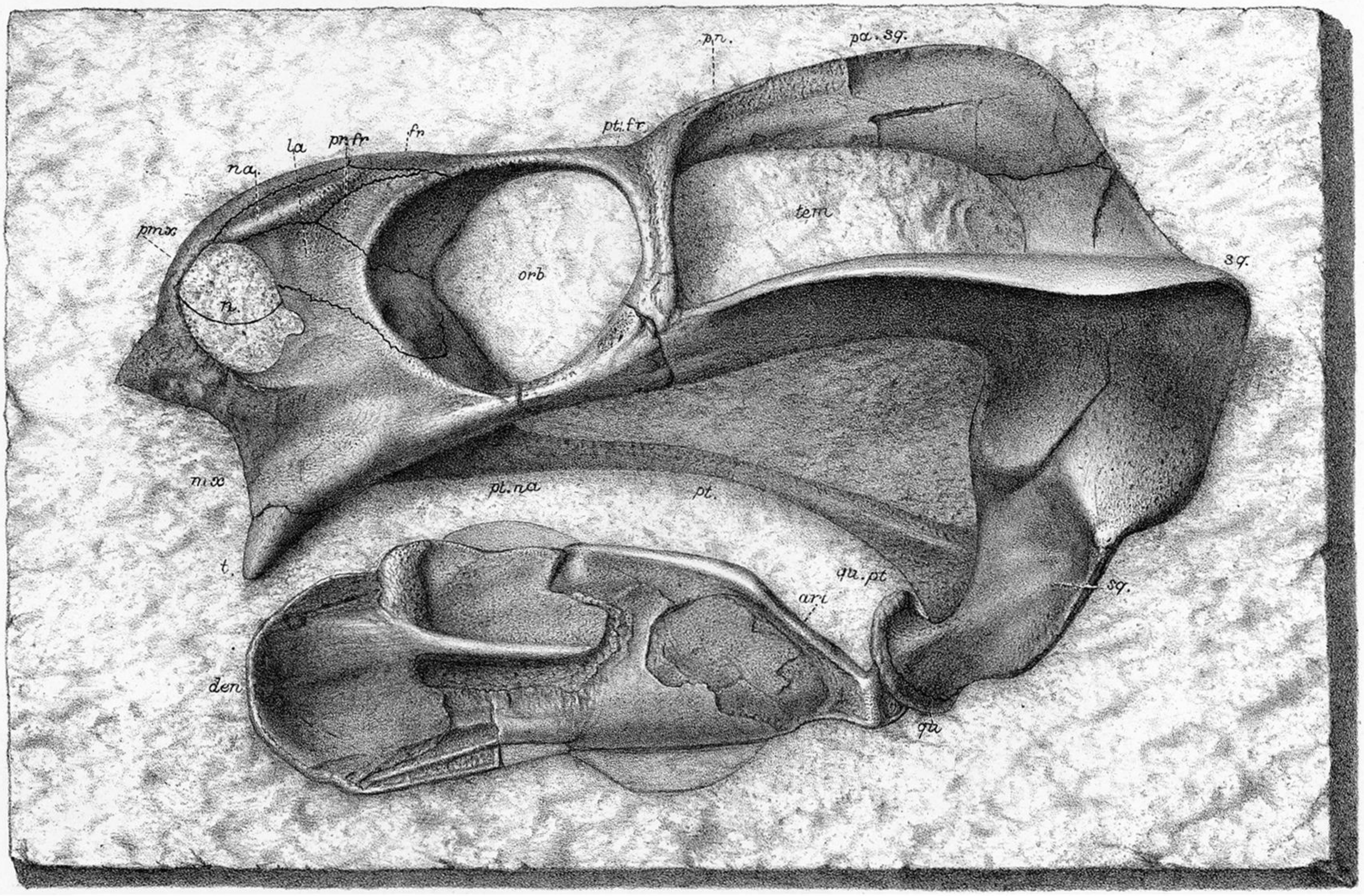


PLATE 27.

Gordonia Traquairi.

Cast from same specimen as Plate 26, fig. 2. Left side of skull and lower jaw. Natural size.

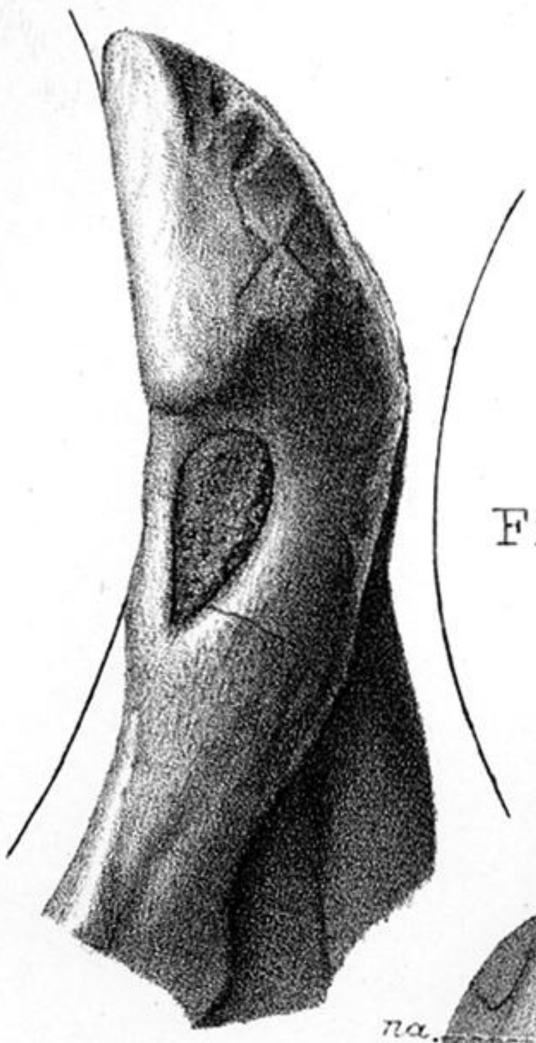


Fig. 3.

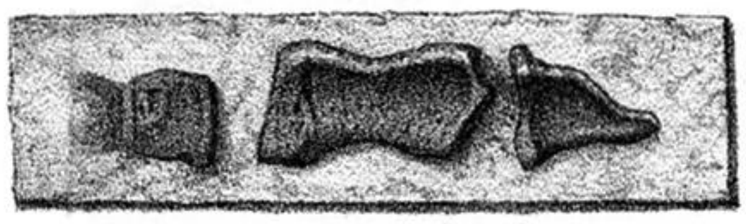


Fig. 5.

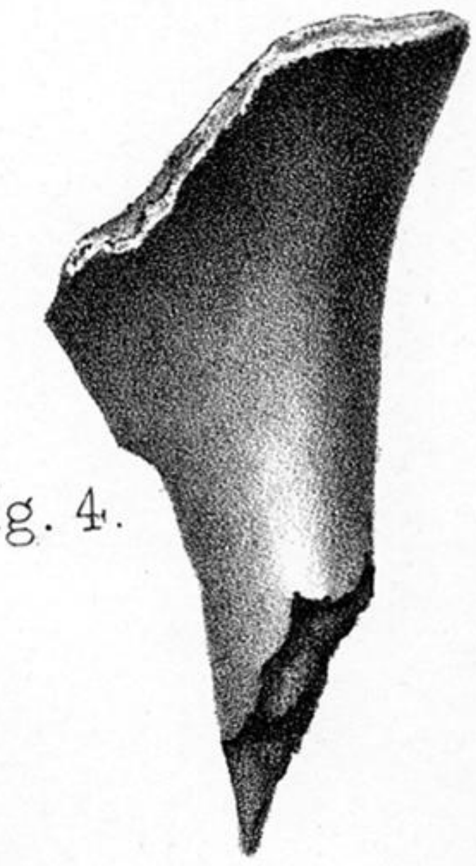


Fig. 4.

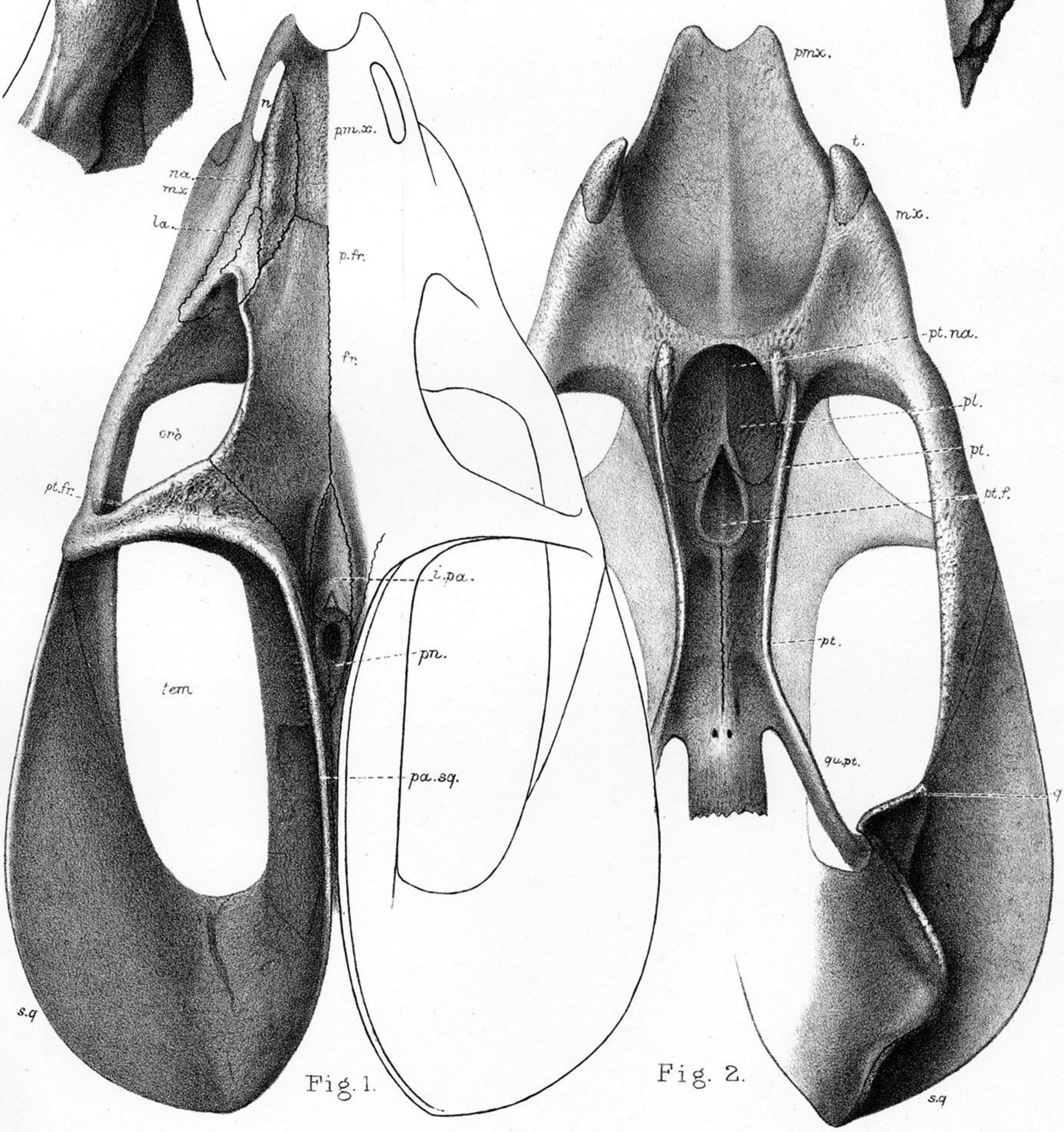


Fig. 1.

Fig. 2.

Gordonia Traquairi, *sp. nov.*

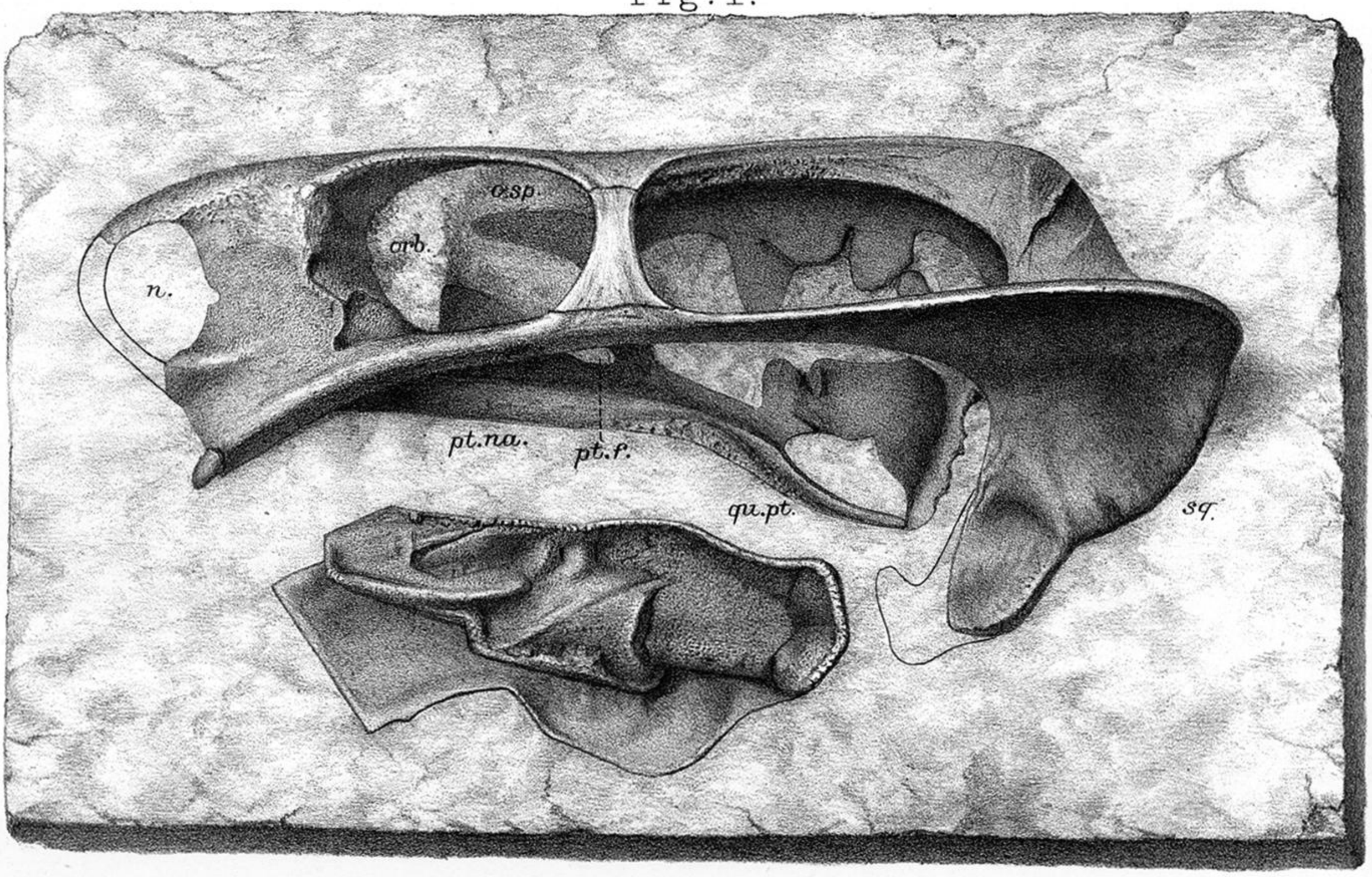
PLATE 28.

