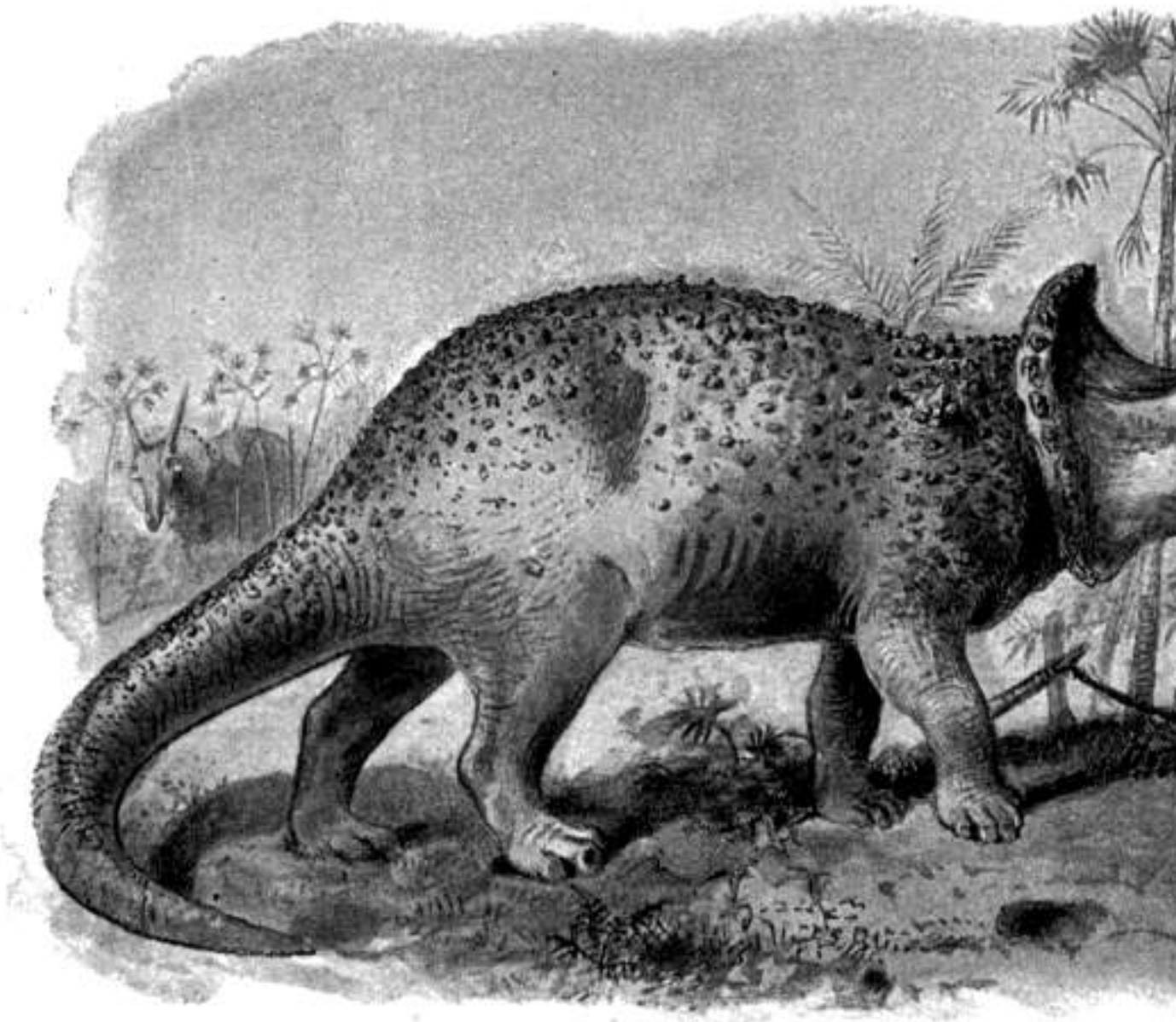


**Extinct Monsters**

**Plate XI.**



A GIGANTIC HORNED DINOSAUR, TRICERATOPS PRORSUS. Length about 25 feet.

[iii]

**EXTINCT MONSTERS.**

***A POPULAR ACCOUNT OF SOME OF THE LARGER FORMS OF ANCIENT ANIMAL LIFE.***

**BY**

**REV. H. N. HUTCHINSON, B.A., F.G.S.,**

**AUTHOR OF "THE AUTOBIOGRAPHY OF THE EARTH," AND "THE STORY OF THE HILLS." WITH ILLUSTRATIONS BY J. SMIT AND OTHERS.**

***FIFTH AND CHEAPER EDITION. LONDON: CHAPMAN & HALL,***

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[iv]

“The possibilities of existence run so deeply into the extravagant that there is scarcely any conception too extraordinary for Nature to realise.”—Agassiz.

[v]

**PREFACE BY DR. HENRY WOODWARD, F.R.S.  
KEEPER OF GEOLOGY, NATURAL HISTORY MUSEUM.**

I have been requested by my friend Mr. Hutchinson, to express my opinion upon the series of drawings which have been prepared by that excellent artist of animals, Mr. Smit, for this little book entitled “Extinct Monsters.”

Many of the stories told in early days, of Giants and Dragons, may have originated in the discovery of the limb-bones of the Mammoth, the Rhinoceros, or other large animals, in caves, associated with heaps of broken fragments, in which latter the ignorant peasant saw in fancy the remains of the victims devoured at the monster’s repasts.

