

earth in the fissure which was quarried to the depth of 17ft., and bored to the depth of 20ft.

2ndly. Above the thick stalagmite we found there rested stratified sand and gravel of considerable thickness. It is my belief that this deposit was washed into the cave by an ancient Wye, which flowed 300ft. above the level of the existing Wye, and when the land was higher than at present, before it was so much degraded by the atmospheric denudation of ages, and before it had assumed its present aspect of deep valleys and glens. It is probable that the soft Old Red strata, north of the Great Doward, once rose higher than the harder limestones of the Dowards, and that long ages of atmospheric wear and tear have reduced their height since the land was occupied by ancient man and the cave animals. And here I may mention that my friend Mr. Lucy, who has done so much in Gloucestershire for the elucidation of the Drifts, thinks it possible that the drift sand and pebbles in Arthur's Cave may have been derived from the washing in of the materials by the agency of melting snow and ice from higher sites and previously deposited gravels. The only reason why I object to this opinion of Mr. Lucy's is that I recognize in these pebbles a *river drift*, the deposit of some ancient stream which flowed as the present Wye flows, viz., through the Lower Silurian rocks of Rhayader and Builth.

Years ago I showed that the Drift of the higher lands, as on the platform above Symonds Yat, is a true Boulder-clay, containing large rounded and unrounded erratics, such as the Machen Boulder, near Symonds Yat, and in which I have never seen such river pebbles. I therefore prefer the hypothesis I arrived at from a study of the district, viz., that these pebbles were washed in by the stream of an ancient Wye, before the excavation of the mountain limestone gorge to its present depth, 300 feet below.

Be this as it may, there rests that sand and pebbles, sealed by a stalactitic floor, the droppings of the cave roof upon its stratified layers, and separated from a lower cave earth by a mass of stalagmite more than two feet thick. In that lower cave earth are associated the remains of ancient Men and the extinct Mammalia; and what with the evidence of the old river-bed and the stalagmites, I doubt if there be better authenticated evidences of the antiquity of Man in the records of cave history.

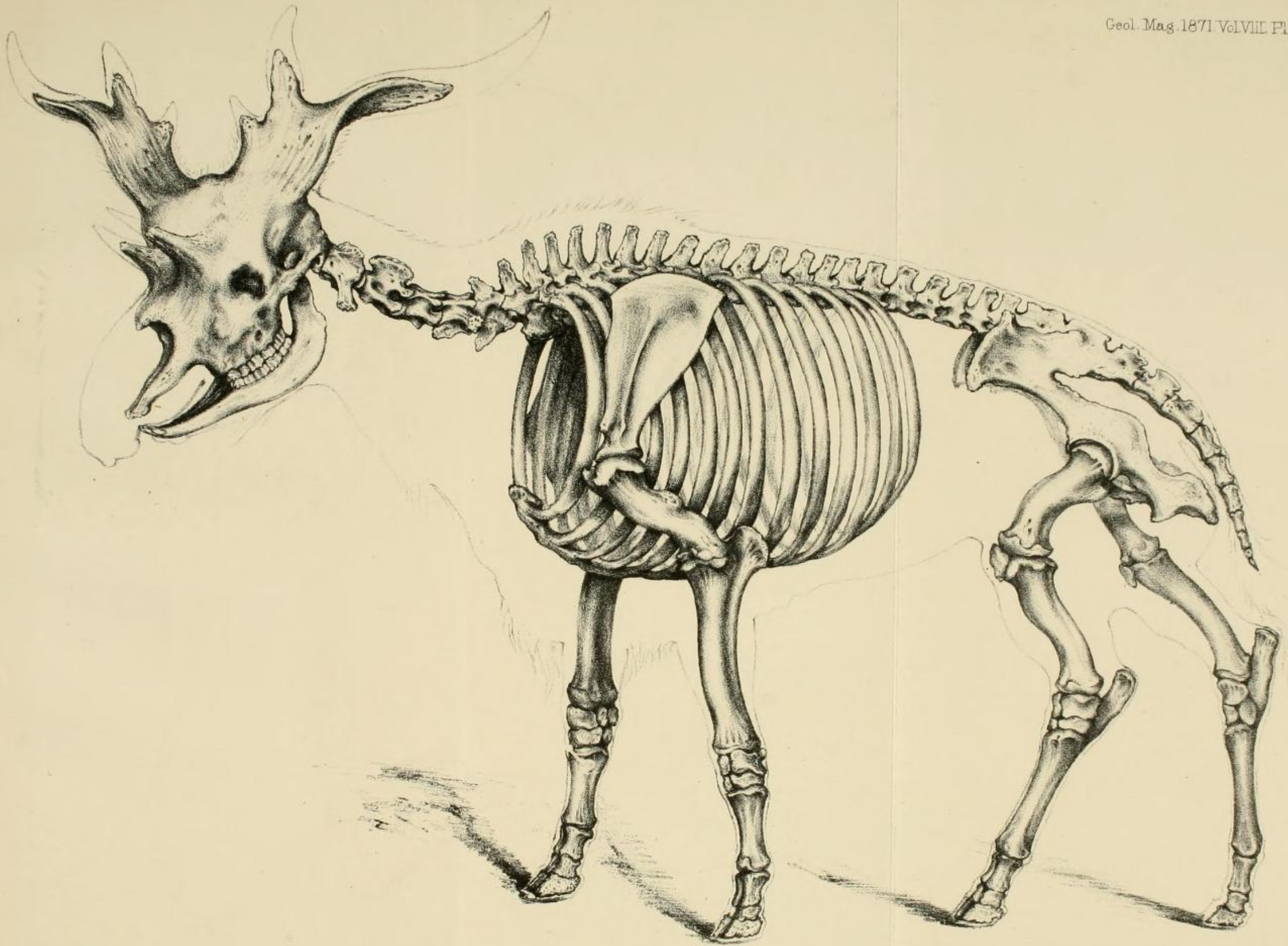
II.—ON THE SYSTEMATIC POSITION OF THE *SIVATHERIUM GIGANTEUM* OF FALCONER AND CAUTLEY.¹