Gordonia Traquairi.

Casts from same specimen as Plate 26. All the figures natural size.

Fig. 1. Skull seen from above, with right half restored in outline. The median portions are in part drawn from the right half of the specimen.
Fig. 2. View of palate, partly restored.
Fig. 3. Fragment of humerus showing entepicondylar foramen.
Fig. 4. Same specimen, back view.
Fig. 5. Parts of three caudal vertebræ (?).

Fig. 1.



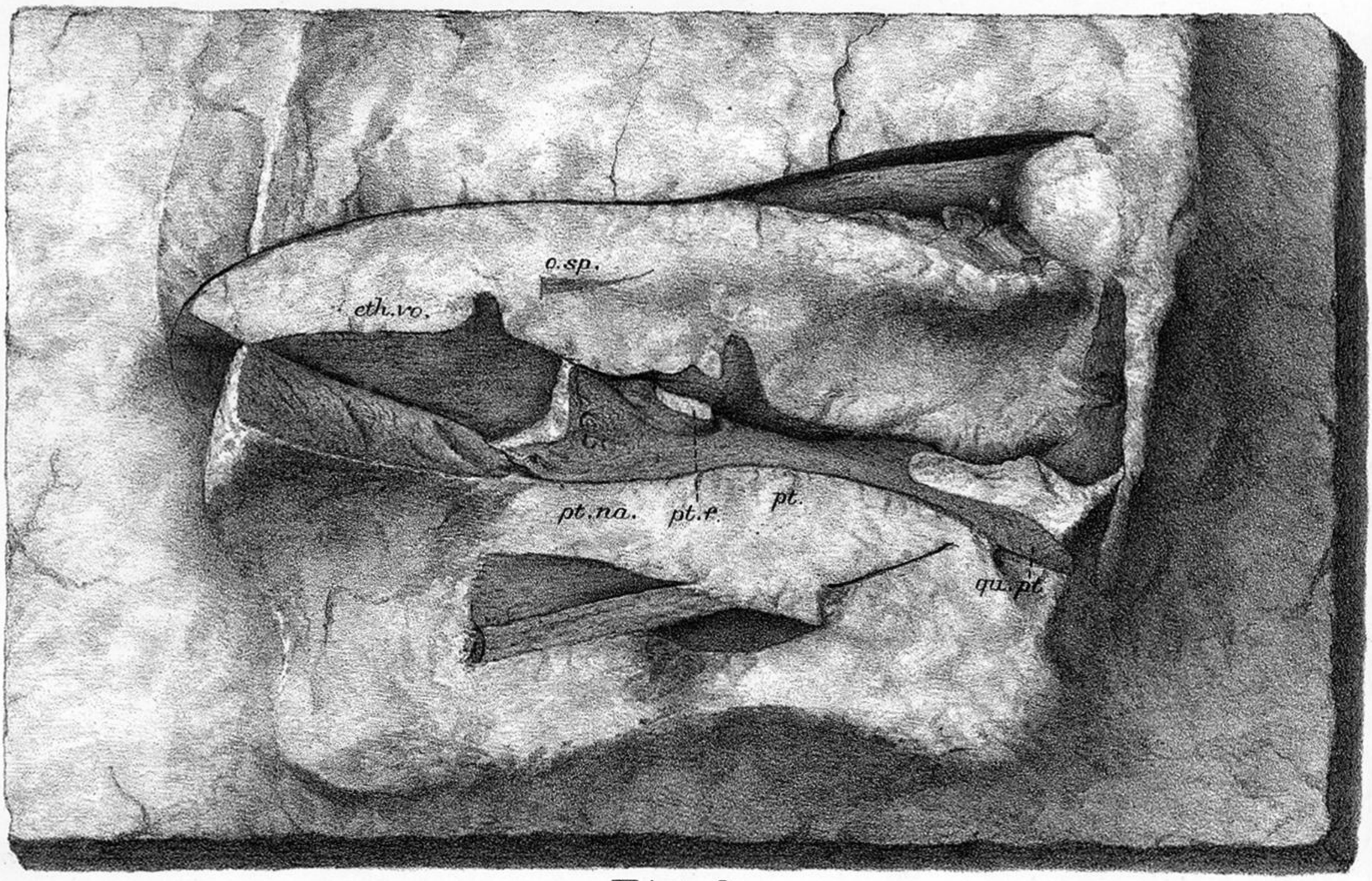


Fig. 2.

PLATE 29.

Gordonia Huxleyana, sp. nov.

Specimen belonging to the Geological Survey. Both figures natural size.

Fig. 1. Left half of skull and lower jaw.

Fig. 2. Right half of skull and lower jaw, drawn from the actual specimen, showing the cavities left by the bones and especially the palate.

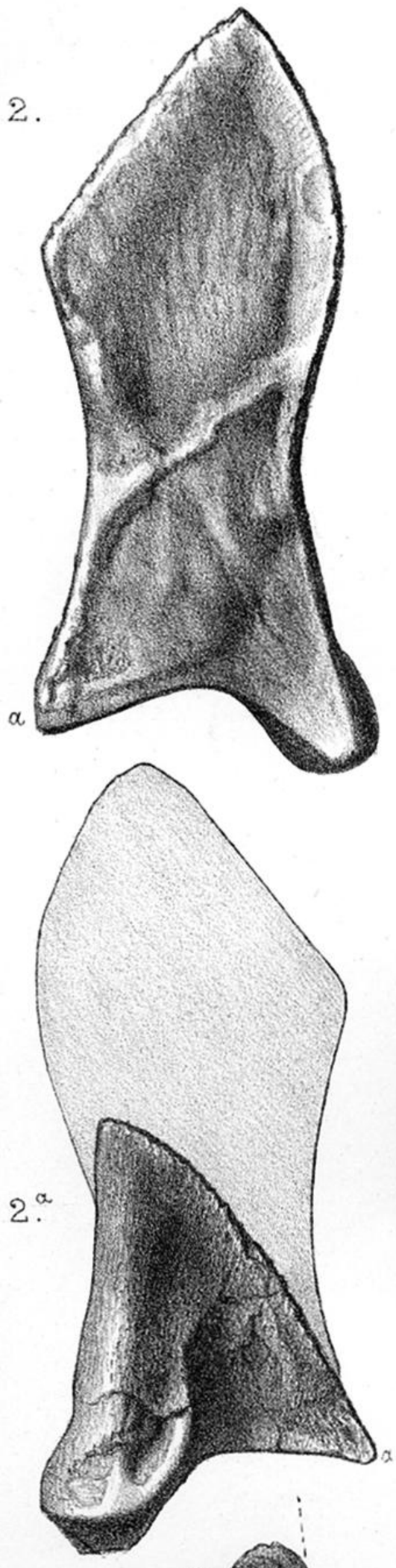


Fig. 2.

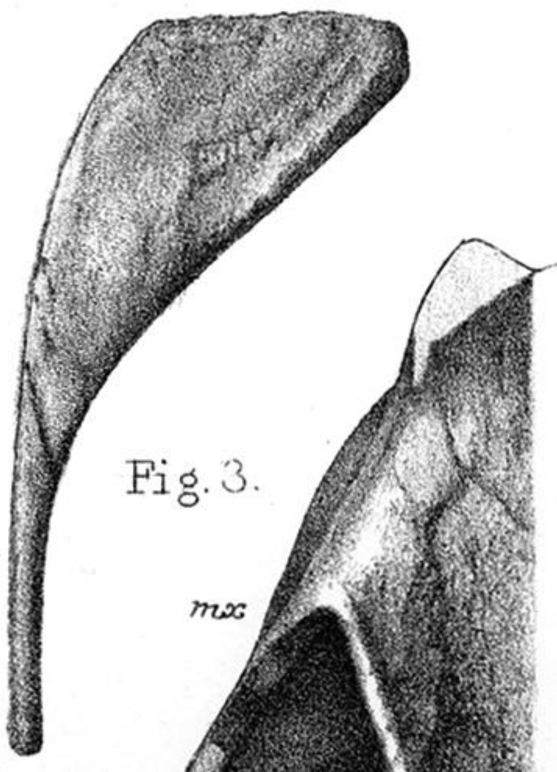


Fig. 3.

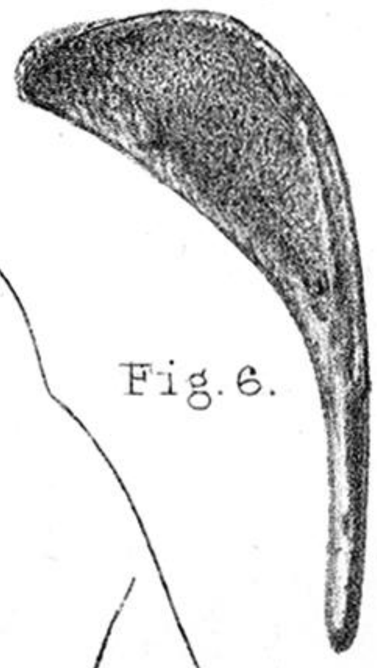


Fig. 6.

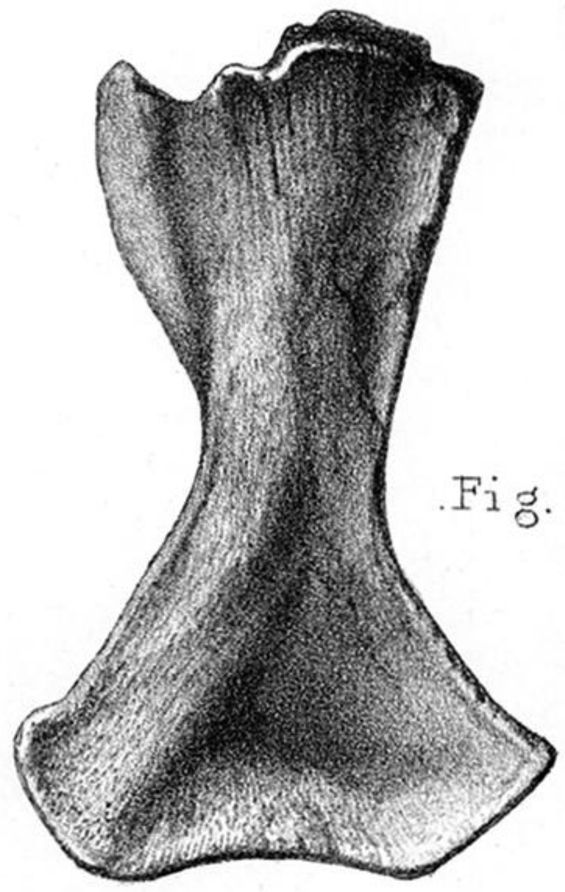


Fig. 8.

Fig. 1.

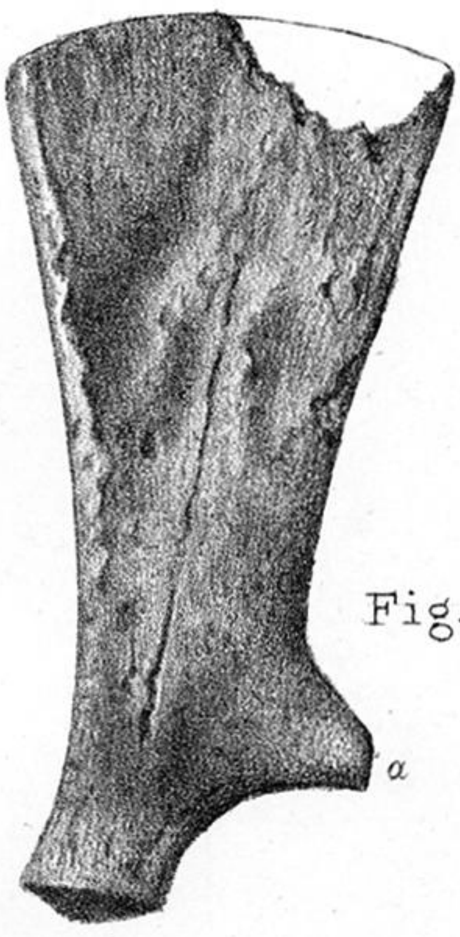


Fig. 7.