In Louis Figuier’s *World before the Deluge* we are favoured with several highly sensational views of extinct monsters; whilst the pen of Dr. Kinns has furnished valuable information as to the “slimy” nature of their blood!

The late Mr. G. Waterhouse Hawkins (formerly a lithographic artist) was for years occupied in unauthorised restorations of various Secondary reptiles and Tertiary mammals, and about 1853 he received encouragement

[vi]

from Professor Owen to undertake the restorations of extinct animals which still adorn the lower grounds of the Crystal Palace at Sydenham.

But the discoveries of later years have shown that the Dicynodon and Labyrinthodon, instead of being toad-like in form, were lacertilian or salamander-like reptiles, with elongated bodies and moderately long tails; that the Iguanodon did not usually stand upon “all-fours,” but more frequently sat up like some huge kangaroo with short fore limbs; that the horn on its snout was really on its wrist; that the Megalosaurus, with a more slender form of skeleton, had a somewhat similar erect attitude, and the habit, perhaps, of springing upon its prey, holding it with its powerful clawed hands, and tearing it with its formidable carnivorous teeth. Although the Bernissart Iguanodon has been to us a complete revelation of what a Dinosaur really looked like, it is to America, and chiefly to the discoveries of Marsh, that we owe the knowledge of a whole series of new reptiles and mammals, many of which will be found illustrated within these pages.

Of long and short-tailed Pterodactyles we now know almost complete skeletons and details of their patagia or flying membranes. The discovery of the long-tailed feathered bird with teeth—the Archæopteryx, from the Oolite of Solenhofen, is another marvellous addition to our knowledge; whilst Marsh’s great Hesperornis, a wingless diving bird with teeth, and his flying toothed bird, the Ichthyornis dispar, are to us equally surprising.

Certainly, both in singular forms of fossil reptilia and in early mammals, North America carries off the palm.

Of these the most remarkable are Marsh’s Stegosaurus,

[vii]

a huge torpid reptile, with very small head and teeth, about twenty feet in length, and having a series of flattened dorsal spines, nearly a yard in height, fixed upon the median line of its back; and his Triceratops, another reptile bigger than Stegosaurus, having a huge neck-shield joined to its skull, and horns on its head and snout. Nor do the Eocene mammals fall short of the marvellous, for in Dinoceras we find a beast with six horns, and sword-bayonet tusks, joined to a skeleton like an elephant. Latest amongst the marvels in modern palæontological discovery has been that made by Professor Fraas of the outline of the skin and fins in Ichthyosaurus tenuirostris, which shows it to have been a veritable shark-like reptile, with a high dorsal fin and broad fish-tail, so that "fish-lizard" is more than ever an appropriate term for these old Liassic marine reptiles.

As every palæontologist is well aware, restorations are ever liable to emendation, and that the present and latest book of extinct monsters will certainly prove no exception to the rule is beyond a doubt, but the author deserves our praise for the very boldness of his attempt, and the honesty with which he has tried to follow nature and avoid exaggeration. Every one will admire the simple and unaffected style in which the author has endeavoured to tell his story, avoiding, as far as possible, all scientific terms, so as to bring it within the intelligence of the unlearned. He has, moreover, taken infinite pains to study up his subject with care, and to consult all the literature bearing upon it. He has thus been enabled to convey accurate information in a simple and pleasing form, and to guide the artist in his difficult task with much wisdom and intelligence. That the excellence of the sketches is

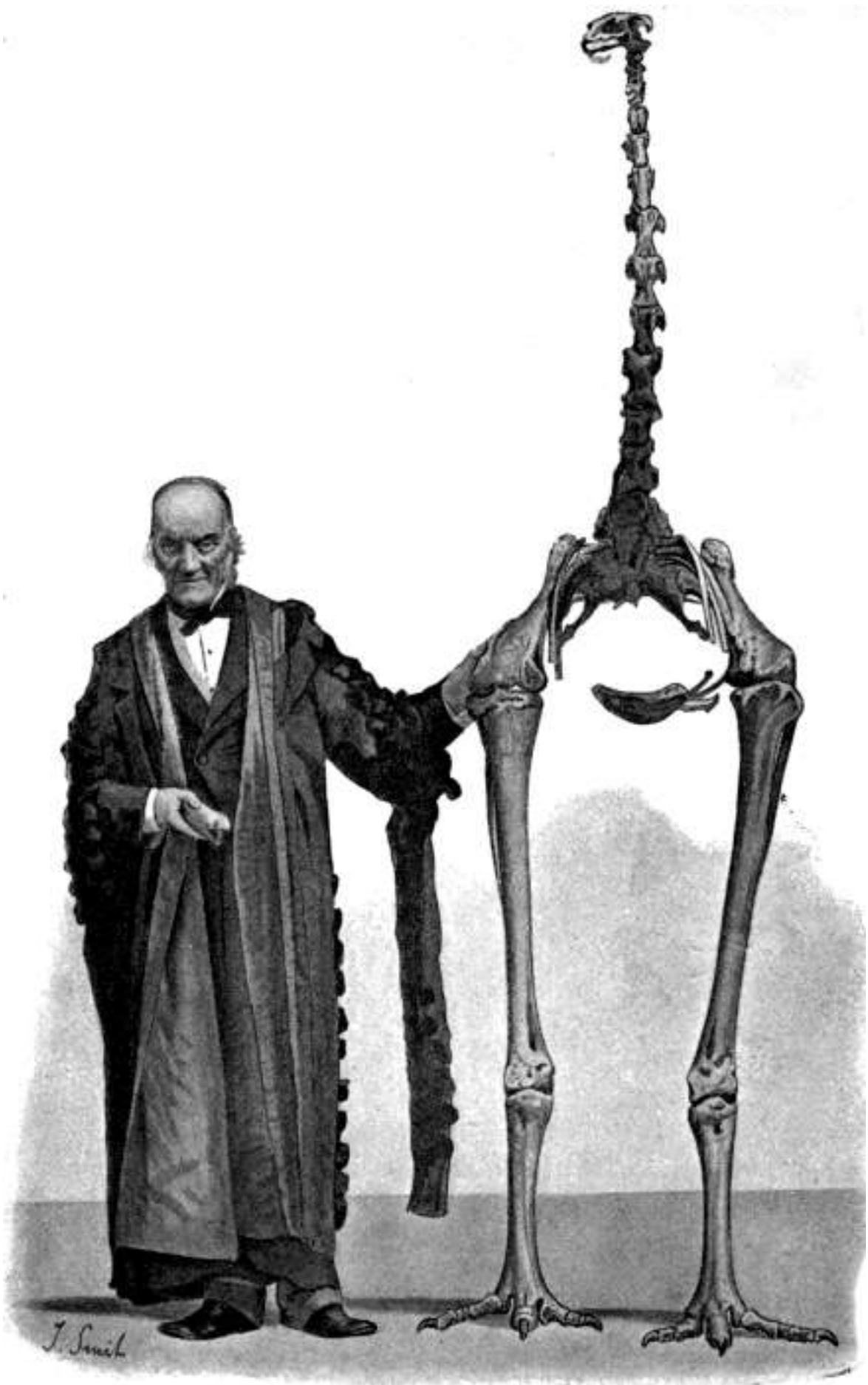
[viii]

