XXVI. A short account of the mammoth

Mr. Rembrandt Peale

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comparison, many of whose discriminations of strength being, as I had reason to believe, merely conjectural.

Before I proceed to explain Mr. Gilpin's tables, and the columns added to them, it becomes necessary to define what is meant by the term *pure spirit*, and to inquire whether the spirit which Sir Charles describes can with propriety be called such.

"The first step (says he, in the Report made on this subject in 1790) towards a right performance of the experiments, was to procure the two substances with which they were to be made, as pure as possible. Distilled water is in all cases so nearly alike, that no difficulty occurred with regard to it; but the specific gravity of pure spirit, or alcohol, has been given so very differently by the authors who have treated of it, that a particular set of experiments appeared necessary for determining to what degree of strength rectified spirit could conveniently be brought. The person engaged to make these experiments was Dr. Dollfus, an ingenious Swiss gentleman, then in London, who had distinguished himself by several publications on chemical subjects. Dr. Dollfus, having been furnished by government with spirit for the purpose, rectified it, by repeated and slow distillations, till its specific gravity became stationary in this manner of operating: he then added dry caustic alkali to it, let it stand for a few days, poured off the liquor, and distilled it with a small addition of burnt alum, placing the receiver in ice. By this method he obtained a spirit whose specific gravity was 8188, at 60 of heat. Perceiving, however, that he could not conveniently get the quantity of spirit he wanted lighter than 82527, at 60, he fixed upon that strength as a standard.

Several highly respectable authorities might be produced to prove this specific gravity to be a proper standard for *pure spirit*.

[To be continued.]

XXVI. *A short Account of the Mammoth.* By Mr. REMBRANDT PEALE*.

THE mammoth is so called from the Russian name, supposed to have been derived from the Hebrew *Behemoth*, Job, chap. xl. It is properly continued, both words being expressive of a large and extraordinary animal.

For a number of years past many large and extraordinary

* Communicated by the Author.

bones

bones and teeth have been discovered both in Siberia and America, which at first were generally attributed to the elephant *, except some very large teeth of the carnivorous kind totally different from those of any animal known.

In Siberia they were attributed to the mammoth, whose fabulous existence they supposed to be under ground, and of which Isbrand Ides pretends to give a description. In North America these large bones and carnivorous grinders have been found in great abundance on the Ohio and its tributary streams, washed from their banks, or discovered by digging in salt morasses in the neighbourhood of Cincinnati; where they are found intermixed with the bones of buffaloes and deer, which a tradition of the Indians states to have been destroyed by a herd of these animals which came upon them from the north. This event happened, the Indians believe, as a punishment for their sins; but they say the good spirit at length interposed to save them, and, seating himself on a neighbouring rock, where they show you the print of his seat and of one foot, hurled his thunderbolts among them. All were killed except one male, who, presenting his forehead to the shafts, shook them off, until, at length wounded, he sprung over the Wabash, the Illinois, and the Great Lake, where he still lives.

These bones were forwarded with great eagerness to all parts of Europe, and deposited in museums, where they attracted the curiosity of all naturalists, whose conjectures and theories on them were very various, until Dr. Hunter, by a more accurate comparison between them and the bones of other animals, determined that they must have belonged to a large non-descript animal of the carnivorous kind, somewhat resembling the hippopotamus and the elephant, yet essentially different from both.

The subject is now completely elucidated. Not long since some farmers in the State of New York, in America, digging marble from their morasses in the neighbourhood of New-Windfor, accidentally discovered several of these bones, which were preserved by physicians in the neighbourhood. In the autumn of 1801, my father Charles W. Peale and myself, having obtained possession of these bones, persevered for nearly three months, at the expense of much time, labour, and money, in a search for the remainder of the animal; and were fortu-

* Naturalists were led to this idea in consequence of finding, in a few instances in America, but frequently in Siberia, some large graminivorous teeth, which probably belonged to an animal of the elephant kind, though certainly of different species from any known: these teeth are remarkable for size, and in the number of lamellated veins of enamel which pervade them.

nate enough to obtain two skeletons, found in two distinct situations, and unmixed with bones of any other individual whatever: one of these is preserved in the Museum at Philadelphia, and the other is now exhibiting in the Old Academy-room, Pall-Mall, previously to its being taken to Paris.