Fig. 2.[a]

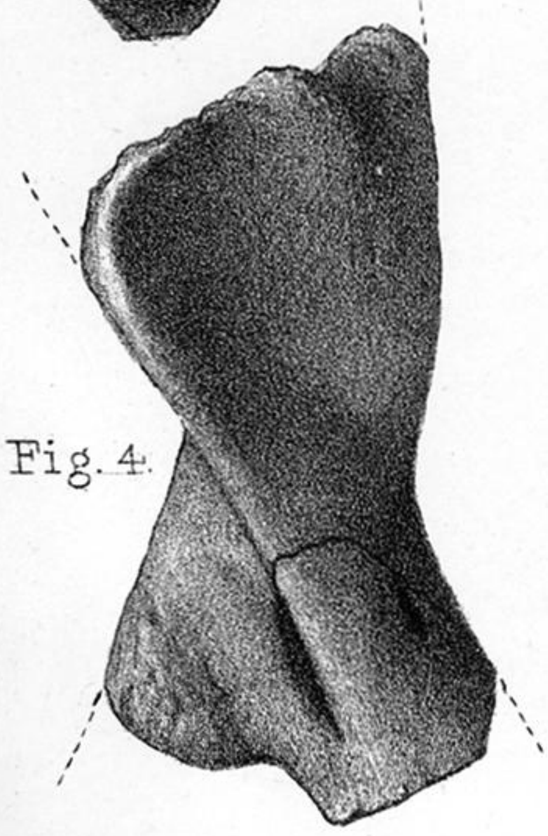


Fig. 4.

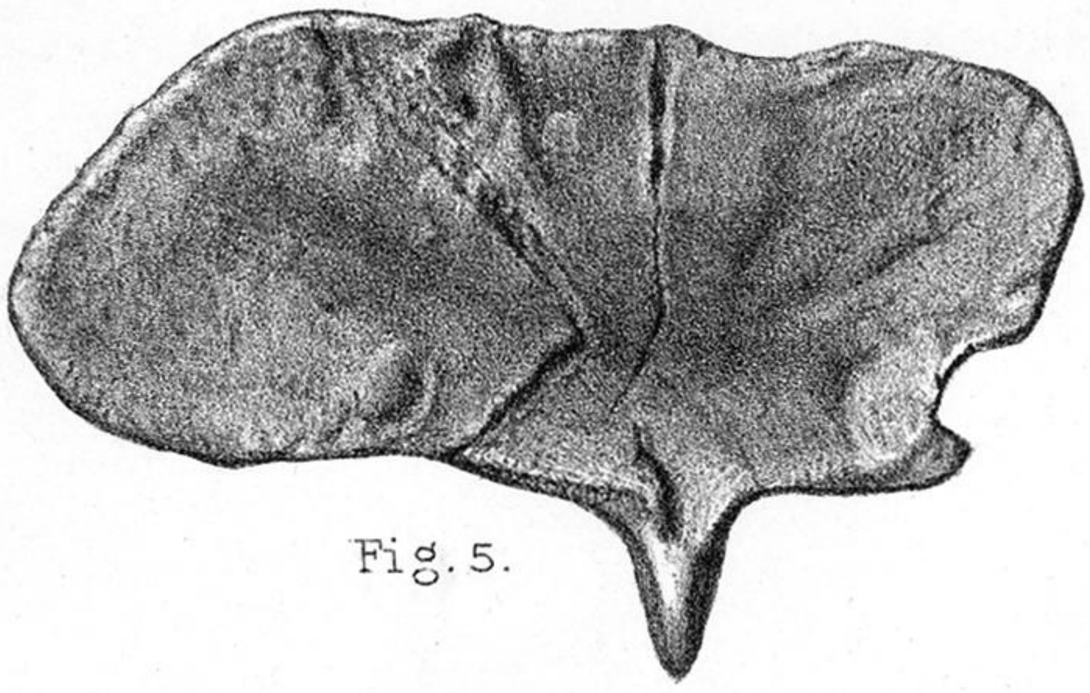


Fig. 5.

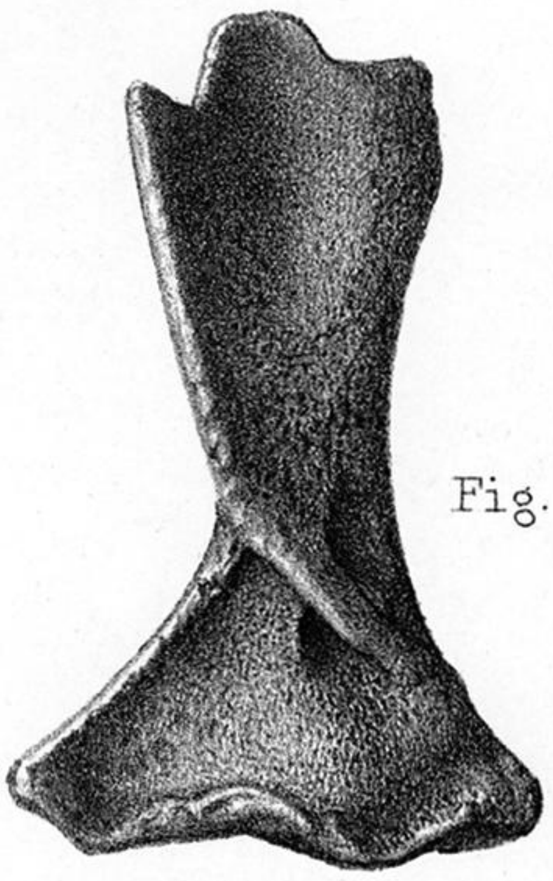


Fig. 9.

PLATE 30.

Gordonia Huxleyana.

Same specimen as Plate 29. All figures natural size.

Fig. 1. Skull seen from above, right side restored in outline.
Fig. 2. Left scapula, outer surface.
Fig. 2*a*. „ „ inner surface.
Fig. 3. Clavicle.
Fig. 4. Right humerus wanting both extremities.
Fig. 5. Left ilium.

Gordonia Huxleyana?

The following figures, 6 to 9, are drawn natural size, from casts of a specimen preserved in the Elgin Museum, which is provisionally referred to this species.

Fig. 6. Clavicle.
Fig. 7. Right scapula, outer surface.
Fig. 8. Left humerus, hinder aspect.
Fig. 9. Right humerus, front aspect.

PLATE 31.

Gordonia Duffiana, sp. nov.

From a photograph of two blocks of stone, about one-third natural size, containing a large part of a skeleton, with a skull. Preserved in the Elgin Museum. There is every reason to believe that this skull was found with and belongs to the trunk, but there is no positive proof that such is the case.

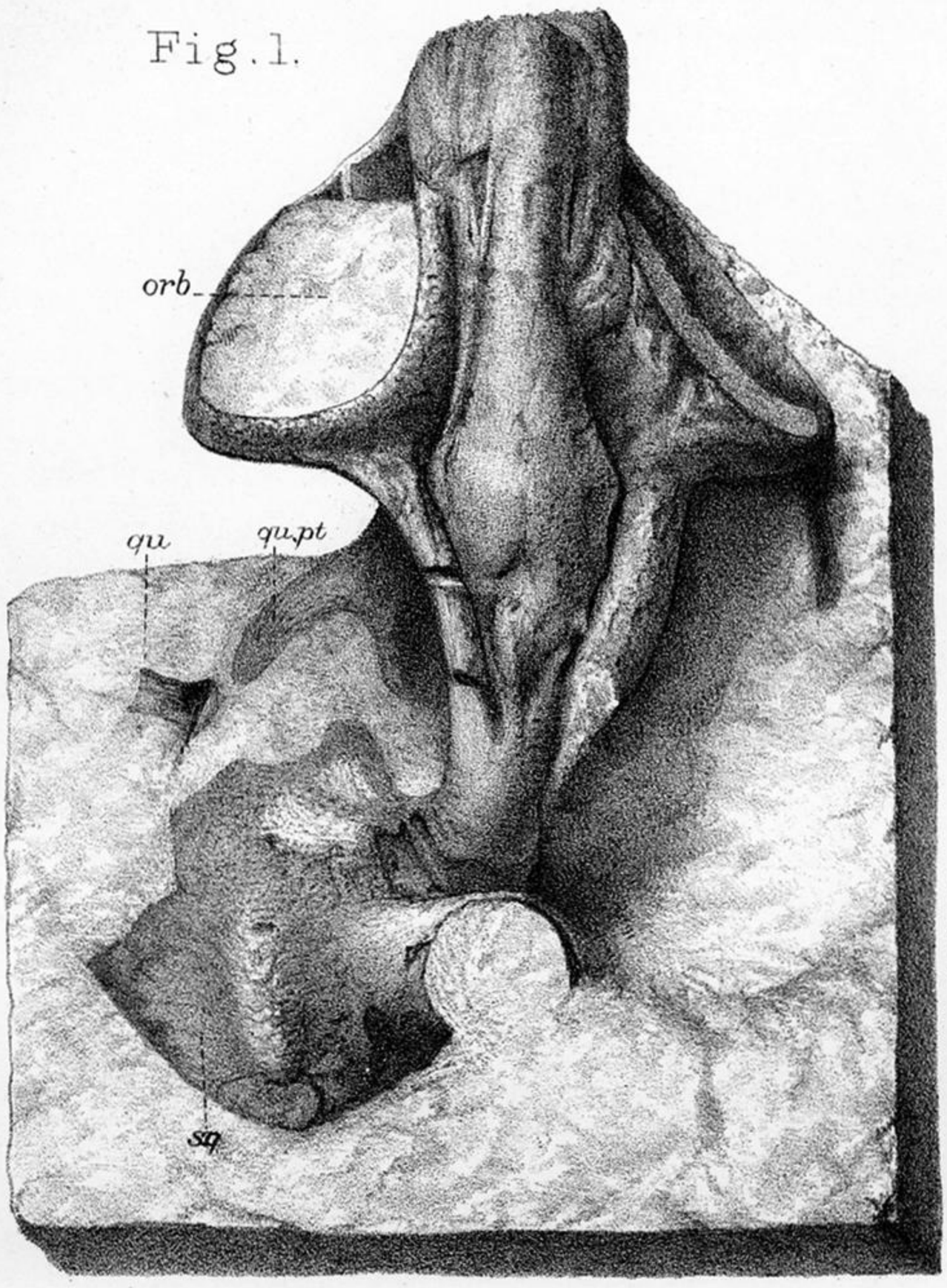


Fig. 1.

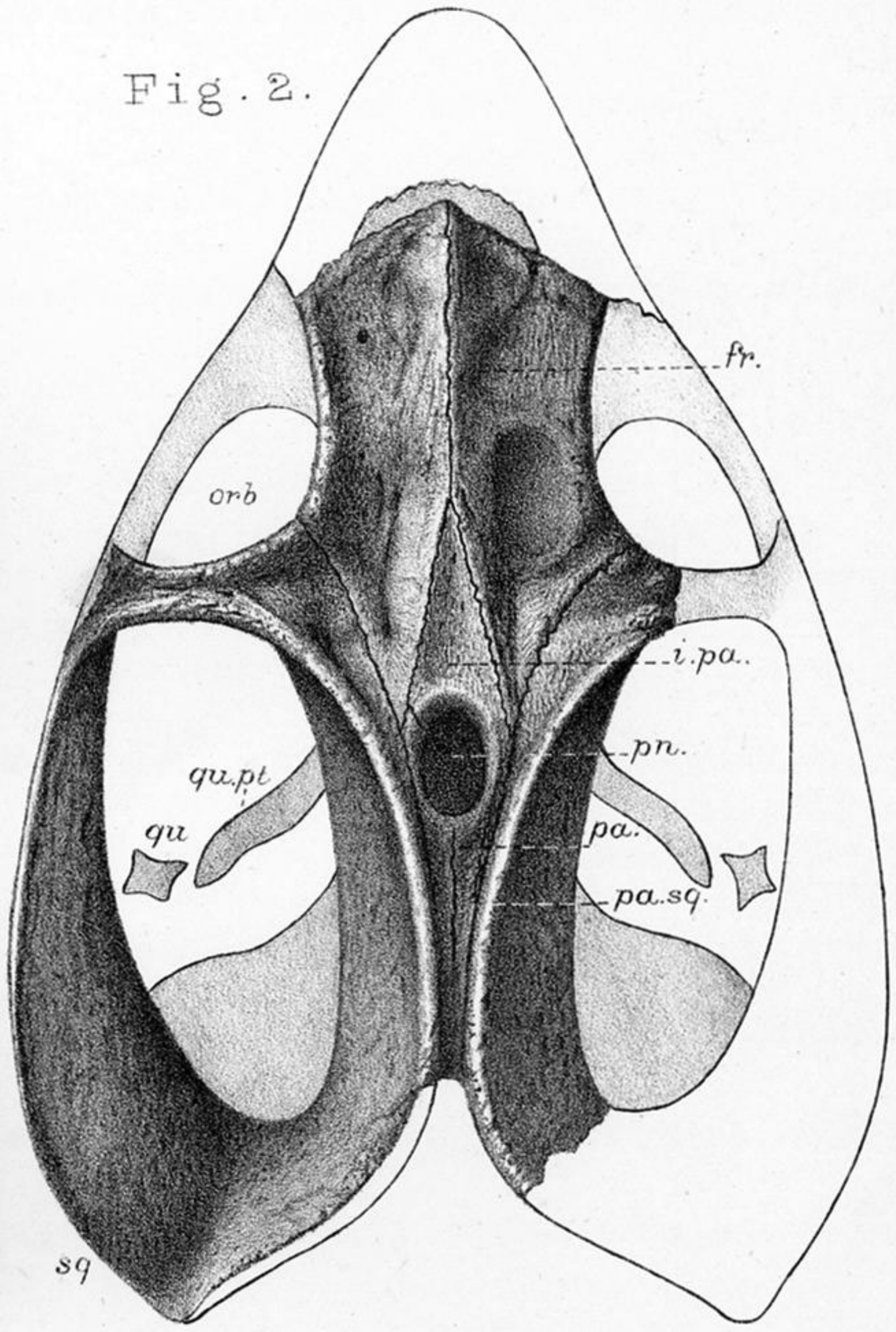


Fig. 2.