due to the artist, Mr. Smit, is a matter of course, and so is the blame, where criticism is legitimate; and no one is more sensible of the difficulties of the task than Mr. Smit himself.

Speaking for myself, I am *very well pleased* with the series of sketches; and I may say so with the greater ease and freedom from responsibility, as I have had very little to do with them, save in one or two trifling matters of criticism. I may venture, however, to commend them to my friends among the public at large as the happiest set of restorations that has yet appeared.

H. W.

**Plate XXIV.**



THE LATE SIR RICHARD OWEN AND A SKELETON OF DINORNIS MAXIMUS. (*From a photograph.*)

[ix]

#### **AUTHOR'S PREFACE.**

Natural history is deservedly a popular subject. The manifestations of life in all its varied forms is a theme that has never failed to attract all who are not destitute of intelligence. From the days of the primitive cave-dwellers of Europe, who lived with mammoths and other animals now lost to the world; of the ancient Egyptians, who drew and painted on the walls of their magnificent tombs the creatures inhabiting the delta of the Nile; of the Greeks, looking out on the world with their bright and child-like curiosity, down to our own times, this old, yet ever new, theme has never failed. Never before was there such a profusion of books describing the various forms of life inhabiting the different countries of the globe, or the rivers, lakes, and seas that diversify its scenery. Popular writers have done good service in making the way plain for those who wish to acquaint themselves with the structures, habits, and histories of living animals; while for students a still greater supply of excellent manuals and text-books has been, and still continues to be, forthcoming. But in our admiration for the present we forget the great past. How seldom do we think of that innumerable

[x]

host of creatures that once trod this earth! How little in comparison has been done for *them*! Our natural-history books deal only with those that are alive now. Few popular writers have attempted to depict, as on a canvas, the great earth-drama that has, from age to age, been enacted on the terrestrial stage, of which we behold the latest, but probably not the closing scenes.

When our poet wrote "All the world's a stage," he thought only of "men and women," whom he called "merely players," but the geologist sees a wider application of these words, as he reviews the drama of past life on the globe, and finds that animals, too, have had "their exits and their entrances;" nay more, "the strange eventful history" of a human life, sketched by the master-hand, might well be chosen to illustrate the birth and growth of the tree of life, the development of which we shall briefly trace from time to time, as we proceed on our survey of the larger and more wonderful animals of life that flourished in bygone times.

We might even make out a "seven ages" of the world, in each of which some peculiar form of life stood out prominently, but such a scheme would be artificial.

There is a wealth of material for reconstructing the past that is simply bewildering; and yet little has been done to bring before the public the strange creatures that have perished.<sup>[1]</sup>

[1]

Figuier's *World before the Deluge* is hardly a trustworthy book, and is often not up to date. The restorations also are misleading. Professor Dawson's *Story of the Earth and Man* is better; but the illustrations are poor. Nicholson's *Life-History of the Earth* is a student's book. Messrs. Cassells' *Our Earth and its Story* deals with the whole of geology, and so is too diffusive; its ideal landscapes and restorations leave much to be desired.

[xi]

To the writer it is a matter of astonishment that the discoveries of Marsh, Cope, Leidy, and others in America, not to mention some important European discoveries, should have attracted so little notice in this country. In the far and wild West a host of strange reptiles and quadrupeds have been unearthed from their rocky sepulchres, often of incredibly huge proportions, and, in many cases, more weird and strange than the imagination could conceive; and yet the public have never heard of these discoveries, by the side of which the now well-known “lost creations” of Cuvier, Buckland, or Conybeare sink into the shade. For once, we beg leave to suggest, the hungry pressman, seeking “copy,” has failed to see a good thing. Descriptions of some of “Marsh’s monsters” and how they were found, might, one would think, have proved attractive to a public ever on the look out for something new.

