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THOMAS H. HUXLEY

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MONOGRAPH III.

THE CROCODILIAN REMAINS FOUND IN THE ELGIN SANDSTONES,

WITH

REMARKS ON THE ICHNITES OF CUMMINGSTONE.

BY

THOMAS H. HUXLEY, LL.D., F.R.S.,
OF H.M. GEOLOGICAL SURVEY AND
PROFESSOR OF NATURAL HISTORY, ROYAL SCHOOL OF MINES.

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PREFACE.

In the following Monograph Professor Huxley has given detailed descriptions of all that is yet known of the scutes, bones, and teeth of *Stagonolepis Robertsoni* of the Elgin Sandstones, which so much resemble the neighbouring Old Red Sandstone, that, not unnaturally, they were considered to be of that age.

The masterly work done by the Author in proving the crocodilian nature of Stagonolepis, taken in connexion with the discovery of Telerpeton and Stagonolepis in the same strata, very soon satisfied Geologists that the Elgin Sandstones must be considered as part of the Trias, and, most probably, to that part of the series known as the Lower Keuper Sandstone.

The importance of this revolution will be recognised by all persons competent to judge of the subject, whether from a palæontological or a purely geological point of view.

Andrew C. Ramsay,
Director General.

Jermyn Street,
August 4th, 1877.

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THE

CROCODILIA OF THE ELGIN SANDSTONES.

I.—STAGONOLEPIS ROBERTSONI.

I. Introductory Remarks upon the Discovery of Reptilian Remains in the Elgin Sandstones, and upon the Geological Age of those Sandstones.

At p. 139 of the late Professor Agassiz's celebrated "Poissons Fossiles du vieux Grès rouge," a passage occurs of which I give the following translation.

Genus *Stagonolepis*, Agass.

"I have established this genus upon a slab on which are observable the impressions of many series of great rhomboidal scales, disposed in the same manner as those of the *Lepidosteidæ*. The angular form of these impressions allows of no doubt that the fish whence they proceeded was a great Ganoid allied to *Megalichthys*. The absence of the fins, of the head, and of teeth, however, prevents the rigorous determination of the family to which this fossil belongs. I arrange it, provisionally, near the genus *Glyptopomus*, with which it has some analogy in the ornamentation of its scales. However, this genus *Stagonolepis* cannot be confounded with any of those which I have hitherto established. The surface of its scales is adorned with hollows, having the shape of elongated drops, disposed like a rosette around the centre of each scale; these hollows increase in size towards the periphery, without, however, reaching the margins, which are smooth. I know as yet but a single species of this genus, the *Stagonolepis Robertsoni*, Ag., Old Red., Tab. 31, figs. 13 and 14.

"Figure 13 represents the impression of four scales, of the natural size and in their normal position. Figure 14 is a drawing of the entire specimen which was observed by Mr. Robertson, reduced to one half of the natural size. This fossil was obtained from the upper beds of the Old Red Sandstone of Morayshire. It was discovered in the neighbourhood of Elgin, at Lossiemouth. I have not examined the original

myself, but the drawings which Mr. Robertson has communicated to me, and which I have reproduced in the plates of my Atlas cited above, are sufficient to enable me to recognise the type of an entirely new genus. In the fossil in question, the ornaments of the scales are in relief; but it must not be forgotten that it is only an impression and that, consequently, the scales, in their natural state, must have their ornamentation hollow."

Considering that when Professor Agassiz wrote, the Devonian age of the Elgin Sandstones was generally accepted, and keeping in mind the singular resemblance in arrangement and ornamentation which really obtains between the exoskeleton of *Stagonolepis* and that of *Glyptopomus*, an undoubtedly Devonian fish, there is nothing to excite surprise either in his determination of the nature of the fossil, or in the fact that Agassiz's interpretation was adopted, without hesitation, by geologists and zoologists. The late Sir Charles Lyell, however, informed me that, many years ago, after perusing Dr. A. Wagner's Memoir on *Mystriosaurus*, the strong resemblance between the sculpture of the dermal plates of *Stagonolepis* and that exhibited by the scales of *Mystriosaurus*, as figured by Wagner, excited his suspicions as to whether, after all, *Stagonolepis* might not be a reptile. But, on communicating these doubts to the late Mr. Hugh Miller, that experienced investigator of the fishes of the Old Red Sandstone expressed himself so unhesitatingly in favour of the piscine nature of *Stagonolepis* that Sir Charles Lyell's scruples were satisfied, and it was not until the year 1858 that the question, whether *Stagonolepis* was really a fish, was revived.

In that year, however, the late Sir Roderick Murchison, the then Director General of the Geological Survey of the United Kingdom, was engaged in those remarkable investigations of the structure of the Highlands of Scotland which led to a complete change in the views which geologists had, up to that time, entertained on the subject.

In the course of his inquiries, Sir Roderick Murchison was led to visit Elgin and its neighbourhood, and to inspect the fossils of the district contained in the Elgin Museum and in the private collections of the late Mr. Patrick Duff and the Reverend Dr. George Gordon. Among these was the original specimen of *Stagonolepis Robertsoni* (Plate I., fig. 1), a cast in sandstone of the ornamented dermal plates of an animal which Agassiz had every reason to think might be a fish, and of which, it must be recollected, he saw only a drawing transmitted to him by Dr. Robertson. But, subsequently to the publication of Agassiz's observations upon *Stagonolepis*, additional specimens had been obtained, in which, associated with the *Stagonolepis* scutes in such a manner that there could be no doubt that they belonged to the same animal, were fragments or casts of bones of so obviously reptilian a character as to awaken grave doubts in the mind of their discoverer, the Rev. Dr. Gordon, as to the nature of the supposed fish, and to lead him to believe that *Stagonolepis* must be an animal of higher organization.