The skeleton of the mammoth bears some general resemblance to that of the elephant, yet on examination even the general figure is found to be considerably different; principally in the effect of the tusks, structure of the head, prominence and pointedness of the back over the shoulders, its great descent thence to the hips, together with the comparative smallness of the body and the necessarily detached effect of the hind-legs—proofs of greater activity than in the elephant. On a closer examination, the characteristic features are greatly multiplied; and with respect to the hind-legs, the idea of activity is confirmed from the structure of the thigh-bones, which are extremely broad and flat, and well adapted for great exertions of strength, beyond that of the elephant, whose thigh-bones are not flat, but round. This effect of strength likewise prevails in the ribs, which are of a very unusual structure, being bent edgewise and having their greatest thickness at top, gradually becoming smaller towards their junction with the cartilage; whereas in the elephant they are bent flatwise, like those of the ox, and are narrow at top and broad at the lower ends. This peculiarity in the ribs of the mammoth is worthy of particular notice, not only on account of the unusual position of strength, but because, from their distance between each other, they show the animal to have had considerable flexibility in its body; to which the breadth and proximity in the ribs of the elephant, as well as the ox, are a certain impediment. Besides, as I observed before, the body is comparatively smaller, in consequence of the small length of the ribs.

The spines of the back over the shoulders are of an unusual magnitude, which gives the appearance of a hump, like the bison, and are calculated to give power and motion to the head. Those in the elephant are not so large over the shoulders, but much more so all the way to the sacrum: consequently his back is more arched. The proportionate length of the processes from the spine of the scapula differs essentially from all other animals. And, independently of any other variation in form, all the bones, of the limbs in particular, are astonishingly thick and strong.

We now come to the head, where the most striking features of this animal are to be found; and since between the corresponding parts of all animals there is a general analogy, it is
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the province of comparative anatomy not only to trace out the points of distinction, but, since they originate from certain fixed principles, in the discrimination of variations, to confirm their propriety by an examination of the principles on which they are founded.

Although it is sufficiently evident to those who are accustomed to this kind of investigation, from the observation of a few facts, that this animal must have been carnivorous; yet to others it is necessary to introduce every proof and conclusive evidence. Many persons, from a false impression, believe that teeth are determined to be carnivorous merely from their having a rugged surface: with this opinion they very properly ask, "May not the vegetable food be of a coarser quality?" It is true that the surface is roughest on those graminivorous teeth which are employed in the mastication of the coarsest vegetable substances, not only because such roughness is requisite, but because the teeth are rendered so from the quality of the food, the bony interstices wearing down more easily than the ridges of enamel, which operate as the roughness in a mill-stone. It is not therefore from this species of roughness that we presume on so important a determination: the roughness existing on the surface of carnivorous teeth is of another nature, much more strongly marked, and far from being rendered so by usage: the more they are used, the more even do they become. The tooth of a graminivorous animal is composed of *alternate veins* of enamel and bone, which thus pervade the whole mass: those of carnivorous animals are covered with a shell or crust of enamel, which is merely external, and exists as well in the cavities as on the ridges; which is not the case with other teeth. This enamel is required in the cavities, because the teeth interlock with each other, the prominences striking into the cavities.

An uniform composition of tooth, as it respects the intermixture of enamel and bone, is observed to prevail in those of the elephant, horse, ox, &c. principally differing from each other in the *figure* which those veins of enamel assume, and by which alone they may be discriminated among themselves. On the other hand, carnivorous teeth, incrustated with enamel as far as the gums, yet vary in the form and number of their protuberances, so as generally to designate their species: yet among them there is a very proper distinction to be observed, which is, that those carnivorous animals, the form of whose teeth and the attachment of whose jaws allow them the side or grinding motion, are always of the mixt kind. Man, the monkey, hog, &c. are carnivorous ani-

mals, because their teeth are incrufted with enamel, and because they do eat flefh; yet they are adapted for other food, by the rotatory motion of their jaws and the form of their teeth: this rotatory motion does not exift in the jaws of thofe animals which live entirely upon flefh; for they are attached by an oblong head or procefs inferted into a tranfverfe groove, and confequently have no other motion than up and down. In graminivorous animals the under jaw is attached by means of a confiderably round head (condyloid procefs) to a prominence or flat furface, fo that they *rotate*; and, to favour this motion, the coronoid procefs is generally thicker and not fo long as the condyloid; whereas in carnivorous animals the coronoid procefs is extremely flat and long, being never acted on except lengthwife.