Professor Huxley, comparing our present knowledge of the mammals of the Tertiary era with that of 1859, states that the discoveries of Gaudry, Marsh, and Filhol, are “as if zoologists were to become acquainted with a country hitherto unknown, as rich in novel forms of life as Brazil or South America once were to Europeans.” The object of this book is to describe some of the larger and more monstrous forms of the past—the lost creations of the old world; to clothe their dry bones with flesh, and suggest for them backgrounds such as are indicated by the discoveries of geology: in other words, to endeavour, by means of pen and pencil, to bring them back to life. The ordinary public cannot learn much by merely gazing at skeletons set up in museums. One longs to cover their nakedness with flesh and skin, and to see them as they were when they walked this earth.

[xii]

Our present imperfect knowledge renders it difficult in some cases to construct successful restorations; but, nevertheless, the attempt is worth making: and if some who think geology a very dry subject, can be converted to a different opinion on reading these pages, we shall be well rewarded for our trouble.

We venture to hope that those who will take the trouble to peruse this book, or even to look at its pictures, on which much labour and thought have been expended, will find pleasure in visiting the splendid geological collection at Cromwell Road. We have often watched visitors walking somewhat aimlessly among those relics of a former world, and wished that we could be of some service. But, if this little book should help them the better to understand what they see there, our wish will be accomplished.

Another object which the writer has kept in view is to connect the past with the present. It cannot be too strongly urged that the best commentary on the dead past is the living present. It is unfortunate that there is still too great a tendency to separate, as by a great gulf, the dead from the living, the past from the present, forms of life. The result of this is seen in our museums. Fossils have too often been left to the attention of geologists not always well acquainted with the structures of living animals. The more frequent introduction of fossil specimens side by side with modern forms of life would not only be a gain to the progress and spread of geological science, but would be a great help to students of anatomy and natural

history. The tree of life is but a mutilated thing, and half its interest is gone, when the dead branches are lopped off.

It is, perhaps, justifiable to give to the term "monster" a somewhat extended meaning. The writer has therefore

[xiii]

included in his menagerie of extinct animals one or two creatures which, though not of any great size, are nevertheless remarkable in various ways—such, for instance, as the winged reptiles, and anomalous birds with teeth, of later times, and others. Compared with living forms, these creatures appear to us as "monstrosities," and may well find a place in our collection.

The author wishes, in a few words, to thank those friends who have rendered him assistance in his task.

Dr. Henry Woodward, F.R.S., Keeper of Geology, Natural History Museum, has from the first taken a lively interest in this little book. He kindly helped the author with his advice on difficult matters, criticising some of the artist's preliminary sketches and suggesting improvements in the restorations. With unfailing courtesy he has ever been willing, in spite of many demands on his time, to place his knowledge at the disposal of both the author and artist; and in this way certain errors have been avoided. Besides this, he took the trouble to read through the proof-sheets, and made suggestions and corrections which have greatly improved the text. For all this welcome aid the author begs to return his sincere thanks.

To Mr. Smith Woodward, of the Natural History Museum, the author is also much indebted for his kindness in reading through the text and giving valuable information with regard to the latest discoveries.

The artist, Mr. Smit, notwithstanding the novelty of the subject and the difficulties of the task, has thrown himself heartily into the work of making the twenty-four restorations of extinct animals. To him, also, the author is greatly indebted, and considers himself fortunate in having secured the services of so excellent an artist.

[xiv]

To the publishers his thanks are due for their liberality in the matter of illustrations, and the readiness with which they have responded to suggestions.

With regard to minor illustrations the following acknowledgments are due:—

To the Palæontological Society of Great Britain for permission to reproduce three of the illustrations in Sir Richard Owen's great work, *British Fossil Reptiles*, published in their yearly volumes, viz. Figs. 3, 4, and 8.

To Messrs. Bell and Co. for the following cuts from the late Dr. Gideon A. Mantell's works: viz. Figs. 12, 14, 20, 33, 37, 38.

To Messrs. A. and C. Black for the following cuts from Owen's *Palæontology*: viz. Figs. 51, 54, 56, 57.

Appendix IV. contains a list of some of the works of which the writer has made use; but it would be impossible within reasonable limits to enumerate all the separate papers which have necessarily been consulted. The reader will find numerous references, such as "Case Y on Plan," in brackets; these refer to the plan given at the end of the excellent little *Guide to the Exhibition Galleries in the Department of*



*Geology and Palæontology in the Natural History Museum, Cromwell Road* (price one shilling), which visitors to the Museum are advised to obtain.

[xv]

#### **PREFACE TO SECOND EDITION.**

The appearance of a second edition affords the author a pleasant opportunity of thanking the reading public, and the Press, for the kind way in which his endeavour to popularise the results of modern Palæontology has been received. There seem to be fashions in all things—even in sciences; and perhaps the wonderful advances we have witnessed of late years in the physical sciences on the one hand, and in biological sciences on the other, may have tended to throw Palæontology somewhat into the shade. Let us hope that it will not remain there long.

A large number of illustrations have been added for the present edition, besides additional matter here and there in the text. Three of the plates (viz. Plates II. X. XV.) have been redrawn. Plate II. shows the Ichthyosaurus as interpreted by the latest discovery from Würtemberg. Plate X. gives a somewhat different interpretation of the Stegosaurus, suggested by some remarks of Mr. Lydekker.