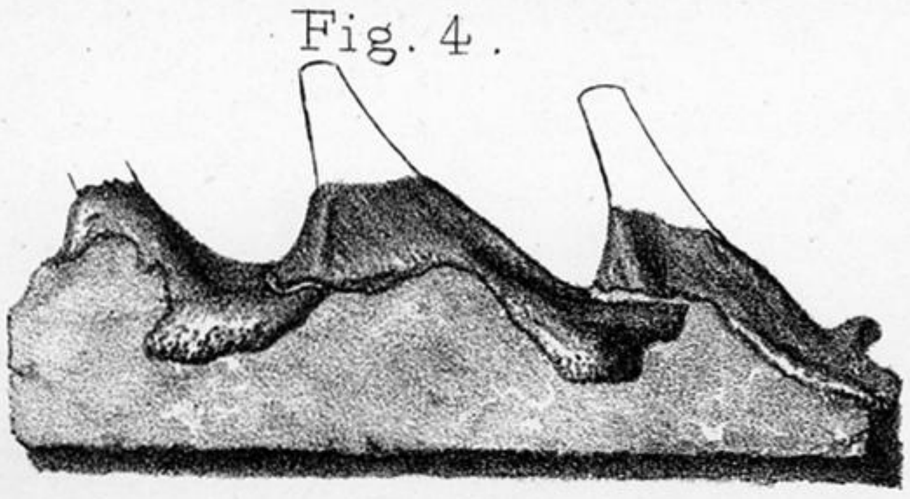
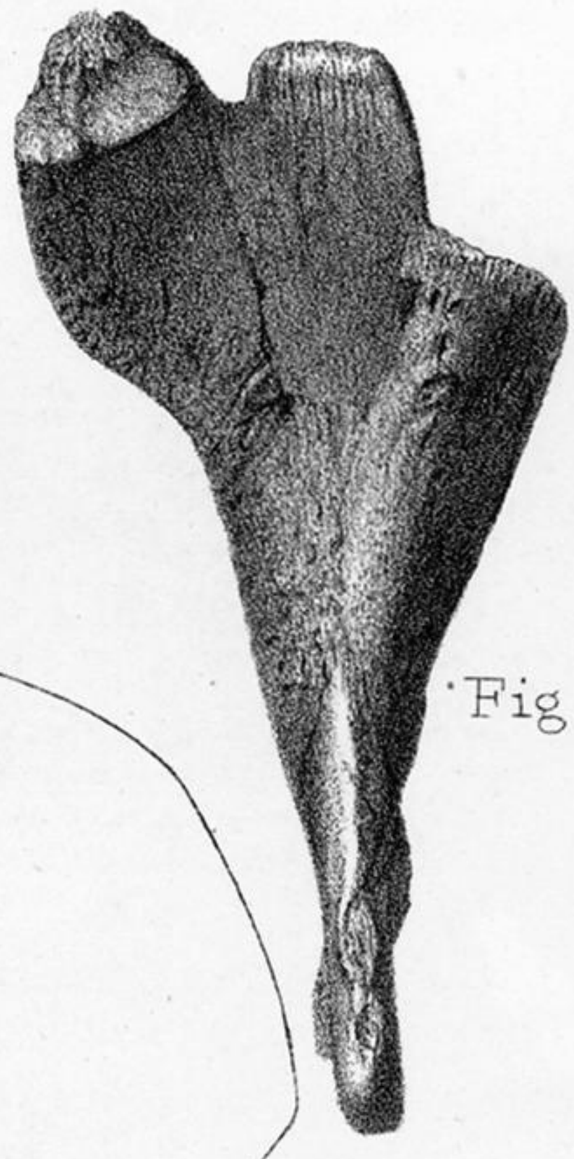


Fig. 4.



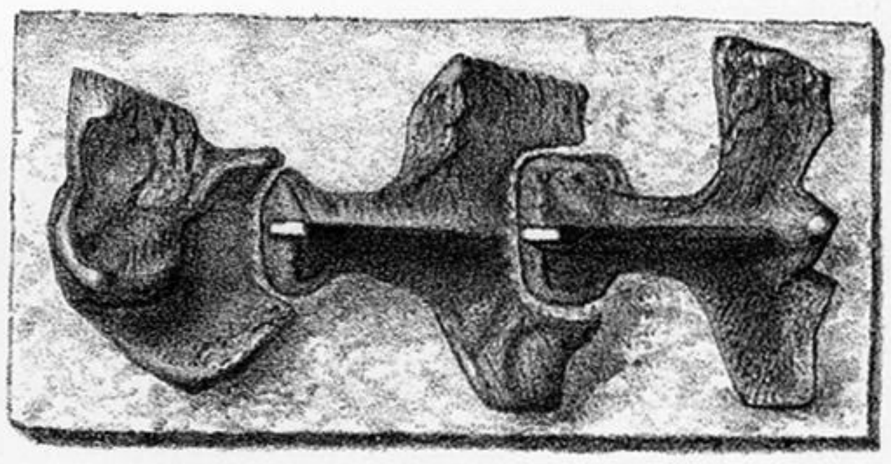


Fig. 5.

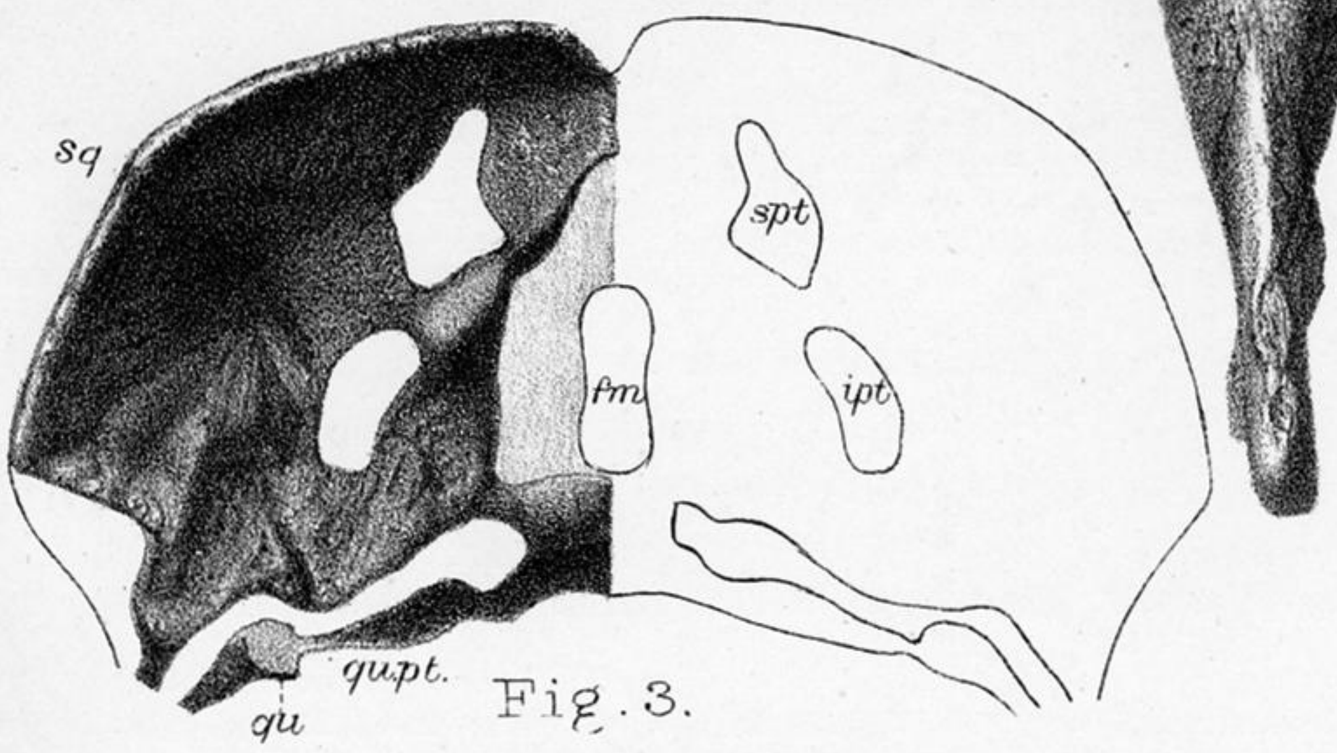


Fig. 3.

Fig. 6.

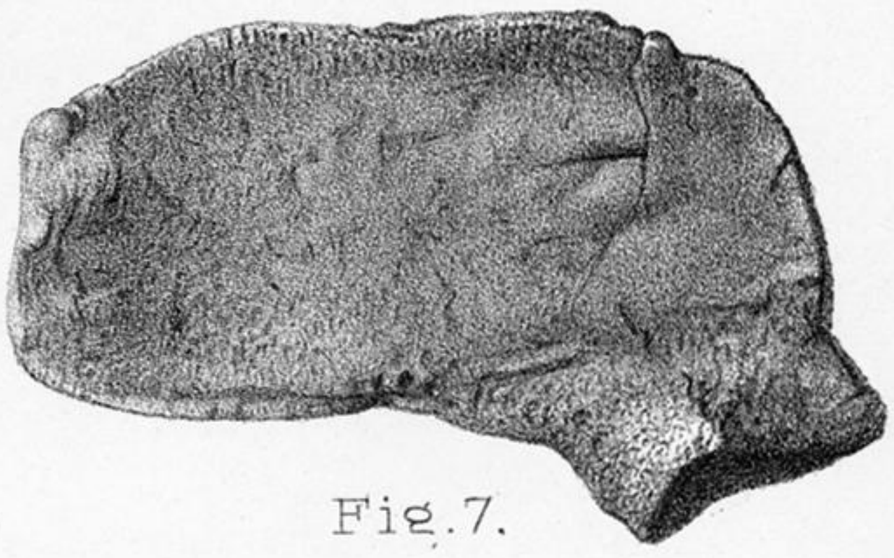


Fig. 7.

Gordonia Duffiana, *sp. nov.*

PLATE 32.

Gordonia Duffiana.

Same specimen as Plate 31. All the figures natural size.

Fig. 1. Natural cast of the inner parts of the skull. The external surface is shown in fig. 2.

Fig. 2. Upper surface of skull, drawn from a cast of the counterpart of fig. 1. Some of the under parts are seen below this, and the right side and muzzle are completed in outline.

Fig. 3. Occiput.

Fig. 4. Parts of neural arches of three dorsal vertebræ seen from the side.

Fig. 5. Same seen from above.

Fig. 6. Humerus, side view.

Fig. 7. Left ilium, outer surface

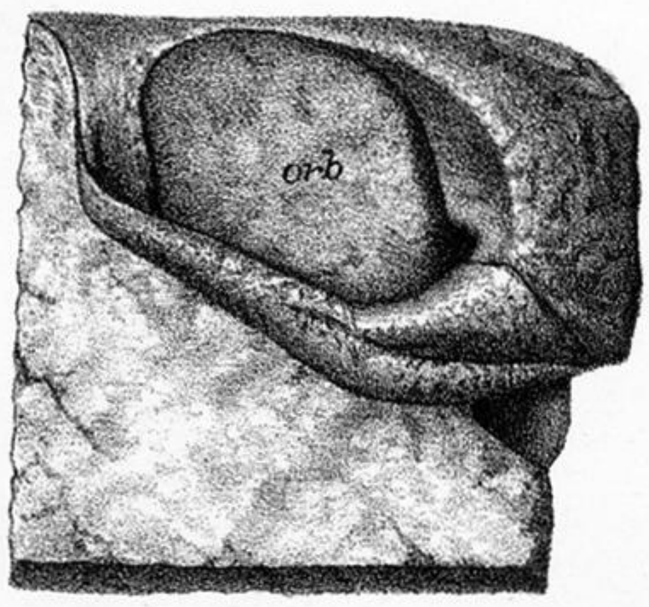


Fig. 2.