By Dr. JAMES MURIE, F.G.S., F.L.S., etc., Lecturer on Comparative Anatomy, Middlesex Hospital, and late Prosecutor to the Zoological Society.

(PLATES XII. AND XIII.)

1. *Introductory*.—The fragmentary evidence attesting the presence of former tenants of our globe is just sufficiently tantalizing to permit of glimpses of bygone forms to be evoked; and what is lacking in the relics themselves is supplied by the imagination or reasoned out

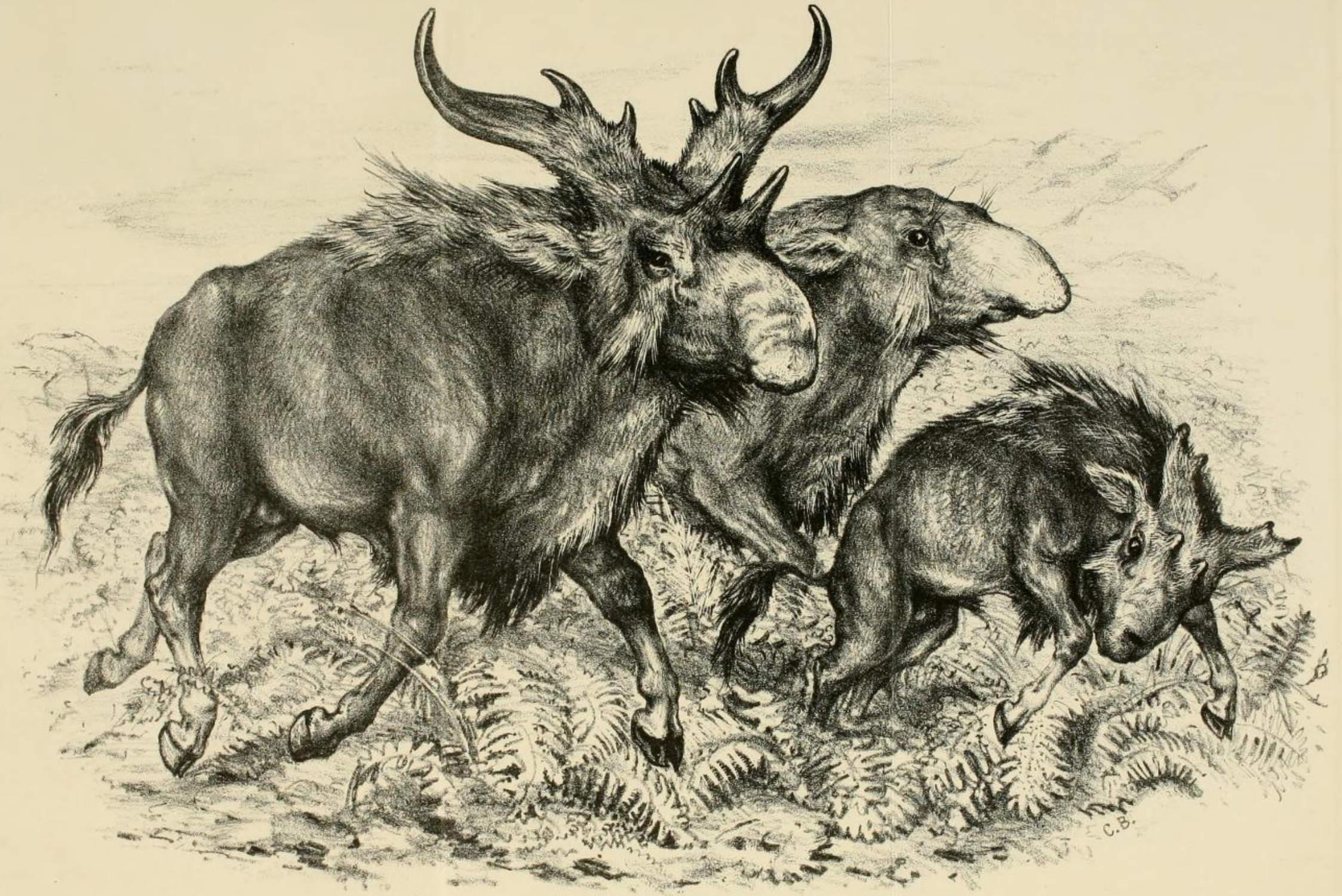
¹ Read at the Meeting of the British Association, Edinburgh, 1871.