A slight change will be noticed in Plate XV. (Brontops). Plate XVII. is a great improvement on the old drawing (Fig. 28, old edition) of the Megatherium skeleton. Plate XXIV., besides containing a valuable portrait of the late Sir Richard Owen, gives another drawing of the Dinornis skeleton.

*April, 1893.*

[xvi]

[xvii]

#### **CONTENTS.**

Preface by Dr. Henry Woodward

Author's Preface

Preface to Second Edition

Introduction

CHAPTER I.

How Extinct Monsters are preserved

CHAPTER II.

Sea-scorpions

CHAPTER III.

The Great Fish-lizards

CHAPTER IV.

The Great Sea-lizards and their Allies

CHAPTER V.

The Dragons of Old Time—Dinosaurs

CHAPTER VI.

The Dragons of Old Time—Dinosaurs

CHAPTER VII.

The Dragons of Old Time—Dinosaurs

CHAPTER VIII.

Flying Dragons

CHAPTER IX.

Sea-serpents

CHAPTER X.

Some American Monsters

CHAPTER XI.

Some Indian Monsters

CHAPTER XII.

Giant Sloths and Armadillos

CHAPTER XIII.

The Mammoth

CHAPTER XIV.

The Mastodon and the Woolly Rhinoceros

CHAPTER XV.

Giant Birds

CHAPTER XVI.

The Great Irish Deer and Steller's Sea-cow

APPENDICES.

I.—Table of Stratified Rocks

II.—The Great Sea-serpent

III.—List of British Localities where Remains of the Mammoth have been discovered

IV.—Literature

V.—Ichthyosaurs

Index

[xix]

**LIST OF FULL-PAGE ILLUSTRATIONS.**

PLATE

<u>XI.</u>	A Gigantic Horned Dinosaur, <i>Triceratops prorsus</i>	TO F
<u>XXIV.</u>	Sir Richard Owen and Skeleton of <i>Dinornis maximus</i>	<i>Fron</i>
<u>I.</u>	Sea-scorpions	ix
<u>II.</u>	Fish-lizards	25
<u>III.</u>	Pterodactyls—Long-necked Sea-lizard—Cuttle-fish or Belemnite	41
<u>IV.</u>	A Gigantic Dinosaur, <i>Brontosaurus excelsus</i>	55
<u>V.</u>	Thigh-bone of the Largest of the Dinosaurs, <i>Atlantosaurus</i>	69
<u>VI.</u>	A Carnivorous Dinosaur, <i>Megalosaurus Bucklandi</i>	71
<u>VII.</u>	A Gigantic Dinosaur, <i>Iguanodon Bernissartensis</i>	79
<u>VIII.</u>	A Gigantic Dinosaur, <i>Iguanodon Mantelli</i>	97
<u>IX.</u>	An Armoured Dinosaur, <i>Scelidosaurus Harrisoni</i>	101
<u>X.</u>	A Gigantic Armoured Dinosaur, <i>Stegosaurus unguatus</i>	105
<u>XII.</u>	Group of Small Flying Dragons, or Pterodactyls	113
<u>XIII.</u>	Group of Sea-serpents, <i>Elasmosaur</i> , and Fishes	131
<u>XIV.</u>	A Large Extinct Mammal, <i>Tinoceras ingens</i>	141
<u>XV.</u>	A Huge Extinct Mammal, <i>Brontops robustus</i>	151
<u>XVI.</u>	A Gigantic Hoofed Mammal, <i>Sivatherium giganteum</i>	161
<u>XVII.</u>	Skeleton of Great Ground Sloth of South America	169
<u>XVIII.</u>	Great Ground Sloth of South America, <i>Megatherium americanum</i>	179
		181
		[xx]

<u>XIX.</u>	A Gigantic Armadillo, <i>Glyptodon asper</i>	189
<u>XX.</u>	The Mammoth, <i>Elephas primigenius</i>	205
<u>XXI.</u>	The Mastodon of Ohio, <i>M. americanus</i>	219
<u>XXII.</u>	The Woolly Rhinoceros, <i>Rhinoceros tichorhinus</i>	225
<u>XXIII.</u>	Moa-birds	233
<u>XXV.</u>	The Great Irish Deer, <i>Cervus megaceros</i>	243
<u>XXVI.</u>	Steller's Sea-cow, <i>Rhytina gigas</i>	249

[xxi]

### LIST OF FIGURES IN TEXT.

FIG

- . . .
1. Pterygotus anglicus
2. Silurian Merostomata
3. Ichthyosaurus intermedius
4. Teeth of Ichthyosauri
5. Skull of Ichthyosaurus latifrons
6. Skull of Ichthyosaurus platyodon
7. Mandibles of Long-necked Sea-Lizards
8. Skeleton of Plesiosaurus macrocephalus
9. Restored Skeleton of Brontosaurus excelsus
10. Neck Vertebræ of Brontosaurus
11. Head of Diplodocus
12. Lower Jaw-bone of Megalosaurus, with Teeth
13. Skeleton of Megalosaurus
14. Portion of a Slab of New Red Sandstone
15. Portion of a Slab, with Tracks
16. Limb-bones of Allosaurus
17. Skull of Ceratosaurus
18. Skull of Ceratosaurus nasicornis
19. Skeleton of Compsognathus longipes
20. Tooth of Iguanodon
21. Skeleton of Iguanodon Bernissartensis
22. Skull and Skeleton of Iguanodon Mantelli
23. Tracks of Iguanodon
24. Restored Skeleton of Scelidosaurus Harrisoni
25. Skeleton of Stegosaurus unguatus
26. Tail Vertebræ of Stegosaurus
27. Limb-bones of Stegosaurus
28. Plates of Stegosaurus
29. Head of Triceratops
30. Skeleton of Triceratops prorsus
31. Bony Spines belonging to the Skin of Triceratops
32. Skeleton of Dimorphodon Macronyx
33. Skeleton of Scaphognathus crassirostris
34. Skeleton of Pterodactylus spectabilis