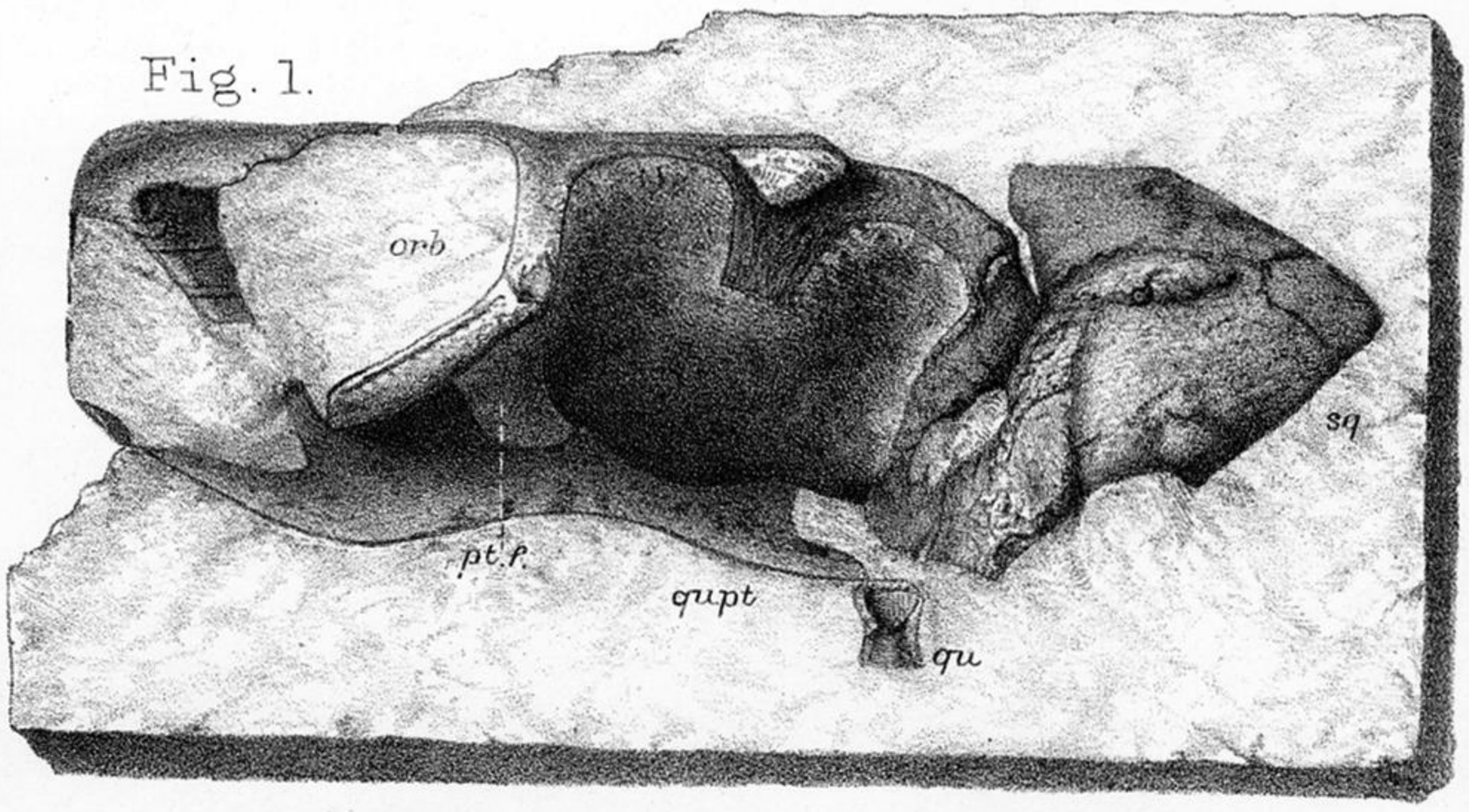


Fig. 1.

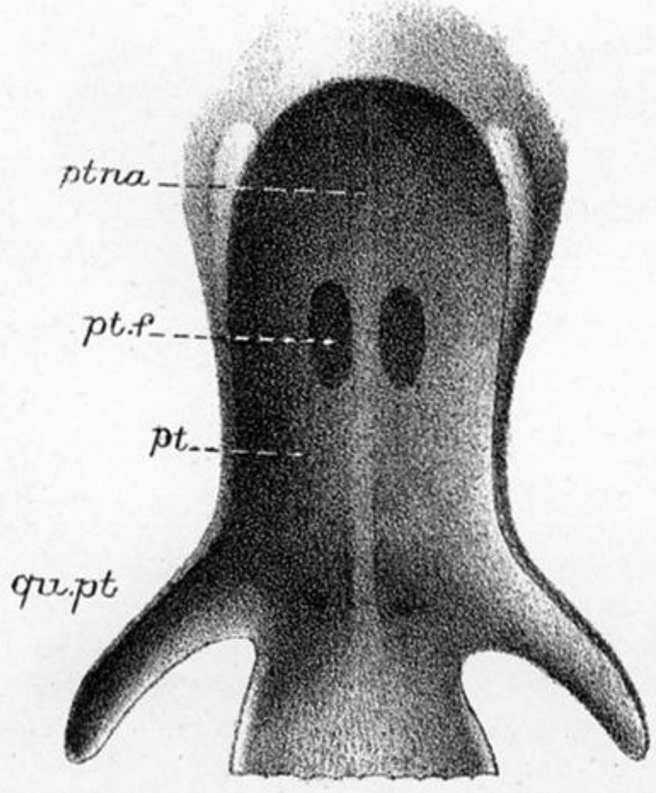


Fig. 4.

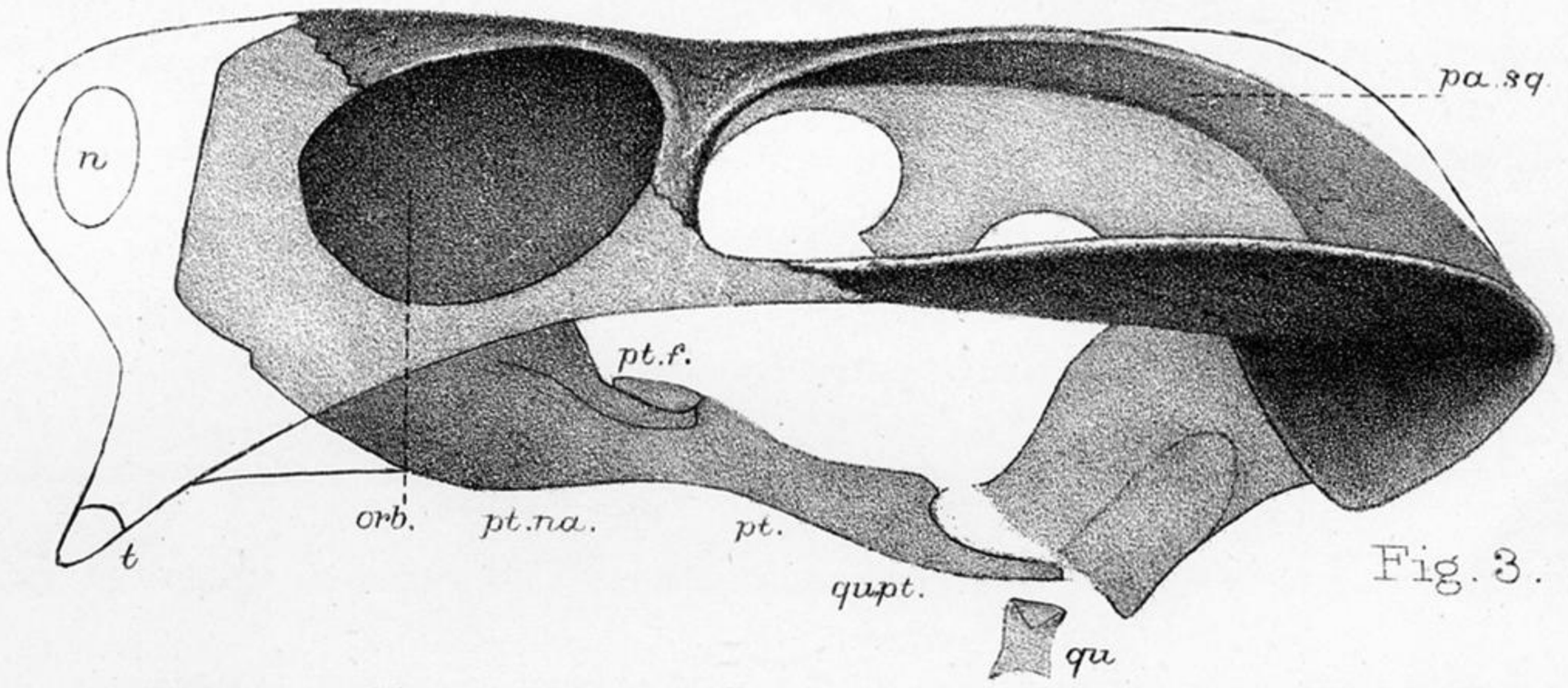


Fig. 3.

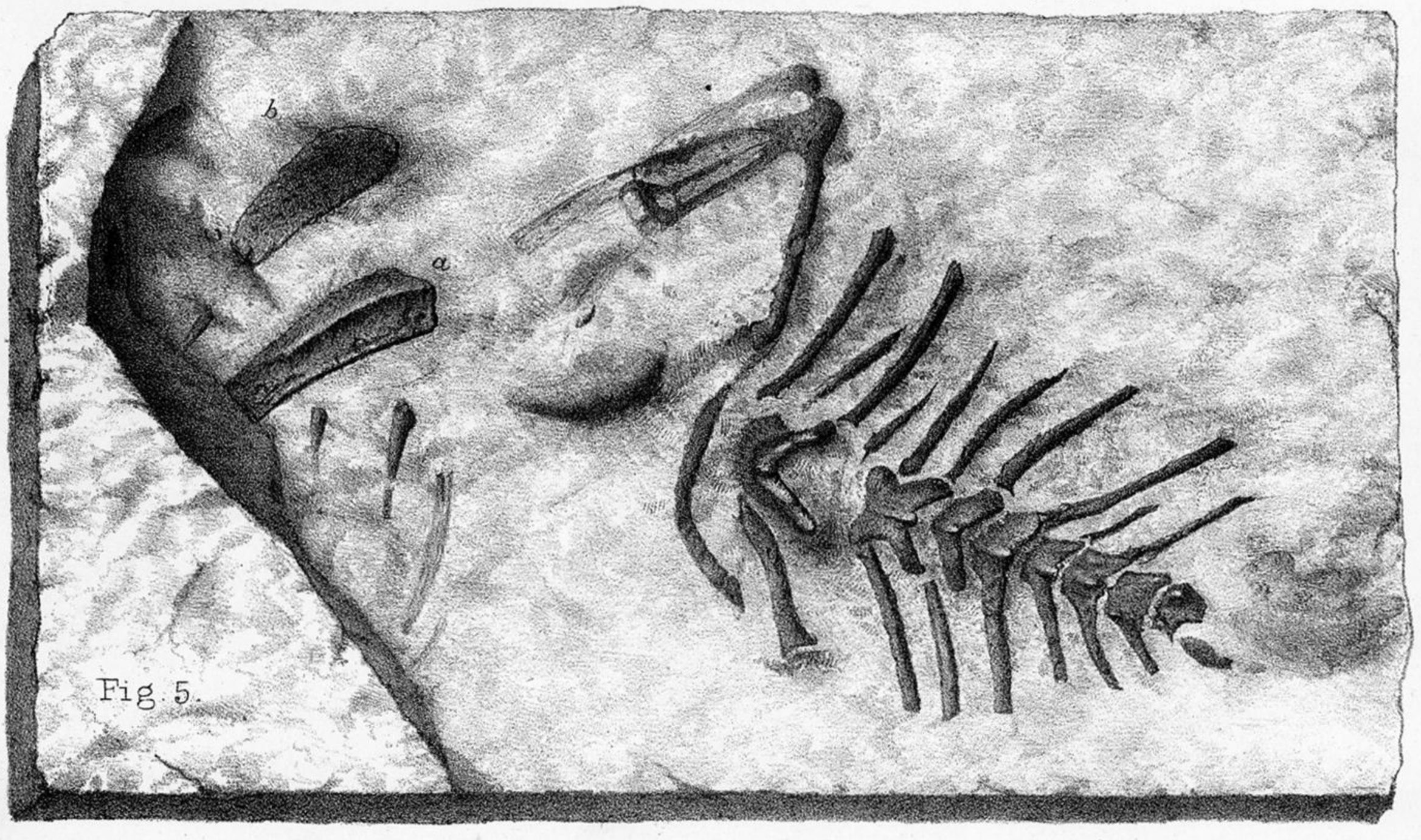


Fig. 5.

1-4 Gordonia Duffiana *sp. nov.*
5 Gordonia ?

PLATE 32.

Gordonia Duffiana.

Same specimen as Plate 31. All the figures natural size.

Fig. 1. Natural cast of the inner parts of the skull. The external surface is shown in fig. 2.

Fig. 2. Upper surface of skull, drawn from a cast of the counterpart of fig. 1. Some of the under parts are seen below this, and the right side and muzzle are completed in outline.

Fig. 3. Occiput.

Fig. 4. Parts of neural arches of three dorsal vertebræ seen from the side.

Fig. 5. Same seen from above.

Fig. 6. Humerus, side view.