G. Barjeau del. et lith.

SIVATHERIUM GIGANTEUM. Fabr. & Caut.
J. Murie.

Printed by H. Colver.



G. Barjeau del et lith.

SIVATHERIUM GIGANTEUM. ♂, ♀ et juv.

J. Murie.

Monterot Bro^t imp

by the aid of existing forms. Palæontology, in truth, is based as yet on a narrow but solid foundation of fact, propped up by much that is uncertain or unstable, which future time must test, try,—accept, or reject. For this reason all adventitious drapery thrown around the remnants of the departed requires to undergo a close scrutiny of its genuineness; and no seeming fittingness can save it from the ruthless hands of succeeding inquirers should any counterfeit be detected.

The very singular animal which I purpose treating of in this paper is one of the magnificent series of fossil forms excavated from the Valley of the Murkunda, in the Sewalik branch of the Sub-Himalayan Mountains.

The indefatigable discoverers of the ancient fauna of the Sewalik range, the late lamented Dr. Hugh Falconer and Capt. Sir Proby T. Cautley (also deceased), first made known and described the remains of the extinct *Sivatherium giganteum*, in a very lucid communication in the Asiatic Researches, vol. xix., p. 1 (1836).¹

The main deduction may be gathered from the following passage of these authors:—

“The isolated position, however, of the Giraffe and the *Camelidæ* make it probable that certain genera have become extinct which formed the connecting links between them and the other genera of the family, and further between the Ruminantia and the Pachydermata.”

“In the *Sivatherium* we have a ruminant of this description connecting the family with the Pachydermata, and at the same time so marked by individual peculiarities as to be without an analogue in its order.”

Dr. Falconer's description² of the individual bones obviates any lengthened remarks on my part further than what pertains to their supposed taxonomic value. Whilst my observations in some respects support the verdict arrived at by the above-mentioned palæontologist, they nevertheless differ materially as to their ultimate tendency, pending the attempted restoration of the animal.

2. *Form and structure of the horns*.—As regards these, the remarks of the authors of the “Fauna Sivalensis” are so appropriate, and convey so much truth in their deductions, that I do not hesitate to quote their words. Afterwards I shall add what new light my studies enable me to evoke. They observe:—

“Now what was the character of the horns? Were they cores of hollow horns, as in the *Bovidæ*? or branched antlers, as in the *Cervidæ*? or were the front the former and the rear the latter?”

¹ A number of figures of the cranium are to be found in the “Fauna Antiqua Sivalensis,” xci. and xcii., and in unpublished proof-plates of same, now in the Geological Department of the British Museum. Also in Royle's “Illustrations of the Botany of the Himalayas,” vol. ii., pl. vi. See likewise Journ. Asiatic Soc., vols. iv., v. and vi., for descriptions and figures of various bones. Lastly, consult Dr. Charles Murchison's edition of the “Palæontological Memoirs and Notes” of the late Hugh Falconer, M.A., M.D. (Lond., 1868), vol. i., pp. 247-279, where the original paper above mentioned and copious MS. notes are published, accompanied with eight figures, plates 19, 20, and 21.

² I refer both to the original paper and the posthumous MS. notes printed in Dr. Murchison's collected edition of his palæontological labours.

“About the front ones there can be no doubt. They are conical, rise rapidly to a point, are smooth, have no burr, are hollow at their base, and are formed of large cells throughout; no ruminant had ever antlered horns of this sort.

“They must, therefore, have been cavicorned cores. Besides, no ruminant with antlers was ever seen with four bases to the horns.