But it muft not even be fupposed that an animal may be of the mixt kind, unlefs we obferve a capacity for maffication; without which we muft declare it excluſively carnivorous.

Some object to the carnivorous nature of the mammoth from its not having cutting or canine teeth. To this it may be replied, that if we form our rule of judgment, as to what conſtitutes a graminivorous animal, from the conſtruction of an ox's jaw, the elephant would certainly be excluded, becauſe it has not *incifores* at leaſt in the lower jaw: the fact is, that all carnivorous as well as graminivorous animals differ among themſelves with reſpect to the number and ſituation of their teeth; and hence they afforded to the ſagacious and celebrated Linnæus the moſt infallible method of claffification, which has ſince been adopted, either wholly or partially, by all naturaliſts. The probofcis of the elephant answers the purpoſe of *incifores*: he therefore requires no others than grinders, which entirely fill his jaws: hence he is completely graminivorous. And although the mammoth is deficient in cutting teeth, and has no other canine teeth than his enormous tuſks, the deficiencies of which may have been ſupplied by a pair of large and powerful lips, indicated by the uncommon ſinuofity on the front of the lower jaw; yet I am decidedly of opinion, ſince it cannot be contradicted by a ſingle proof or fact, that the mammoth was excluſively carnivorous; by which I mean, that he made no uſe of vegetable food, but either lived entirely on fleſh or fiſh; and not improbably upon ſhell-fiſh, if, as there are many reaſons to ſuppoſe, he was of an amphibious nature. I therefore only require aſſent to theſe facts: 1ſt, The teeth are certainly of the carnivorous kind: 2dly, They are not of the mixt kind, becauſe they have not the leaſt rotatory motion,
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and so completely lock together: 3dly, Since, therefore, they are not graminivorous, since they cannot be of the mixt kind, from a defect in motion, they must be exclusively and positively carnivorous.

Independently of the teeth, the under jaw of the mammoth differs most essentially from that of the elephant, which in its outline is semi-circular, from the condyle to the chin; whereas in the mammoth the outline is distinctly angular, and is much greater in the length than it is in the height, which is the reverse in the elephant: besides several other striking distinctions in both jaws.

When the skeleton was first erected, I was much at a loss how to dispose of the tusks; their sockets showed that they grew out forwards, but did not indicate whether they were curved up or down. I chose, therefore, first to turn them upwards, not because they produced the same effect as in the elephant, for it is evident they could not in any position, owing to two circumstances. In the elephant, taking the level of the teeth for a horizontal base line, the condyle of the neck is at right angles with it; and the perpendicular, one third longer than the base line: hence they are useful on every occasion, the tusks themselves being nearly straight, and pointing downwards; whereas in the mammoth, taking the level of the teeth for a base line, the condyle of the neck is situated but a few inches above it: consequently the sockets for the tusks and the condyle of the neck are in a horizontal direction: this circumstance, together with the extraordinary curve of the tusks, would raise the points in the air, directed in some degree backward over the head, twelve feet from the ground, and never could have been brought lower than six or seven feet from it. This position was evidently absurd: I therefore resolved on reversing them; in which position, in consequence of their twist or double curve, they appear infinitely more serviceable.