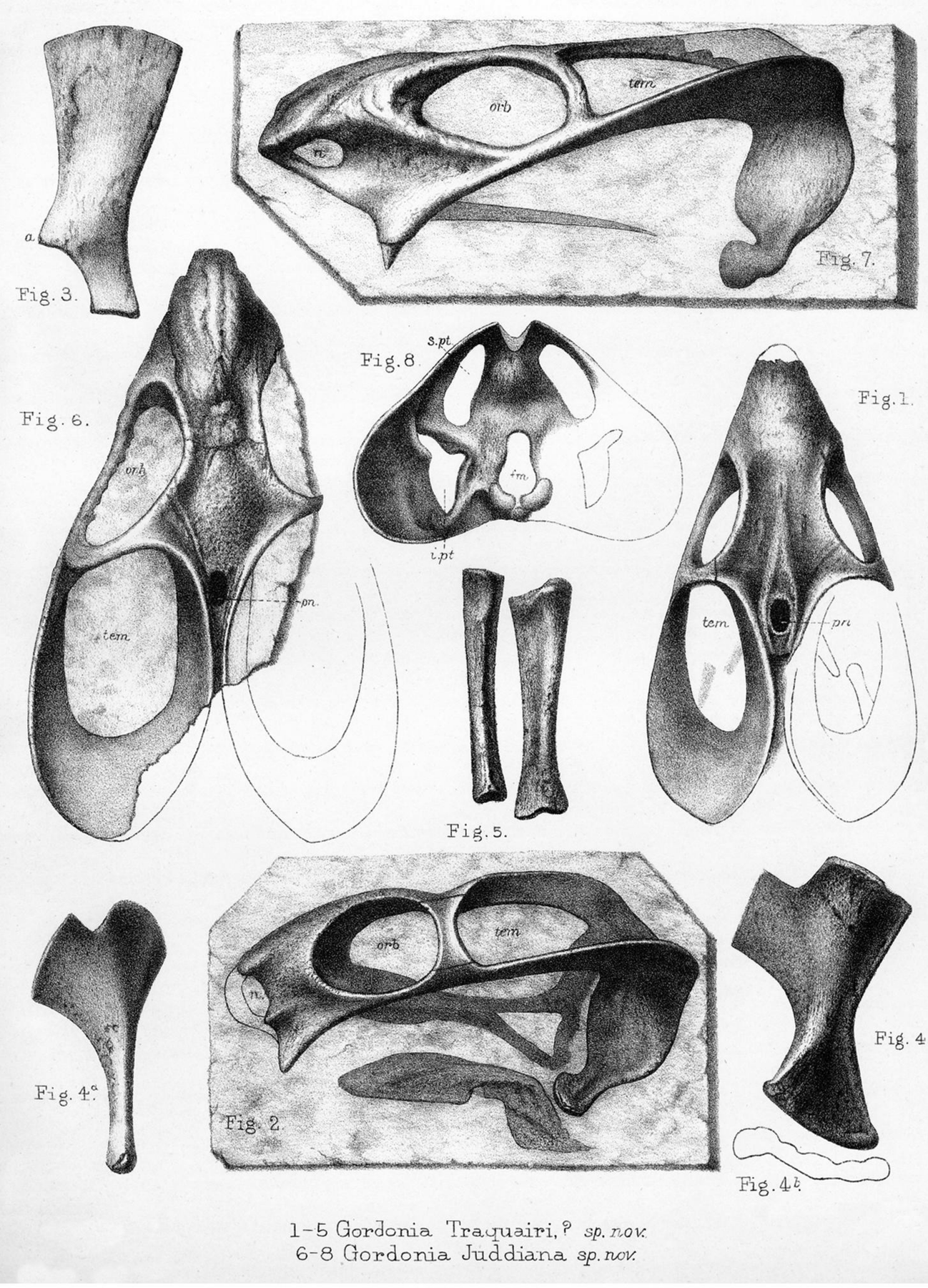
Fig. 7. Left ilium, outer surface

GORDONIA TRAQUAIRI, sp. nov.

PLATE 34.

Gordonia Traquairi?

From a photograph of a block of sandstone containing a nearly entire skeleton provisionally referred to this species. About half natural size. Preserved in the Elgin Museum.



1-5 Gordonia Traquairi,? *sp. nov.*
6-8 Gordonia Juddiana *sp. nov.*

PLATE 35.

Gordonia Traquairi?

Figs. 1 to 5. Same specimen as Plate 34. All figures natural size.

Fig. 1. Skull seen from above, right side partly restored in outline.
Fig. 2. Same, side view of skull and lower jaw. The post-orbital bar and tip of muzzle partly restored.
Fig. 3. Left scapula, outer surface.
Fig. 4. Left humerus, oblique view of hinder and outer surfaces.
Fig. 4*a*. Same, from outer side.
Fig. 4*b*. Same, outline of distal extremity.
Fig. 5. Left radius and ulna.

Gordonia Juddiana, sp. nov.

Figs. 6 to 8. All the figures natural size. Preserved in the Elgin Museum.

Fig. 6. Skull seen from above, right temporal arcade restored in outline.
Fig. 7. Same specimen, left side.
Fig. 8. Same specimen, occiput with part of right side restored.

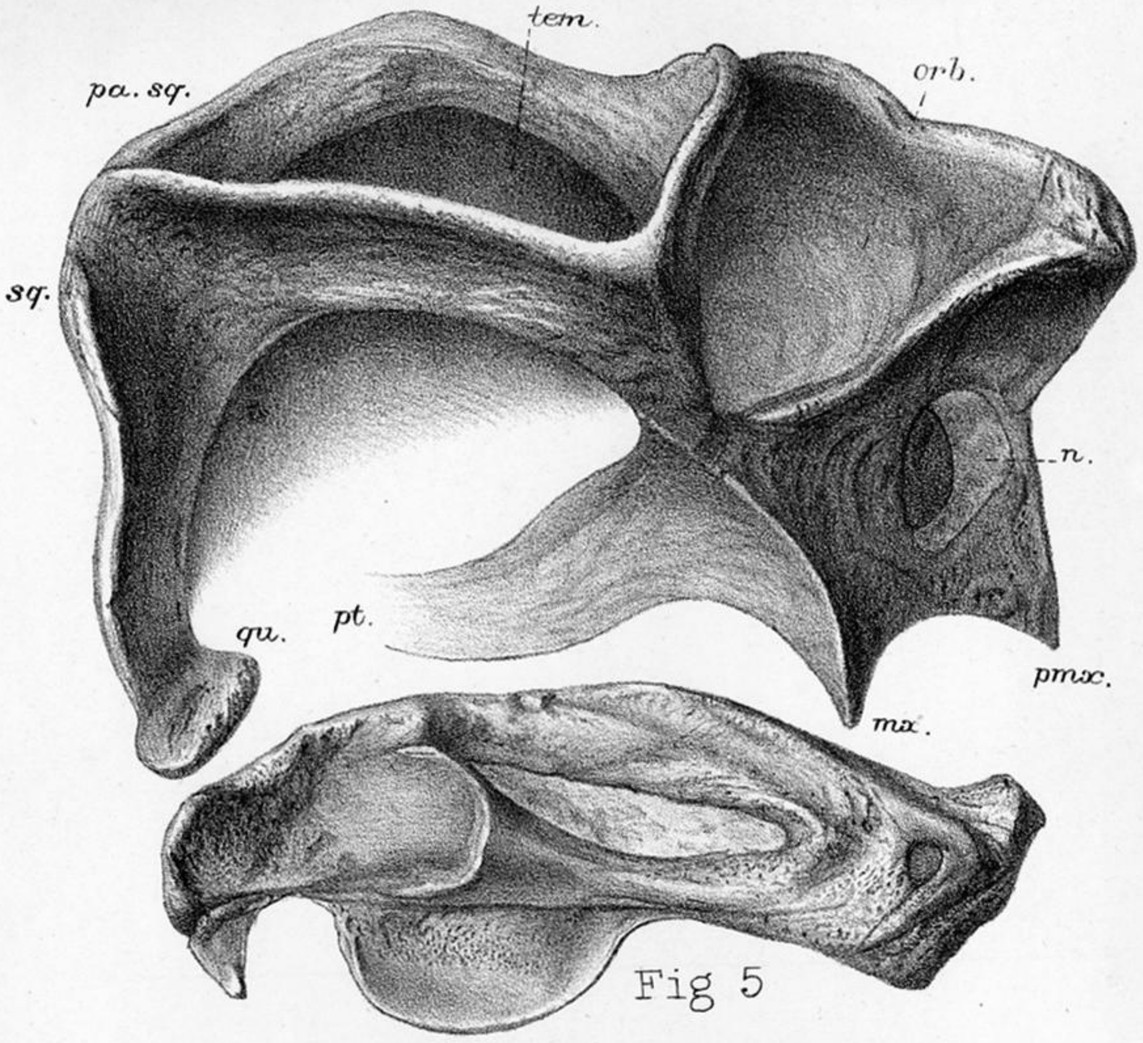


Fig 5

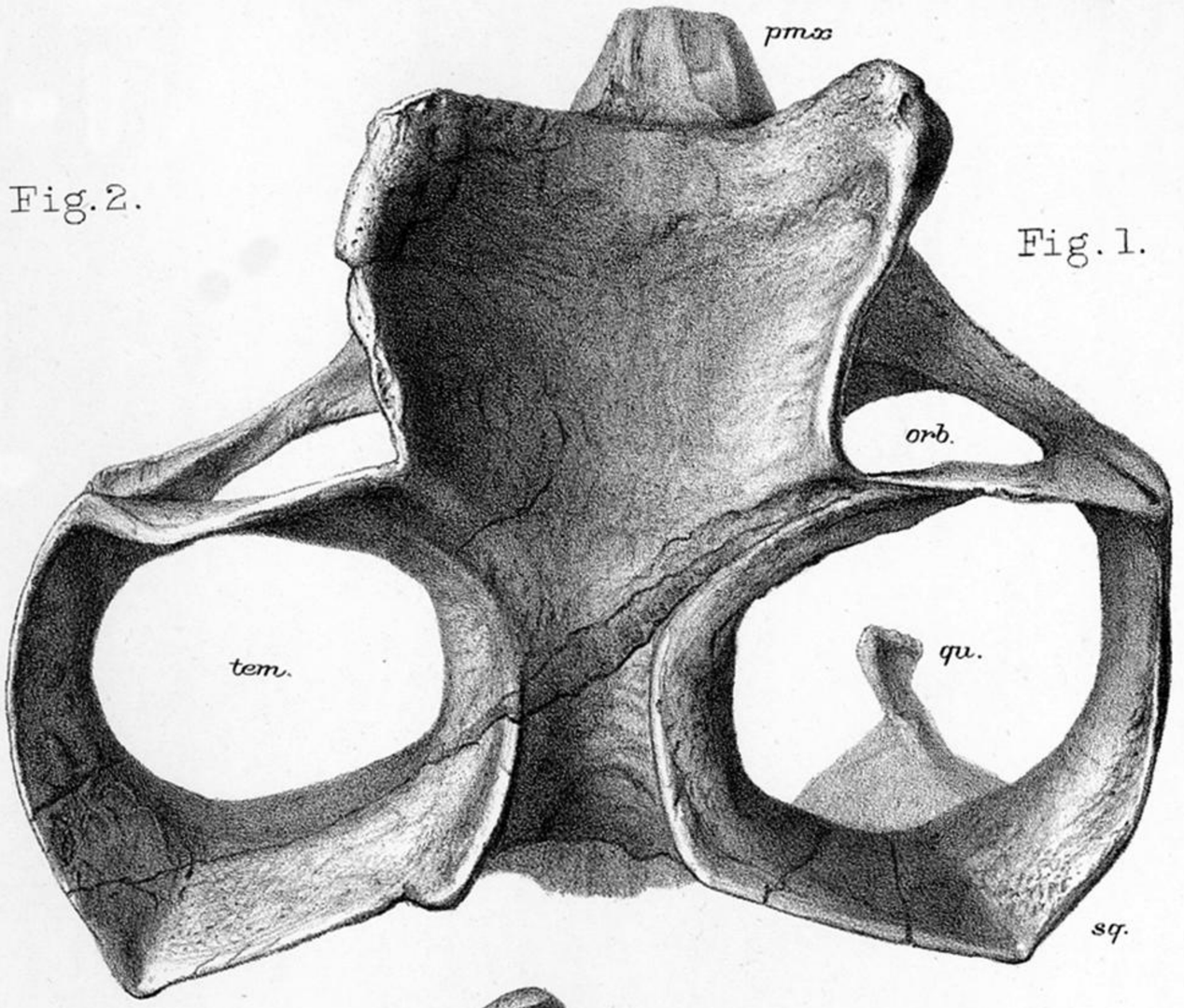


Fig. 2.

Fig. 1.

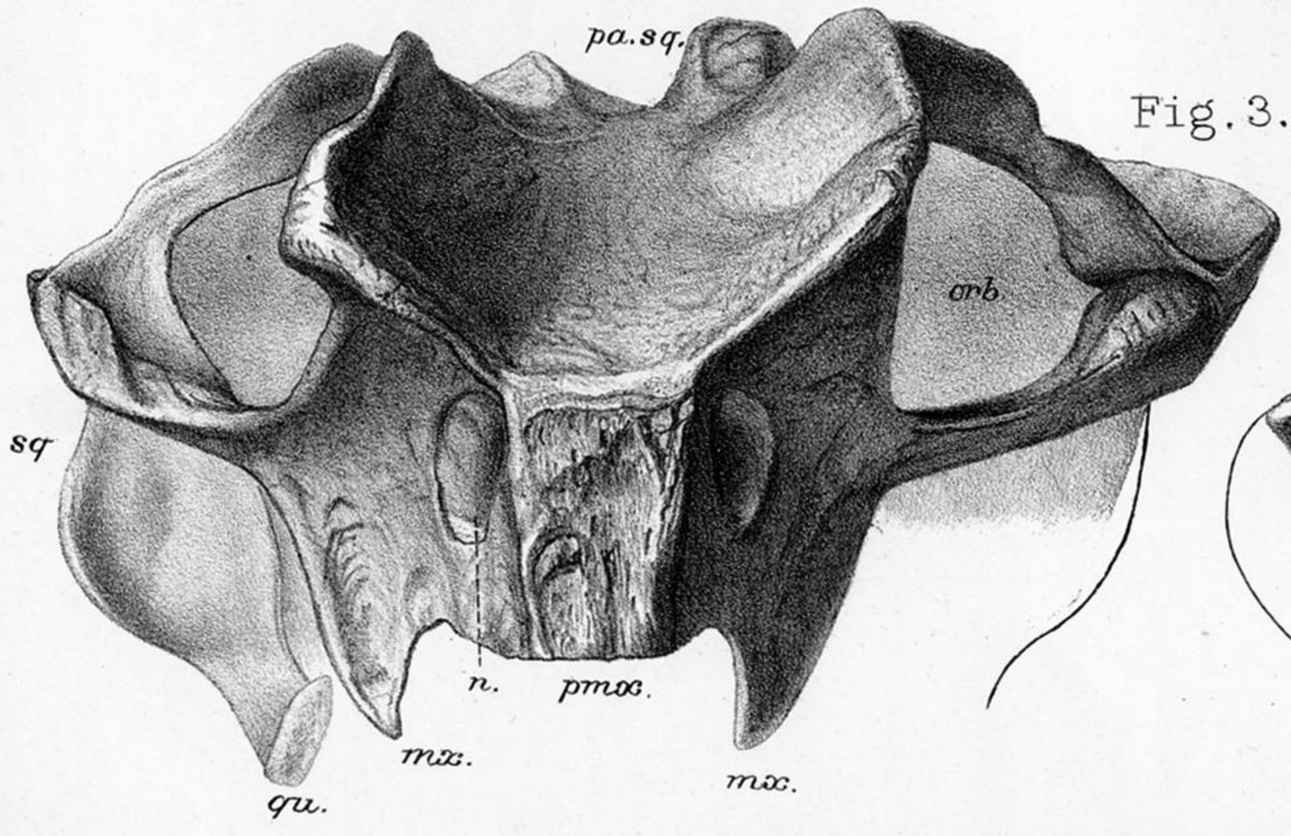


Fig. 3.