35. Skeleton of Rhamphorhynchus phyllurus
36. Skull of Pteranodon
37. Skull of Mosasaurus Hoffmanni
38. Teeth of Mosasaurus
39. Lower Tooth of Leiodon
40. Snout of Tylosaurus
41. Skeleton of Clidastes cineriarum
- 41a Skull of Platecarpus
- .
42. Skeleton of Tinoceras ingens
43. Skull of Dinoceras mirabile
44. Cast of Brain-cavity of Dinoceras mirabile
45. Skeleton of Brontops robustus
46. Skull of Sivatherium giganteum
47. Skeleton of Sivatherium giganteum
48. Restored Figure of Gigantic Tortoise, Colossochelys atlas
49. The Elephant victorious over the Tortoise, supporting the World, and unfolding the Mysteries of the "Fauna Sivalensis"
50. Skeleton of Scelidotherium
51. Extinct Gigantic Armadillo, Glyptodon clavipes
52. Skeleton of Mammoth, Elephas primigenius
53. Figure of the Mammoth, engraved on Mammoth Ivory
54. Skeleton of Mastodon arvernensis
55. Head of Woolly Rhinoceros
56. Skeleton of the Elephant-footed Moa, Dinornis elephantopus
57. Skeleton of Great Irish Deer, Cervus giganteus
58. Skeleton of Rhytina gigas

[1]

## **EXTINCT MONSTERS.**

### **INTRODUCTION.**

"The earth hath gathered to her breast again And yet again, the millions that were born Of her unnumbered, unremembered tribes."

Let us see if we can get some glimpses of the primæval inhabitants of the world, that lived and died while as yet there were no men and women having authority over the fishes of the sea and the fowls of the air.

We shall, perhaps, find this antique world quite as strange as the fairy-land of Grimm or Lewis Carroll. True, it was not inhabited by "slithy toves" or "jabberwocks," but by real beasts, of whose shapes, sizes, and habits much is already known—a good deal more than might at first be supposed. And yet, real as it all is, this antique world—this panorama of scenes that have for ever passed away—is a veritable fairy-land. In those days of which geologists tell us, the principal parts were played, not by kings and queens, but by creatures many of which were very unlike those we see around us now. And yet it is no fairy-land after all, where impossible things happen, and where impossible dragons figure largely; but only the same old world in which you and I were born. Everything you will see here is quite true. All these monsters once lived. Truth is

[2]

stranger than fiction; and perhaps we shall enjoy our visit to this fairy-land all the more for that reason. For not even the dragons supposed to have been slain by armed knights in old times, when people gave ear to any tale, however extravagant, could equal in size or strength the real dragons we shall presently meet with, whose actual bones may be seen in the Natural History Museum at South Kensington. Many people who visit this great museum and find their way to the geological galleries on the right, pass hastily by the cases of bones, teeth, and skeletons. These things, it seems, fail to interest them. They do not know how to interpret them. They cannot picture to themselves the kinds of creatures to which the relics once belonged; and so they pass them by and presently go to the more attractive collection of stuffed birds on the other side. There they see the feathered tribes of the air all beautifully arranged; some poised in the air by almost invisible wires; some perched on branches: but all surrounded by grass, flowers, and natural objects, imitated with marvellous reality, so that they see the birds as they really are in nature, and can almost fancy they hear them singing.

Now, it has often occurred to the present writer that something more might be done for the long-neglected "lost creations" of the world, to bring them out of their obscurity, that they may be made to tell to the passer-by their wondrous story. We can, however, well imagine some of our readers asking, "Can these dry bones live?" "Yes," we would say, "they can be made to live; reason and imagination will, if we give them proper play, provide us eyes wherewith to see the world's lost creations." To such men as Cuvier, Owen, Huxley, and others, these dry bones *do* live. It will be our object to describe to the reader some of the wonderful results that have rewarded the lifelong labours of such great men. We shall take some of the largest and strangest forms of life that once lived, and try to picture them as they really were when alive, whether walking on

[3]

land, swimming in the sea, or flying in the air; to understand the meanings of their more obvious structures; and to form some conclusions with regard to their habits, as well as to find out, if possible, their relations,—as far as such questions have been answered by those most qualified to settle these difficult matters.

All technical details, such as the general reader is unfamiliar with, will be as far as possible suppressed. Let us fancy a long procession of extinct monsters passing in single file before us, and ourselves endeavouring to pick out their "points" as they present themselves to the eye of imagination. It is not, be it remembered, mere imagination that guides the man of science in such matters, for all his conclusions are carefully based on reason; and when conclusions are given, we shall endeavour to show how they have been arrived at.