“With regard to the rear ones, their structure is most perplexing, the main branch is hollow, as in the *Bovidae*, they have no burr, or appearance of articulation; but, at the same time, they give undoubted proofs of having had two branches, the distinct bases of which are seen, and there is every reason to believe they had a third. No cavicorned core is known to be branched in this way, after the manner of the solid antlered horns of the *Cervidae*, but, at the same time, they have no burr, as all the *Cervidae* have. They are smooth, they are not solid, as all the *Cervidae* are, but hollow; at least, the central and outer ones are so. The horns in the *Cervidae* always come off from the forehead, much in advance of the occipital, with long parietals between. In the *Bovidae*, they come off exactly overhanging the occipital; so do these. In the specimen the plane of the occipital is exactly as in the *Bovidae*; there are no distinct parietals, the frontals run up to the occipital crest, and there give off these cores. Therefore, both from structure and analogy, the rear horns of the *Sivatherium* were at least three-branched, and, at the same time, cavicorned.”

When the above was penned, the writers were unaware of the existence of a living ruminant whose horns present some of the bizarre construction which so puzzled them: leaving doubts whether the *Sivatherium* was a deer or an antelope. The weight of their evidence leans chiefly towards the *Antilopidae*. Still the palmate horns, the reverse of antelopes, offered difficulties not easily accounted for.

Recent researches on the interesting North American Prongbuck (*Antilocapra*) reveal the fact that this cavicorned ruminant actually sheds its horns annually, as do the *Cervidae*. In Dr. Canfield's concise paper,¹ the manner of shedding, and the nature of the horns themselves, is sufficiently lucidly told. The patent facts are: the presence of a forked, flat, hollow horn, annually deciduous, and no burr at the base of the bony pedicle.

To all intents, at least as far as shape, shedding, and renewal are concerned, the Prongbuck's horn might be looked upon as a kind of antler. Still even in the above-mentioned peculiarities it is no antler, but strictly a bovine horn, subject to a periodical removal of its investing sheath.

It is not to be forgotten that *Sivatherium* differed from *Antilocapra* in the possession of four, and not two, horns. This, after all, is only of minor importance, as what may be said of the anterior is in many ways applicable to the posterior horns. The living Indian antelopes (*Tetracerus*) have all four horns conical, and the rearmost pair situate much further forwards than obtains in *Sivatherium*.

¹ Proc. Zool. Soc. Lond., 1866, p. 105.

The enigmatical part of the problem in the *Sivatherium*, palmation and absence of burr, is therefore thoroughly explained in *Antilocapra*; for the core of the Sivathere's hinder horns agrees with it, and does not do so either with the antelope, deer, or giraffe.

Knowing, as we do from the fossil specimens, that the *Sivatherium* had four bony horn-cores, it becomes an interesting question, What surmounted these, to constitute the fully-developed horns? For of the covering, whatever that may have been, no trace has as yet been discovered. Of the front horns it will be readily admitted these may have been similar to those of *Tetracerus* and other straight-horned antelopes.

The hind horns are the most difficult ones to appreciate as regards their casing. One or other of the following conditions necessarily existed.

1. Each posterior horn sheath may have consisted of one deciduous mass of agglutinated hairs, with corneous extremity, as obtains in the living Prongbuck; or this may further have split up at the forks on being cast off.

2. The sheath may have consisted of semi-detached pieces corresponding to the snags, shedding taking place by partition.

3. The core covering might be made up of soft epidermal hairy material, such as clothes the reindeer's horns, and this exfoliate, as in that animal, by shreds when the periodical cessation of its growth had occurred.

4. The front horns, and probably the hinder ones also, were, like those of the giraffe, covered with an investment of true skin, and never cast off.

5. Lastly, both front and rear horns might, as in the *Bovidæ*, have had firm corneous envelopes, not subject to shedding, but persistently retained through life, save when accidentally injured.

Analysis of the above five reasons removes a certain amount of equivocation as to their nature. Admitting, for argument's sake, that the covering of the front horns may have consisted entirely of a horny sheath, as in buffaloes and other *Bovidæ*, it does not follow the hind ones were similarly clothed. Indeed, by force of reason, from their flatness, snags, etc., it could not be so. Hence necessarily follows separation from that family.

It is quite as unlikely they resembled, nay, it may be affirmed that they did not agree with, those of the modern giraffe. The median fore-horn of the giraffe is epiphysial, and springs from the frontal suture. The surface of the bony eminence shows impressions indicating a skin covering. These are absent in *Sivatherium*.

The hind horns of the giraffe, again, are not flat, and branched as in the fossil genus compared; and the osseous surface exhibits cuticular markings. The hind horns of *Sivatherium* are unlike those deer with flat palmate antlers clothed with a hairy membrane; and furthermore, as before mentioned, are devoid of burr; therefore separate from all *Cervidæ*.

Lastly, then, it alone in its entirety agrees with the Prongbuck. I have mentioned the possibility of each snag possessing its own

separate covering, though this presents difficulties in the way of the sheath being fastened in separate areas.