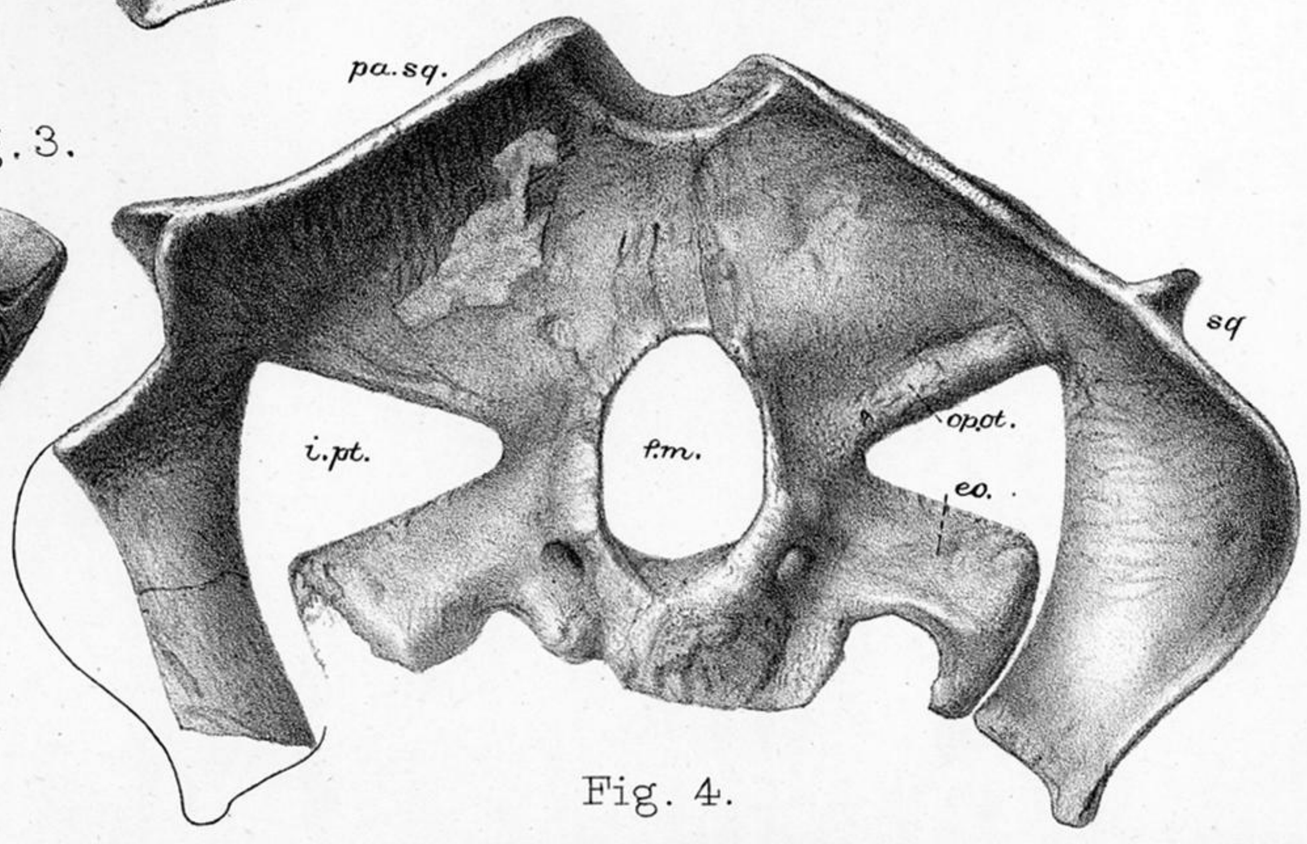


Fig. 4.

PLATE 36.

Geikia Elginensis, gen. et sp. nov.

All the figures natural size. Specimen preserved in the Elgin Museum.

Fig. 1. Skull seen from above.
Fig. 2. Same, right side.
Fig. 3. Same, front view.
Fig. 4. Same, occiput.
Fig. 5. Lower jaw, left ramus.

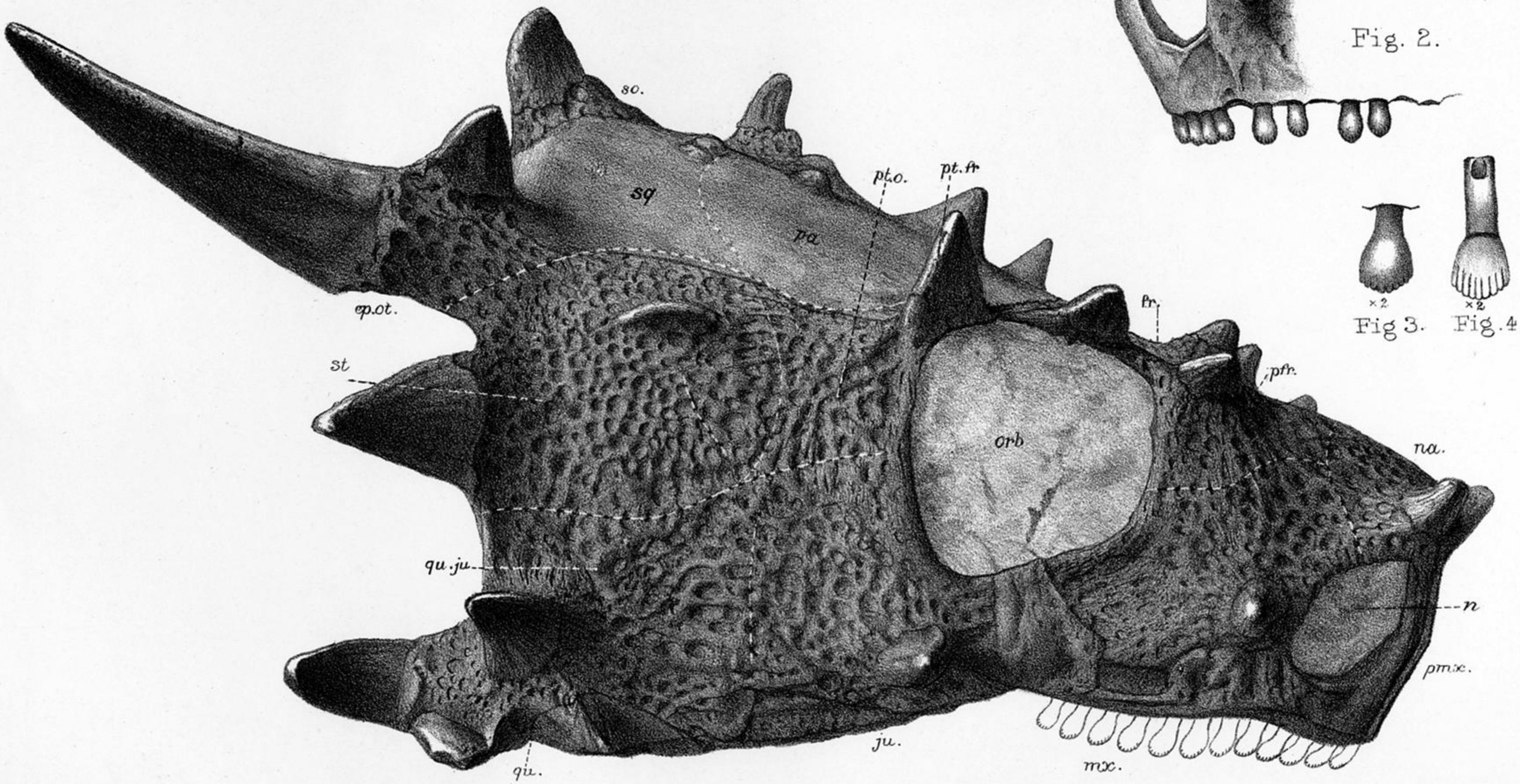


Fig. 1.

Fig. 2.

×2

Fig 3.

×2

Fig. 4.

PLATE 37.

Elginia mirabilis, gen. et sp. nov.

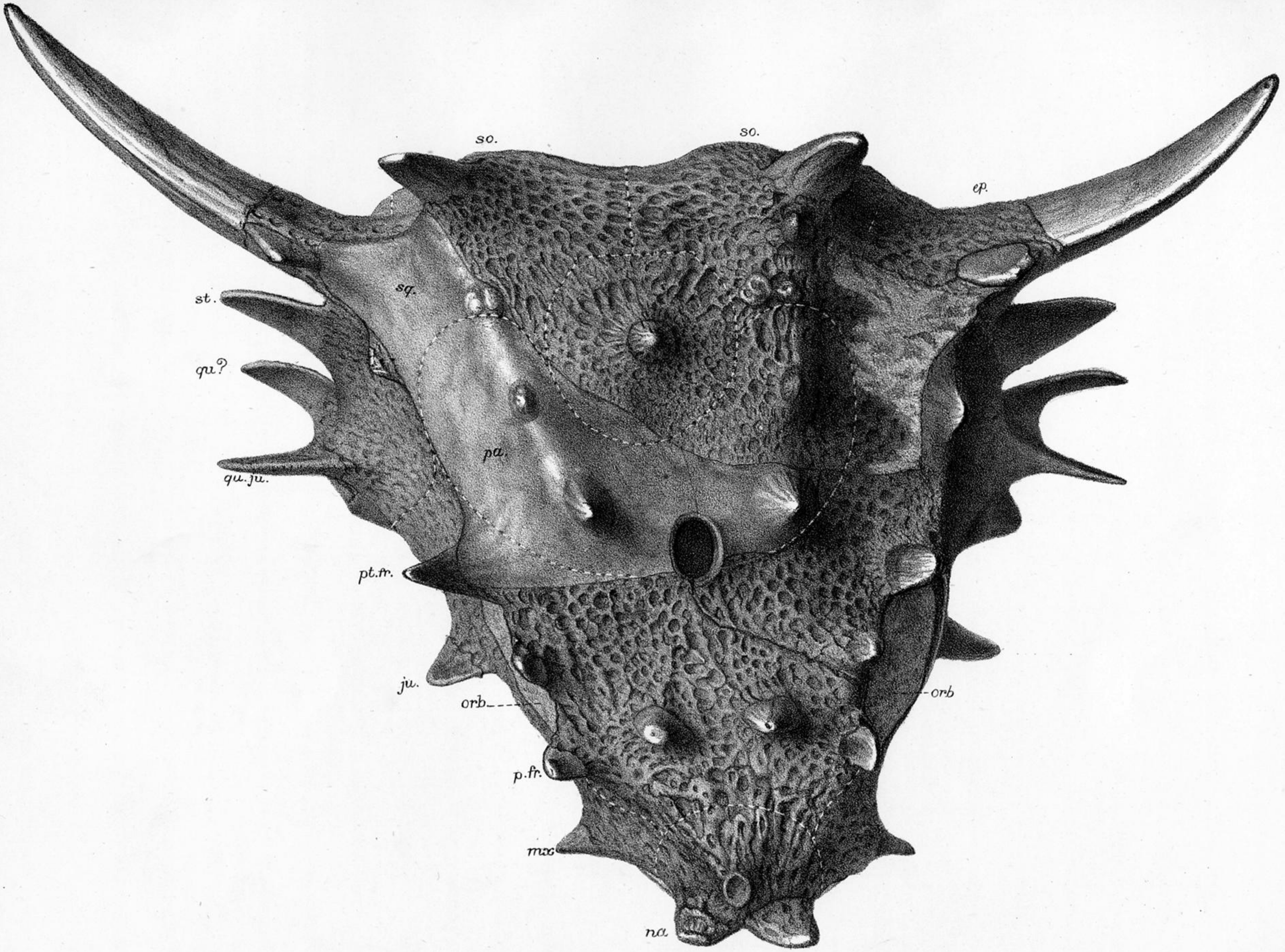
In the possession of the Geological Survey.

Fig. 1. Skull seen from right side. Natural size. The upper part of the temporal region has been drawn from the opposite side (see Plate 38), and the teeth have been restored in outline. The positions of some of the sutures are indicated by fine lines.

Fig. 2. Portion of left maxilla and premaxilla with teeth *in situ*. Natural size.

Fig. 3. Outer view of tooth enlarged two diameters.

Fig. 4. Tooth from inner side enlarged two diameters.