Six miles from the spot where this skeleton was discovered we found two entire tusks, in form exactly like those in the skeleton, but very much worn at the extremities (the point of one I have with me), and worn in so peculiar a manner, considering their form, as could not have happened in an elevated position; unless on the absurd supposition, that the animal amused himself with wearing and rendering them blunt, by rubbing them against high and perpendicular rocks: this in a state of nature can never be supposed, whatever habits may be acquired when in a narrow confinement. There can be no doubt, then, of their having been *used* against the ground, and not improbably in tearing up

shell-fish, if, as we have many reasons to suppose, he was of an amphibious nature: for this species of food his teeth seem admirably adapted. All animals of similar habits have similar teeth: this animal has teeth unlike any other with which we are acquainted: there is much reason, therefore, in supposing his food to have been different; especially when we consider the thickness of enamel which covers the teeth, the peculiar manner in which they are worn, and the small opening for the throat. But, whether amphibious or not, in the inverted position of the tusks he could have torn an animal to pieces held beneath his foot, and could have struck down an animal of common size, without having his sight obstructed, as it certainly would have been in the other position.

The tusks themselves are composed of two very distinct substances: the internal bony or ivory part, which we find in the greatest state of decay; and a thick, distinct coating, doubtless having undergone some decay, yet at present absolutely heavier and harder than the freshest ivory. No part of the skeleton is petrified, but all in their present state of preservation from having been surrounded by a calcareous soil, composed principally of decayed shells, and covered with water even in the driest seasons.

How long since these animals have existed, we shall perhaps ever remain in ignorance; as no judgment can be formed from the quantity of vegetable soil which has accumulated over their bones. Certain we are, that they existed in great abundance, from the number of their remains which are found in America: we are likewise sure that they must have been destroyed by some sudden and powerful cause; and nothing appears more probable than one of those deluges or sudden irruptions of the sea, which have left their traces in every part of the globe, and which are in amazing abundance on the very spot where these bones are found; they consist of petrifications of sea productions, shells, corals, &c. It is extremely probable that, whenever and by whatever means the extirpation of this tremendous race of animals was effected, the same cause must have operated in the destruction of all those inhabitants from whom we might have received some satisfactory account of them.

Dimensions of the Skeleton.

				Ft.	In.
Height over the shoulders	-	-	-	11	0
Ditto over the hips	-	-	-	9	0
Length from the chin to the rump	-	-	-	15	0
				From	

			Ft.	In.
From the point of the tusks to the end of the tail, following the curve	-	-	31	0
Length in a straight line	-	-	17	0
Width of the hips and body	-	-	5	8
Length of the under jaw	-	-	2	10
Weight of the same	-	63 $\frac{1}{2}$ pounds		
Width of the head	-	-	3	2
Length of the thigh-bone	-	-	3	7
Smallest circumference of the same	-	-	1	6
Length of the tibia	-	-	2	0
Length of the humerus, or large bone of the fore-leg	-	-	2	10
Largest circumference of the same	-	-	3	2 $\frac{1}{2}$
Smallest ditto ditto	-	-	1	5
Length of the radius	-	-	2	5 $\frac{1}{2}$
Circumference round the elbow	-	-	3	8
Length of the scapula, or shoulder-blade	-	-	3	1
Length of the longest vertebra, or back-bone	-	-	2	3
Longest rib, without cartilage	-	-	4	7
Length of the first rib	-	-	2	0
Ditto of the breast-bone	-	-	4	0
Length of the tusks, defences, or horns	-	-	10	7
Circumference of one tooth or grinder	-	-	1	6 $\frac{1}{2}$
Weight of the same, 4 pounds 10 ounces				
The whole skeleton weighs about 1000 pounds.				

XXVII. *New Theory of the Constitution of mixed Gases elucidated.* By J. DALTON, Esq.*

IN an essay, published in the Memoirs of the Literary and Philosophical Society of Manchester, vol. v. part 2, I gave a new theory of the constitution of mixed gases, and particularly of the atmosphere, and endeavoured to illustrate my meaning by a plate, &c. Notwithstanding this, I am informed by some of my chemical friends that they do not clearly understand the hypothesis itself, and consequently are not able to judge of its merits or defects: and a late writer (Dr. Thomson) in his System of Chemistry, vol. iii. p. 270, speaking of the uniform diffusion of the different gases of the atmosphere, makes the following observation:—"Even Mr. Dalton's ingenious supposition, that they neither attract nor repel each other, would not account for this equal distribution; for, undoubtedly on that supposition they would arrange

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themselves