By far the most sensible view of the subject, and, indeed, the only satisfactory one which accounts for shape, and absence of suture and burr at the base, is the theory that they must and only could be analogous to those of *Antilocapra*. A horn with certain external aspects peculiar to those of deer; a horn likewise possessing attributes belonging to antelopes and the *Bovidæ*; a horn differing in every respect from that of the Cameleopards.

3. *Peculiarities of the facial bones.*—The imperfect closure of the nostrils by bone, the nasals being of most diminutive size, and apparently unconnected either with the maxillaries or premaxillaries, gives a most aberrant character to the *Sivatherium*.

Its discoverers truly noted its resemblance to the Pachyderms. As a matter of induction, they were led to believe in the probability of its possessing a trunk. A proboscis in a ruminant they considered to be a most anomalous circumstance. Certain genera of the bovine section, *Bos* and *Bubalus*, have shortened nasals, barely impinging on the premaxillaries. Other genera, *Bison*, *Ovibos*, and *Budorcas*, etc., have nasals which do not reach the premaxillaries, a condition met with in few, if any, deer, except *Alces*, and only occurring sparsely in antelopine genera, notably, in *Saiga*, *Panthalops*, and *Rupicapra*.

Excepting in the *Saiga*, however, the nostrils and muzzle of the genera mentioned depart little from the ruminant type generally.

Not only does *Sivatherium* and *Saiga* assimilate in the entire separation of the nasals from the maxillary bones, and great saliency of the former, but with true proboscidean feature, have a great scooping out of the bones surmounting the intermaxillaries and maxillaries.

Pallas, long ago,¹ depicted the trunk-like character of the *Saiga's* nose, and recent researches demonstrate the same thing even more fully than he has done.²

That the *Sivatherium* had a huge long proboscis, tactile and prehensile, as in the Elephant, or to a lessened extent as in the Tapir, does not seem to be established. Falconer and Cautley, from the structure of the facial bones, infer as much. The bones of the face of the *Sivatherium* and *Saiga* assimilate closely in pattern, and individually correspond; and, as in the latter, we have a soft, flabby, enlarged patulous nostril of moderate dimension, it follows, as a matter of probability, that the same existed in the former, as in the Elk and others. For it is to be borne in mind, when we attribute a pachyderm's trunk to the *Sivatherium*, that the animal had large heavy horns, occipital and prefrontal, a circumstance vastly different from the Tapir and Elephant tribes.

4. *Formation of the base of the skull.*—To Mr. H. N. Turner the merit is due of first appreciating trenchant shades of distinction in

¹ "Spicilegia Zoologica." Berlin, 1777.

² Vide Proc. Zool. Soc. 1870, pp. 451, 503, figs. 4, 5, 8, and 12 respectively.

the inferior base of the skull of ruminant tribes and other Mammalian groups.¹ He demonstrated salient characters for classifying, in the foramina and relative disposition and development of the bones.

The fossilized condition of *Sivatherium* crania precludes much being drawn from the foramina. The contour of the basal surface of the skull is a most unusual one for a ruminant, the area posterior to the palate and teeth being remarkably broad and quadriform. The length occupied by the teeth is short, and about equal to that posterior to it. This portion of the palate is of moderate breadth; that anterior to it, comprising portions of the maxillaries, is relatively very narrow. Unfortunately, the fore part of the palate is not preserved, but I presume it to have been comparatively narrower than what obtains in the ordinary antelopes. In the basi-occipital we have an element for judging the affinities of the animal. In sheep and goats the bone in question is broadish throughout, and distinguished by what Turner has denoted as anterior and posterior tubercles of the basi-occipital. In the antelopes there is a greater tendency to narrowing forwards of the basi-occiput, but the anterior tubercles are full and prominent. In *Cervus* the said bones are broader posteriorly, but narrow forwards, which gives them a decided wedge-shape; the tubercles, fore and aft, are less marked than in the preceding forms; the posterior tubercles especially almost running, as it were, into the condyles. Nearly the same characters distinguish the oxen, but with this difference, that the median furrow betwixt the tubercles is shallower.

The basi-occiput of *Sivatherium*, as far as I can judge from the fossil specimen, may be said to be intermediate between these two families. It is of triangular form, narrow anteriorly, and with very moderate elevations, representing posterior tubercles. The occipital condyles are very large and wide, and so set backwards as in a great measure to hide the foramen magnum when the skull is viewed from below.

The posterior nares appear rather short and with no great width crosswise. The tympanic bullæ are small and, I presume, laterally compressed, but the mastoid and ex-occipital regions have a considerable breadth, though flat. The glenoid surfaces are very large, and, as Falconer remarks, truly ruminant in character. The result of the characters of the base of the skull with the proviso of a certain amount of obscurity or indefiniteness from deposition of stony matrix, inferentially demonstrate the skull's basis as a modification between that of the deer and ox tribe, with tendencies quite as much to the latter as the former.