For millions of years countless multitudes of living animals have played their little parts on the earth and passed away, to be buried up in the oozy beds of the seas of old time, or entombed with the leaves that sank in the waters of primæval lakes. The majority of these perished beyond all recovery, leaving not a trace behind; yet a vast number of fossilised remains have been, in various ways, preserved; sometimes almost as completely as if Dame Nature had thoughtfully embalmed them for our instruction and delight.

Down in those old seas and lakes she kept her great museum, in order to preserve for us a selection of her treasures. In course of time she slowly raised up sea-beds and lake-bottoms to make them into dry land. This museum is everywhere around us. We have but to enter quarries and railway cuttings, or to search in coal-mines, or under cliffs at the sea-side, and we can consult her records. As the ancient Egyptians built tombs, pyramids, and temples, from which we may learn their manner of life and partly read their history, so Nature has entombed, not one race only, but many races of the children of life. Her

[4]

records are written in strange hieroglyphs, yet it is not difficult to interpret their meaning; and thus many an old story, many an old scene, may be pictured in the mind of man.

Shall we call this earth-drama a tragedy or a comedy? Doubtless tragic scenes occurred at times; as, for instance, when fierce creatures engaged in deadly combat: and probably amusing, if not comic, incidents took place occasionally, such as might have provoked us to laughter, had we been there to see them. But let us simply call it a drama. Backgrounds of scenery were not wanting. Then, as now, the surface of the earth was clothed with vegetation, and strange cattle pastured on grassy plains. Vegetation was at times very luxuriant. The forests of the coal period, with their giant reeds and club-moss trees, must have made a strange picture. Then, as now, there rose up from the plains lofty ranges of mountains, reaching to the clouds, their summits clothed with the eternal snows. These, too, played their part, feeding the streams and the rivers that meandered over the plains, bringing life and fertility with them, as they do now. The sun shone and the wind blew: sometimes gently, so that the leaves just whispered in an evening breeze; at other times so violently that the giants of the forest swayed to and fro, and the seas lashed themselves furiously against rocky coasts. Nor were the underground forces of the earth less active than they are now: volcanic eruptions often took place on a magnificent scale; volcanoes poured out fiery lava streams for leagues beneath their feet; great showers of ashes and fine dust were ejected in the air, so that the sun was darkened for a time, and the surface of the sea was covered for many miles with floating pumice and volcanic dust, which in time sank to the bottom, and was made into hard rock, such as we now find on the top of Snowdon.

Earthquake shocks were quite as frequent, and no doubt the ground swayed to and fro, or was rent open as some unusually great earth-movement took place, and perhaps a mountain

[5]

range was raised several feet or yards higher. All this we learn from the testimony of the rocks beneath our feet. It only requires the use of a little imagination to conjure up scenes of the past, and paint them as on a moving diorama.

We shall not, however, dwell at any length on the scenery, or the vegetation that clothed the landscape at different periods; for these features are sufficiently indicated in the beautiful drawings of extinct animals by our artist, Mr. J. Smit. The researches of the illustrious Baron Cuvier, at Paris, as embodied in his great work, *Ossemens Fossiles*, gave a great impetus to the study of organic remains. It was he who laid the foundations of the science of Palæontology,<sup>[2]</sup> which, though much

has already been accomplished, yet has a great future before it. Agassiz, Owen, Huxley, Marsh, Cope, and others, following in his footsteps, have greatly extended its boundaries; but he was the pioneer.

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Palæontology is the science which treats of the living beings, whether animal or vegetable, which have inhabited this globe at past periods in its history. (Greek—*palaios*, ancient; *onta*, beings; *logos*, discourse.)

Before his time fossil forms were very little known, and still less understood. His researches, especially among vertebrates, or backboned animals, revealed an altogether undreamed-of wealth of entombed remains. It is true the old and absurd notion that fossils were mere “sports of Nature,” sometimes bearing more or less resemblance to living animals, but still only an accidental (!) resemblance, had been abandoned by Leibnitz, Buffon, and Pallas; and that Daubenton had actually compared the fossil bones of quadrupeds with those of living forms; while Camper declared his opinion that some of these remains belonged to extinct species of quadrupeds.

It is to Cuvier, however, that the world owes the first systematic application of the science of comparative anatomy, which he himself had done so much to place on a sound basis, to the study of the bones of fossil animals. He paid great attention to

[6]

the relative shapes of animals, and the different developments of the same kind of bones in various animals, and especially to the nature of their teeth. So great did his experience and knowledge become, that he rarely failed in naming an animal from a part of its skeleton. He appreciated more clearly than others before him the mutual dependence of the various parts of an animal’s organisation. “The organism,” he said, “forms a connected unity, in which the single parts cannot change without modifications in the other parts.”

It will hardly be necessary to give examples of this now well-known truth; but, just to take one case: the elephant has a long proboscis with which it can reach the ground, and consequently its neck is quite short; but take away the long proboscis, and you would seriously interfere with the relation of various parts of its structure to each other. How, then, could it reach or pick up anything lying on the ground? Other changes would have to follow: either its legs would require to be shortened, or its neck to be lengthened. In every animal, as in a complex machine, there is a mutual dependence of the different parts.

As he progressed in these studies, Cuvier was able with considerable success to restore extinct animals from their fossilised remains, to discover their habits and manner of life, and to point out their nearest living ally. To him we owe the first complete demonstration of the possibility of restoring an extinct animal. His “Law of Correlation” however, has been found to be not infallible; as Professor Huxley has shown, it has exceptions. It expresses our experience among living animals, but, when applied to the more ancient types of life, is liable to be misleading.