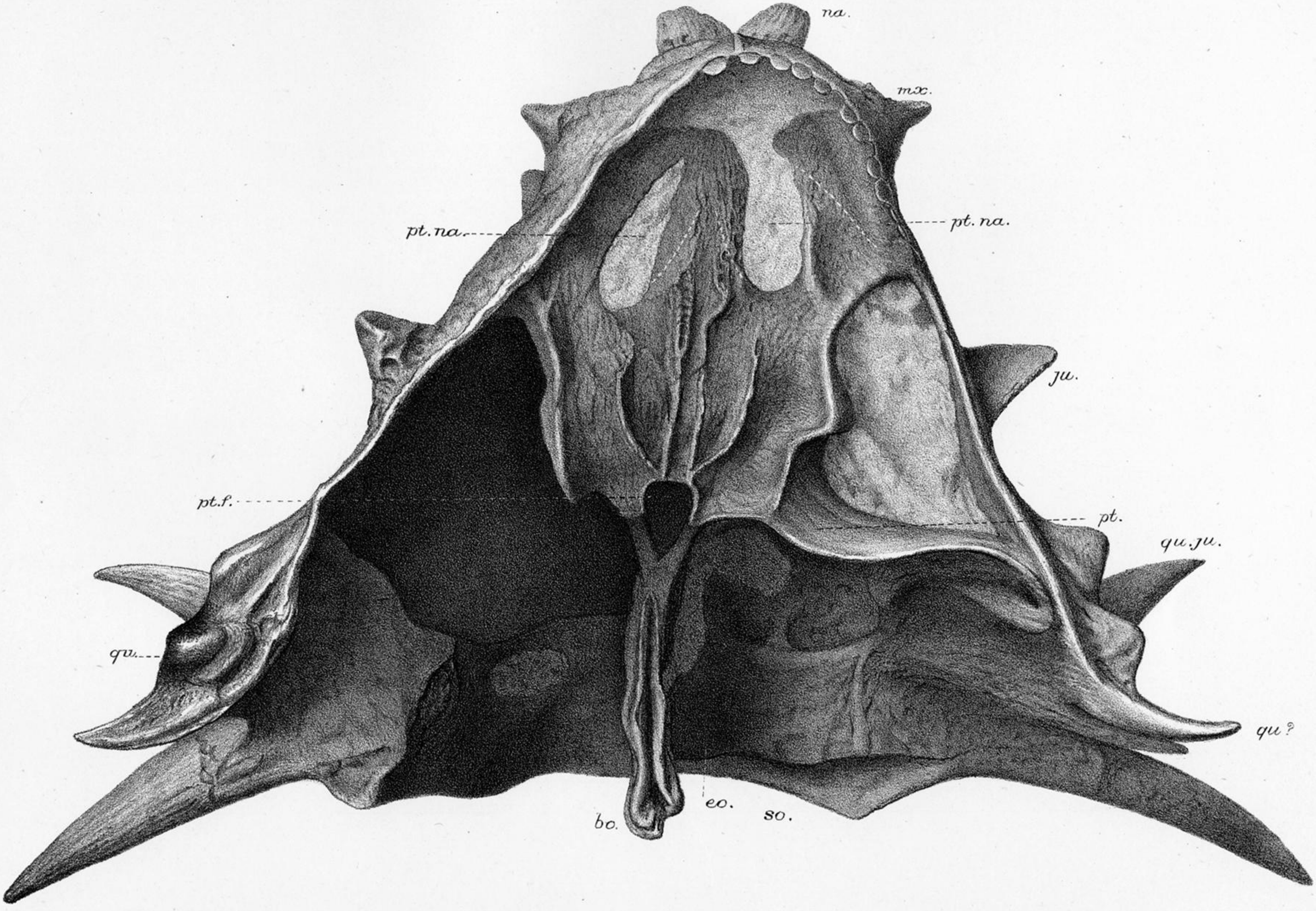


Elginia mirabilis, *gen. et sp. nov.*

PLATE 38.

Elginia mirabilis.

Same specimen as Plate 37, natural size. Skull seen directly from above. The portion represented without ornament is wanting in the original, and has been restored from the opposite side.

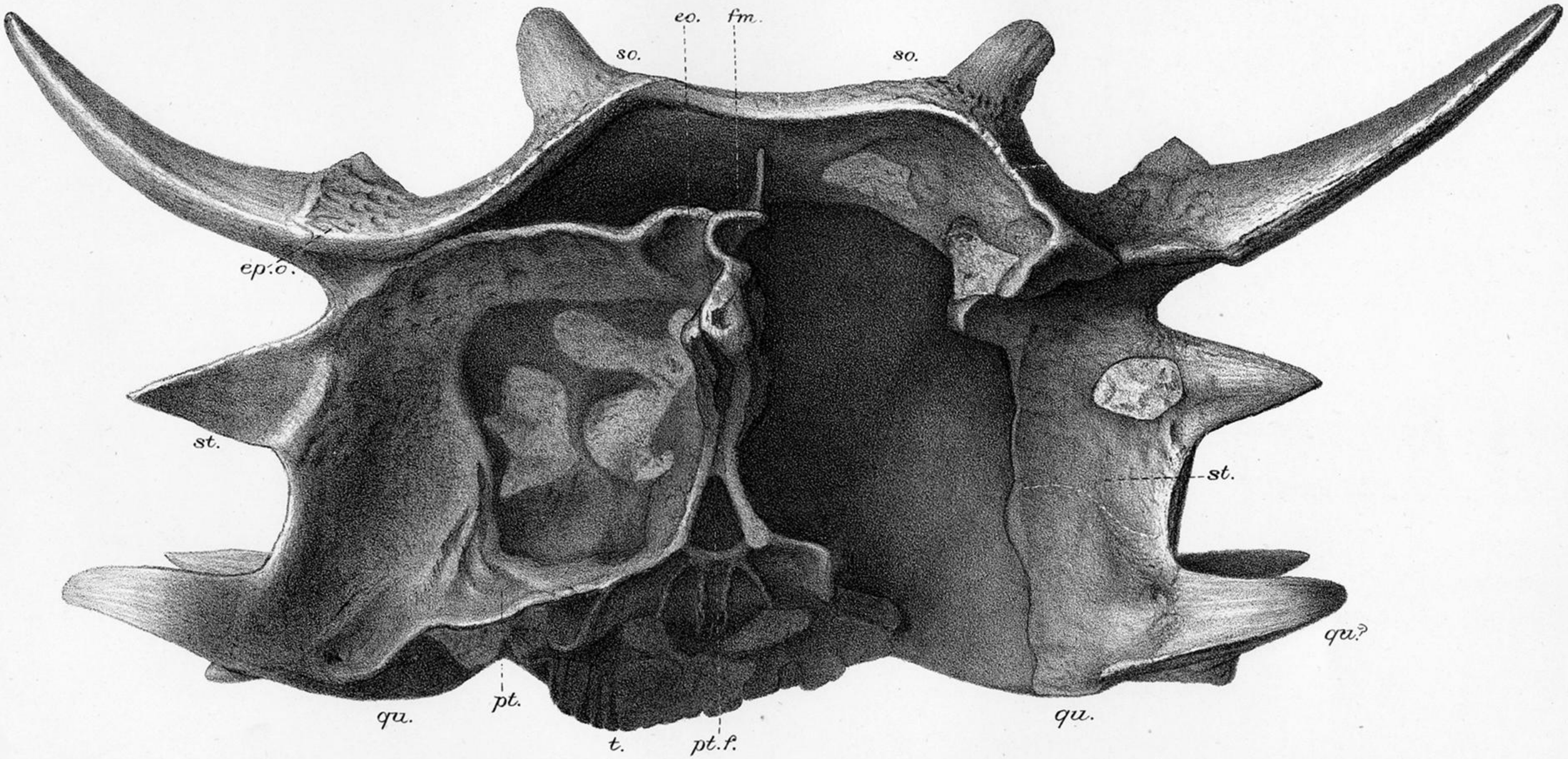


Elginia mirabilis, *gen. et sp. nov.*

PLATE 39.

Elginia mirabilis.

Same specimen as Plates 37 and 38, seen from below. Natural size. Showing palate and base of skull.



Elginia mirabilis, *gen. et sp. nov.*

PLATE 40.

Elginia mirabilis.

Same specimens as Plates 37 to 39, seen from behind and partly from below. Natural size.

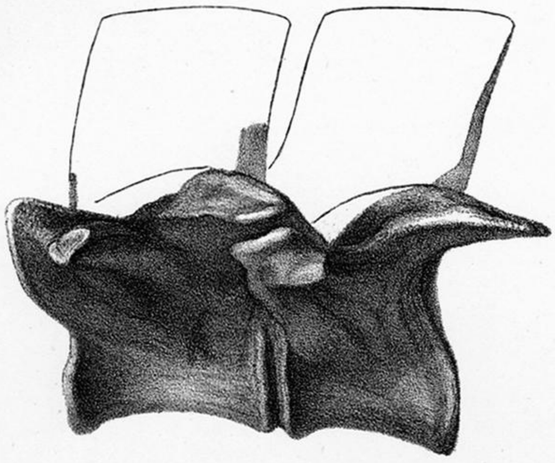


Fig. 1.

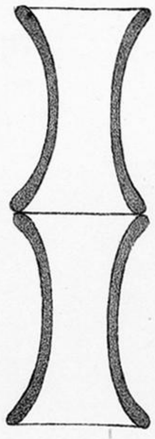


Fig. 3.

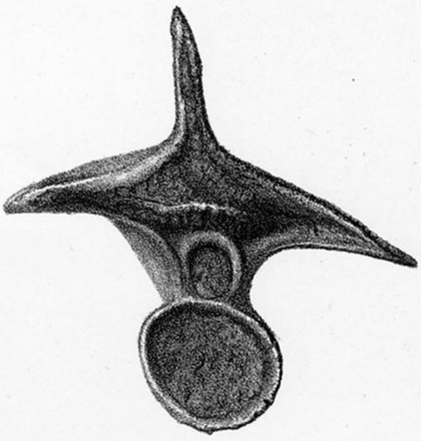


Fig. 2.

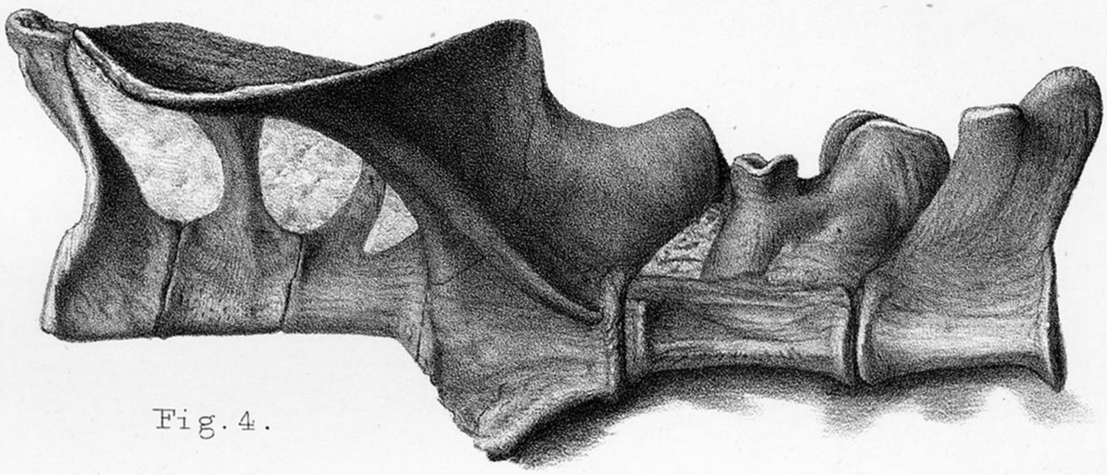


Fig. 4.

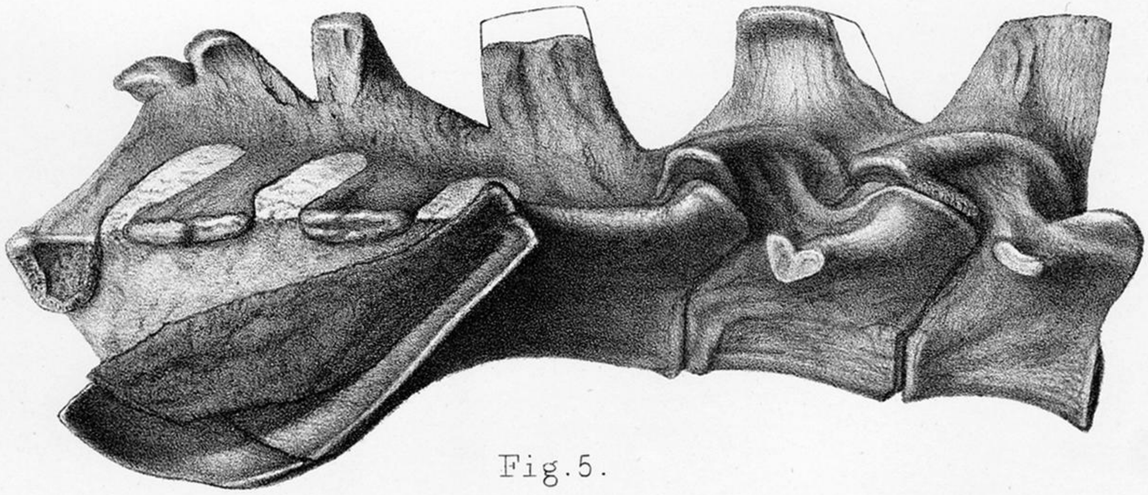


Fig. 5.

Sacrum and Vertebræ, *gen?*

PLATE 41.

Sacrum and Vertebræ.

Both the specimens figured on this Plate are from the Elgin Sandstone, but it is not quite certain that they are from Cuttie's Hillock Quarry. Their affinities are uncertain. They are represented natural size.

Fig. 1. Two late dorsal or lumbar vertebræ belonging to the Geological Survey, seen from the left side with the neural spines restored in outline. These two vertebræ are said to have been found with the skull of *Elginia*.

Fig. 2. Posterior end of the hindermost vertebra of fig. 1.

Fig. 3. Diagrammatic section through the two vertebral centra to show the thin bone which covered the notochord.

Fig. 4. Sacrum, with two presacral vertebræ, seen from below, and showing the large sacral rib. The three hinder vertebræ (to the left of the Plate) show little more than half of each centrum, the left side having been crushed. The left sides of the other vertebræ are also imperfect. Preserved in the Elgin Museum.

Fig. 5. Same specimen seen from right side.