5. *The Nature of the Teeth*.—It has been conjectured on good grounds that the *Sivatherium* had no upper incisors nor canines. This necessarily excludes it from the ruminant groups possessing these. As to the molar series, these have one attribute peculiar to a limited section of the ruminants, viz., the enamel exhibits rugose

¹ In three communications laid before the Zool. Soc., respectively published in Proc. 1848-9-50.

reticulations; a mark of giraffe alliance, but one also met with in the fossil *Bramatherium* and *Megacerops*.¹ The next point of importance is the manner of folding of the enamel ridges. "The inner crescent, instead of sweeping in a nearly simple curve, runs zigzag-wise in large sinuous flexures somewhat resembling the form in *Elasmotherium*."² Finally, the last true molar, as Owen³ observes, presents in the *Megaceros* (*M. Hibernicus*, the extinct gigantic Irish Deer) and *Sivatherium* a deeper central enamel island or fold, which also characterizes the smaller third lobe in the giraffe. In short, the construction of the teeth, like that of the horns and fore face, borrow from or assimilate to several incongruous mammalian forms.

6. *Considerations applicable to the neck, chest, and limb bones.*—The remains of seven neck vertebræ are tolerably complete. They show, from their magnitude and strength, that great fleshy masses overlying them must have conduced to the support of the massive head. The atlas is chiefly remarkable on account of the shape of its transverse process, which is concave towards the body, and this, according to Falconer's opinion, distinguishes it from that of other ruminants. The peculiar features of the atlas, as far as I can make out, approach those of the Saiga, save in greater magnitude and relative shortness. The other cervical vertebræ partly resemble those of the buffalo, the ox, and the eland. The spinous processes of the third and fourth are apparently imperfectly developed, and the ends of the posterior ones being broken off, renders it difficult to say what might have been their natural length. The transverse and inferior processes are also incomplete; but doubtless they, as well as the spinous processes, were very strong. Falconer and Cautley in their original paper suggested "that the vertebræ were condensed as in the elephant, and the neck short and thick, admitting of limited motion to the head, circumstances indirectly corroborating the existence of a trunk." The specimens in the British Museum, however, show them to have been truly ruminant cervicals fairly proportioned. Much cannot be inferred concerning the dorsal vertebræ because of their mutilation. They were indeed powerful, and the spines of the first and second at least, long and strong.

The sternum in the antelope and deer groups in general is flat and moderately shallow. Its very great depth and narrowness in *Sivatherium* removes it from these groups, and shows affinity with the stouter-chested oxen. As Falconer's posthumous notes attest, it agrees closely with *Bos urus*, but it differs from this as well as from other ruminants in its complete ossification.

There is a camel-like tendency in the glenoid segment of the scapula.

The humerus in pre-eminence of the deltoid crest trends to equine character. But the general massiveness of the bone altogether ap-

¹ This North American form, the *Megacerops Coloradensis*, has been determined and named by Dr. Linz from fragments described by him at the Meeting of the Acad. of Nat. Science, Philadelphia, Jan. 1870.

² Fauna Antiqua Sivalensis.

³ "Odontology," p. 535.

proaches that of the bullock. Falconer (MS.) avers, "the fore arm presents a sort of transition from the ruminants to the pachyderms." To his able descriptive remarks thereon I can but acquiesce. The carpus is fashioned as is that of a buffalo, and the other bones of the fore limb evince considerable resemblance to those of the same animal.

What has been said of the anterior limb applies in a great measure to the posterior one. Both long and short bones dividing their characters somewhat betwixt the Camelidæ and Bovidæ. The middle shaft of the femur has not been discovered, so that the precise length of this bone is unknown. With this deficiency, it may be said broadly that all four limbs have not the delicacy of pattern of the antelopes; nor are they by any means equivalent to the giraffes in length. Furthermore, they present a greater comparative stoutness relative to length than is found either in sheep, goats, or deer. As has been hinted, with some faint resemblance to camels, they most nearly assimilate to the heavy-limbed cattle tribe, a dawning of pachyderm-like structure being intermingled.

7. *General taxonomic inferences, etc.*—Revising, as I have done, the data from which Falconer and Cautley drew their inferences, and incorporating such new facts as science has furnished, it devolves upon me to elucidate the creature's alliances, and suggest its probable appearance, with hints as to habit.

The most recent division of the ruminants into families gives the grouping as follows¹:—1. *Camelidæ*; 2. *Giraffidæ*; 3. *Antilocapridæ*; 4. *Bovidæ*; 5. *Cervidæ*; 6. *Moschidæ*; 7. *Tragulidæ*.

The first and two last mentioned for obvious reasons may be excluded as apart from our horned Sivathere, they being deficient in such appendages.