To take one out of many examples of this law: Carnivorous animals, such as cats, lions, and tigers, have claws in their feet, very different from the hoofs of an ox, which is herbivorous; while the teeth of the former group are very different to those of

[7]

the latter. Thus the teeth and limbs have a certain definite relation to each other, or, in other words, are correlated. Again, horned quadrupeds are all herbivorous (or graminivorous), and have hoofs to their feet. The following amusing anecdote serves to illustrate Cuvier's law. One of his students thought he would try and frighten his master, and, having dressed up as a wild beast, entered Cuvier's bedroom by night, and, presenting himself by his bedside, said in hollow tones, "Cuvier, Cuvier, I've come to eat you!" The great naturalist, who on waking up was able to discern something with horns and hoofs, simply remarked, "What! horns, hoofs—graminivorous—you can't!" What better lesson could the master have given the pupil to help him to remember his "Law of Correlation"?

Cuvier's great work, entitled *Ossemens Fossiles*, will long remain an imperishable monument of the genius and industry of the greatest pioneer in this region of investigation. This work proved beyond a doubt to his astonished contemporaries the great antiquity of the tribes of animals now living on the surface of the earth. It proved more than that, however; for it showed the existence of a great philosophy in Nature which linked the past with the present in a scheme that pointed to a continuity of life during untold previous ages. All this was directly at variance with the prevalent ideas of his time, and consequently his views were regarded by many with alarm, and he received a good deal of abuse—a fate which many other original thinkers before him have shared.

It is somewhat difficult for people living now, and accustomed to modern teaching, to realise how novel were the conclusions announced by Cuvier. In his *Discourse on the Revolutions of the Surface of the Globe*, translated into most European languages under the title *Theory of the Earth*, he lays down, among others, the two following propositions:—

1. That all organised existences were not created at the same time; but at different times, probably very remote from each

[8]

other—vegetables before animals, mollusca and fishes before reptiles, and the latter before mammals.

2. That fossil remains in the more recent strata are those which approach nearest to the present type of corresponding living species.

Teaching such as this gave a new impetus to the study of organic remains, and Palæontology, as a science, began with Cuvier.

[9]

## **CHAPTER I.**

### **HOW EXTINCT MONSTERS ARE PRESERVED.**

"Geology, beyond almost every other science, offers fields of research adapted to all capacities and to every condition and circumstance of life in which we may be placed. For while some of its phenomena require the highest intellectual powers, and the greatest attainments in abstract science for their successful investigation, many of its problems may be solved by the most ordinary intellect, and facts replete with the deepest interest may be gleaned by the most casual observer."—Mantell.



Let us suppose we are visiting a geological museum for the first time, passing along from one department to another with ever-increasing wonder—now admiring the beautiful polished marbles from Devonshire, with their delicate corals, or the wonderful fishes from the Old Red Sandstone, with their plates of enamel; now the delicate shells and ammonites from the Lias or Oolites, with their pearly lustre still preserved; now the white fresh-looking shells from the Isle of Wight; now the ponderous bones and big teeth of ancient monsters from the Wealden beds of Sussex. The question might naturally occur, “How were all these creatures preserved from destruction and decay, and sealed up so securely that it is difficult to believe they are as old as the geologists tell us they are?” It will be worth our while to consider this before we pass on to describe the creatures themselves.

Now, in the first place, “fossils” are not always “petrifications,” as some people seem to think; that is to say, they are not all turned into stone. This is true in many cases, no doubt, yet one frequently comes across the remains of plants and animals that [10]

have undergone very little change, and have, as it were, been simply sealed up. The state of a fossil depends on several circumstances, such as the soil, mud, or other medium in which it may happen to be preserved. Again, the newest, or most recent, fossils are generally the least altered. We have fossils of all ages, and in all states of preservation. As examples of fossils very little altered, we may take the case of the wonderful collection of bones discovered by Professor Boyd Dawkins in caves in various parts of Great Britain. The results of many years of research are given in his most interesting book on *Cave-Hunting*. This enthusiastic explorer and geologist has discovered the remains of a great many animals, some of which are quite extinct, while others are still living in this country. These remains belong to a late period, when lions, tigers, cave-bears, wolves, hyænas, and reindeer inhabited our country. In some cases the caves were the dens of hyænas, who brought their prey into caverns in our limestone rocks, to devour them at their leisure; for the marks of their teeth may yet be seen on the bones. In other cases the bones seem to have been washed into the caves by old streams that have ceased to run; but in all cases they are fairly fresh, though often stained by iron-rust brought in by water that has dissolved iron out of various rocks—for iron is a substance met with almost everywhere in nature. Sometimes they are buried up in a layer of soil, or “cave-earth,” and at other times in a layer of stalagmite—a deposit of carbonate of lime gradually formed on the floors of caves by the evaporation of water charged with carbonate of lime.

Air and water are great destroyers of animal and vegetable substances from which life has departed. The autumn leaves that fall by the wayside soon undergo change, and become at last separated or resolved into their original elements. In the same way when any wild animal, such as a bird or rabbit, dies in an exposed place, its flesh decays under the influence of rain and wind, so that before long nothing but dry bones is left. Hamlet’s wish that

[11]

this “too too solid flesh would melt” is soon realised after death; and that active chemical element in the air known as oxygen, in breathing which we live, has a tenfold power over dead matter, slowly causing chemical actions somewhat similar

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