Apart from the interest of the purely zoological question thus raised, the existence of any vertebrated animal of higher grade than a fish in the sandstones of Findrassie and Lossiemouth was a fact of great geological importance. The Elgin district had yielded a small quadrupedal vertebrated animal, the *Telerpeton Elginense* of Mantell (the amphibian or reptilian nature of which was still a matter of dispute), and, in addition, many footmarks of very much larger quadrupedal *Vertebrata*. So that there was nothing unexpected in the discovery of the actual bones and scutes of such animals. But the discussion respecting the age of the Elgin sandstones, which had been awakened by the discovery of the footprints and of *Telerpeton*, had ended in the general admission that they belonged to the Devonian epoch; and this conclusion was confirmed by Sir R. Murchison's renewed study of the district.

It appeared, therefore, that the remains of *Stagonolepis* were calculated to throw a new light upon the vertebrate Fauna of the Devonian epoch; and Sir R. Murchison used every effort to bring together all the materials which could be of service. In these efforts Sir Roderick Murchison was aided in the most zealous and liberal manner by the committee of management of the Elgin Museum, by the late Mr. Patrick Duff, and by the Rev. Dr. Gordon.

One or two of the fossils thus obtained were exhibited by Sir Roderick Murchison at the meeting of the British Association at Leeds in 1858, but no person who examined them expressed a more definite opinion than that at which Sir Roderick himself had arrived, namely, that they were reptilian in their general character. On his return to London in the autumn of 1858, the Director General informed me of what he had seen at Elgin, and told me that Sir Philip Egerton and Professor Owen, who had cursorily examined the fossils exhibited at Leeds, had as little doubt respecting their reptilian nature as himself. But no one had expressed any opinion as to the group of reptiles to which *Stagonolepis* belonged, and Sir Roderick desired that I should undertake the investigation of the problem. To this end the fossils which had been exhibited at Leeds were placed at my disposal; while the larger and more important series which had remained at Elgin were sent direct to me. It was on these materials that I based the conclusion that *Stagonolepis* is a crocodilian reptile; a fact of which Sir R. Murchison had no suspicion when he placed the inquiry in my hands, and the announcement of which caused him the liveliest surprise, believing as he did that the Elgin beds were of Devonian age. Moreover, I found that all the Elgin fossils did not belong to the same genus; but that, in addition to *Telerpeton*, there was at least one other reptile, which I named *Hyperodapedon Gordoni*.*

* See my paper "On the *Stagonolepis Robertsoni* (Agassiz) of the Elgin Sandstones, and on the recently discovered Footmarks in the Sandstones of Cummingstone," read before the Geological Society, December 15th, 1858.

In 1859, I had the opportunity of examining the collection of Dr. Taylor, and the series of Elgin fossils contained in the Museum of Aberdeen. And, since that time, the Rev. Dr. Gordon, to whose help I am very greatly indebted, has kept me informed of all the discoveries of fossils in the quarries of the neighbourhood which have come to his knowledge; and, aided by a grant from the donation fund of the Royal Society, has made explorations which have yielded most valuable results. Mr. Grant, of the Schoolhouse, Lossiemouth, has further helped by the loan of specimens, and I have thus been enabled to add from time to time to what was known respecting *Hyperodapedon* and *Telerpeton*.* But it is a singular fact that, in the course of the nineteen years during which the produce of the quarries about Elgin has been carefully scrutinized, the only remains which have been discovered are those of *Stagonolepis*, *Hyperodapedon*, *Telerpeton*, and the jaw with large teeth described in my first paper, and which I then ascribed to *Stagonolepis;* though the subsequent discovery of the true teeth of *Stagonolepis* enables me to correct that error.

In the brief notice of *Hyperodapedon*, appended to my paper of 1858, I said that "its marked affinity with certain Triassic "reptiles, when taken together with the resemblance of "*Stagonolepis* to Mesozoic *Crocodilia*, leads me to require the "strongest stratigraphical proof before admitting the Palæozoic "age of the beds in which it occurs." And Sir R. Murchison, even then, admitted that his belief in the Devonian age of the Elgin sandstones was somewhat shaken by the discovery of the true nature and affinities of these reptilian remains.

In fact, this discovery led to a re-investigation of the age of the Elgin sandstones by several eminent geologists, among others, the late Sir Charles Lyell, with the result that opinions and weight of authority were about equally divided; Murchison, Ramsay, Harkness, and others, being inclined still to regard them as Palæozoic, while Lyell and Moore advocated the view that they were Triassic.

In the years 1866, 1867, and 1868, however, some remarkable facts came to light, which brought the question into a new phase. Remains of *Hyperodapedon* were proved to occur in the unquestionable Trias of Coton-End in Warwickshire, and in beds of Triassic age in Devonshire; while, in Central India, jaws of a large species of *Hyperodapedon* were found, in association with Labyrinthodonts and *Crocodilia*, at Maledi, in beds to which, on independent grounds, a Triassic or Permian age had been assigned.†

In view of these facts, Sir Roderick Murchison remarks at p. 267 of the fourth edition of "Siluria" published in 1867:

"To such fossil evidence as this the field geologist must bow; and instead, therefore, of any longer connecting these reptili-

* "On a new specimen of *Telerpeton Elginense*," "Quarterly Journal of the Geological Society," 1866.

† "On *Hyperodapedon*," "Quarterly Journal of the Geological Society," 1869.