To the antlered *Cervidæ* the *Sivatherium* only approximates in seeming aspect. Its horns, while deciduous, being hollow and differently situated, as has been proved. The *Sivatherium* again is no cerf, inasmuch as the fossil skull shows no supra or ant-orbital fissures. Neither does the co-adaptation of lengthened nasals to maxillæ and premaxillæ at all agree with what is the rule in all true deer. Although the back of the skull and its base show a tendency to cervine type, yet is the line of demarcation sufficiently distinct to strengthen separation. Of cranial features, fleshy and bony, the Elk (*Alces*) is almost the only deer exhibiting likeness to what obtains in *Sivatherium*. But even it is trenchantly separate.

The form of the lower jaw, and the dentition of *Sivatherium*, are those points which best ally it with the *Cervidæ*. Nevertheless, it is possible that some extinct forms may have existed bridging over the line of separation spoken of.

Although the *Giraffidæ* can only boast of a single living species, yet this family in geological epochs undoubtedly was a numerous

¹ *Vide* respectively Drs. Gray and Sclater, Ann. and Mag. Nat. Hist., 1866, pp. 326, 401, and a previous paper by the latter, Brit. Assoc. Report, 1866.

one, and presented many variations which would stop the gaps now existing between it and other ruminants. The giraffe is but a modified deer; yet withal it differs from the latter tribe very materially. It is tricorned, and the horns are persistent, etc. The length of its fore and hind limbs, and even of such of the fossil species that are known, are disproportionate to each other, the former far exceeding those of all other ruminants. In the teeth alone does the *Sivatherium* incline to the *Giraffidæ*.

Coming to the *Bovidæ*, as has been demonstrated, the *Sivatherium* affines itself to oxen in the stoutness of its limbs, sternum, and vertebræ, and also in some parts of the skull structure. It is further removed from the goats and sheep, albeit some *Ovidæ* have four horns.

In the fact of all antelopes having persistent horns, and from other points of skeletal structure heretofore mentioned, the *Sivatherium* in strictness cannot belong to that group. Yet, as I have enunciated, the strange Saiga, which wavers between sheep and antelopes, possesses several facial features strikingly brought out in relief in the remains of the extraordinary *Sivatherium*. But thus far likeness ceases, and the *Sivatherium*, with its deciduous hollow horns, clings most strongly to the unique Prongbuck (*Antilocapridæ*). This latter animal, notwithstanding its singleness of structural organization, exhibits deer-like proclivities in several points, and notably in the existence of ant-orbital fissures.

The fossil *Bramatherium* and *Megacerops* link themselves with *Sivatherium* in greatness of dimensions, in being quadricorned, and in similitude of dentition; though these attributes must be used with caution, from the paucity of the fossil remains.

The *Sivatherium*, through the Saiga, as I have mentioned, veers towards pachyderms in nasal conformation, and the splitting of the lower limb bones adds to *Perissodactyle* character.

To not one of the families spoken of does the *Sivatherium* consistently belong. According as we accept horns, skull, teeth, or bodily framework, so does the *Sivatherium* ally itself to the different ruminant families. The strongest expression of character weighs towards *Antilocapridæ*. Admitting as naturalists do that the horns are a guiding wand of taxonomic value, the *Sivatherium*, though not agreeing in all respects, must truly be classed under the family *Antilocapridæ*. But I go further than this, and look upon the *Sivatherium* as a type of a group, and which may be termed the *Sivatheridæ*. Radiating from it can be traced differentiation of structure allying it to the *Bramatherium* and *Megacerops*. Diversely, links lead through the Prongbuck towards the deer, giraffe, and camel; on the other hand, configurations point undoubtedly to the Saiga, and again its affinities are, as it were, split into lines directed towards the antelopes, goats, sheep, and oxen, and even foreshadowing pachydermate conformation. The accompanying diagram illustrates such views, and shows at a glance by what varied tracts we can trace paths from the *Sivatherium* winding and connecting it with nearly all the ruminants besides the thick-skinned *Perissodactyla* and *Proboscidea*.

By such chains of consanguinity are the observations of the

Palæontologist strengthened.¹ After a study of this remarkable form, the *Sivatherium*, one is readily inclined to admit the existence in ages past of generalized forms, towards which the specialized and existent fauna can be traced back.

There is a charm in speculating on the appearance and habits of bygone forms. In the case of the *Sivatherium*, no attempt heretofore has been made to restore it, as has been done to many reptilian, feline, ruminant, and other groups. Witness Dean Buckland's, Mantell's, Waterhouse and Hawkins's, etc., efforts. Plate XIII. gives my ideal of the creature (*vide* descriptive remarks). I have attempted likewise to put together the skeleton on the grounds noticed in the description of Plate XII. How far these are successful must be left for others to judge.

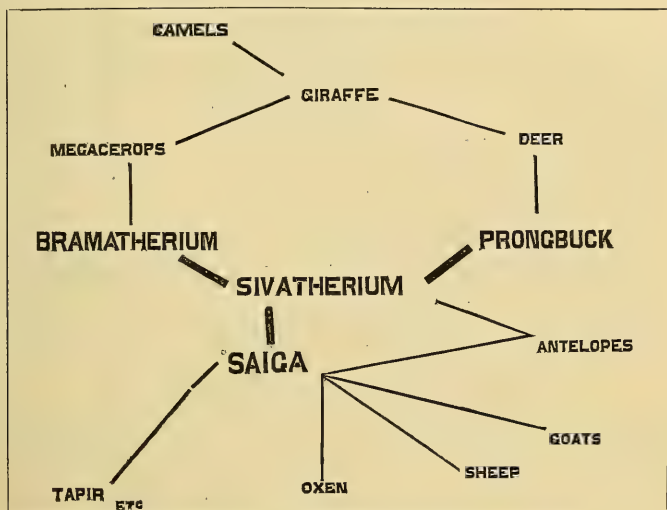


Diagram designed to express the probable relationship of *Sivatherium* with other Mammalian families.

Concerning habits, Falconer threw out the startling doctrine that this ruminant may have possessed and used a proboscis in the manner of the elephants and tapirs. He, moreover, from its dental characteristics, states—"It may hence be inferred that the food of the *Sivatherium* was less herbaceous than that of existing horned ruminants, and derived from leaves and twigs; or that, as in the horse, the food was more completely masticated, the digestive organs less complicated, the body less bulky, and the necessity of regurgitation from the stomach less marked than in the present ruminantia." Only in one of these points am I inclined to give my unqualified adhesion, viz., the probability of its food being coarse and ramal.

¹ Witness the remarks, and genealogical tabular views in the "Animaux Fossiles de l'Attique" of M. Albert Gandry (Paris, 1862): also Rüttimeyer's "Beitrag zur pal. Gesch. der Wiederkauer," Basel, 1865, and various other late writers.

I have already given reasons for believing the nose of *Sivatherium* resembled that of *Saiga*, and remotely the Elk, and was therefore not prehensile. Comparing the same forms, there seems no reason why the digestive organs should not have been as complex as in them and other horned ruminants, and the act of rumination also corresponding. I believe the body to have been quite as bulky as that of cattle and deer, and much more so than in the ordinary antelope group. My conception of the animal I depict and the features tell their own tale, to wit, a creature with several herbivorous traits combined.

I might surmise more regarding this strange animal, and conjure a picture¹ rivalling modern Eastern tales; but with imperfect data haziness, like distance, lends enchantment to the view.

EXPLANATION OF PLATE XII.

Restoration of the skeleton of the *Sivatherium giganteum*, Falc. and Caut.

This is based on the remains deposited in the British Museum, and partly on Dr. Falconer's figures and descriptions of the several fragments in the Calcutta Museum and elsewhere.

The under-mentioned bones, and portions of bones, are separately illustrated in the published and unpublished parts of the "Fauna Sivalensis."

Cranium ♂ and ♀ different views.

Several portions of the horns.

Cervical vertebræ separate and *in situ*.

Dorsal vertebræ, 1st, 4th, and a few joined together, numbers unknown.

Fragments of the sternum, and glenoid, and of scapula.

The fore limb bones nearly complete.

Portions upper and lower end of femur; the entire tibia, calcaneum, astragalus, and scapho-cuboid bones.

The remainder of the skeleton, chiefly ribs, vertebræ, and pelvis, are constructed on a comparative study of similar parts in kindred ruminants.

EXPLANATION OF PLATE XIII.

Design to illustrate the probable appearance of the living form of the *Sivatherium*, male, female, and young. It shows the *Prongbuck*-like horns, *Saiga*-like snout, and other features appertaining to diverse kinds of existing *Herbivores*, which were combined in this extinct form.

III.—ON THE RELATIVE AGES OF IGNEOUS ROCKS.

By S. ALLPORT, F.G.S.

IN the last number of the GEOLOGICAL MAGAZINE there is an abstract from an interesting and important paper by Prof. Hull and Mr. Traill on the relative ages of certain igneous rocks of Co. Down, Ireland. In that paper there is one paragraph on which I should like to offer a few remarks, as it refers to a previous communication from myself, and relates to a subject in which I take a special interest. The paragraph is as follows:—"It might have been supposed that microscopical examination would show some distinction in the basalts of these geological ages, but recent investigations by Zirkel, D. Forbes, Allport, and others, tend to show that there is no

¹ I refer the reader to Dr. Malcolmson's Geological Deductions, etc., Geol. Trans. ser. 2, vol. v., p. 570; Journ. Bombay Geograph. Soc. 1841-44, p. 371; and Falconer's criticism thereon in his "Fossils of Perim Island."