

R. H. Traquair, M.D., LL.D., F.R.S. By John Horne, LL.D., F.R.S.

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By the death of Dr Traquair this Society has lost one of its most distinguished Fellows, and one of the prominent leaders of his time in fossil ichthyology. The record of his early days may be briefly told. He was born at the Manse, Rhynd, Perthshire, in 1840, and received his school education in Edinburgh, where, as a boy, he followed the impulses of a born naturalist. He set himself to collect shells, butterflies, and moths, and he hammered the Carboniferous rocks in search of fossils. In his later life he often remarked that his keen interest in fossil fishes was first aroused when hammering the ironstone nodules of the Wardie Shales, which revealed to him a fragment of a Palæoniscid fish. Even at that early stage the ambition seized him of devoting his life to research in the field of natural science. With this object in view he passed through the medical curriculum in Edinburgh University and graduated in medicine. His skill as a dissector attracted the notice of Professor Goodsir and Sir William Turner, who was then Senior Demonstrator in Anatomy, which led to his appointment as one of the demonstrators in that department. At Goodsir's suggestion he studied the asymmetry of the flat fishes and chose this subject for his medical thesis, for which he was awarded a gold medal. This elaborate memoir, which still remains a model of exact description, was subsequently published in the *Transactions* of the Linnean Society.

In 1866 he became Professor of Natural History in the Royal Agricultural College, Cirencester; in 1867, Professor of Zoology in the Royal College of Science, Dublin; and in 1873 he was appointed Keeper of the Natural History Collections in the Museum of Science and Art, Edinburgh—a post which he held till his retirement in 1906. The last of these appointments gave him the chance in life which he eagerly desired. He had chosen palæichthyology as his special line of research. He came to a Museum enriched by the Hugh Miller and other collections. The labours of Hibbert, Hugh Miller, Fleming, C. W. Peach, Powrie, and others had proved the abundance of fossil fishes in the Old Red Sandstone and Carboniferous systems in Scotland. The department which he served gave him the means of acquiring many of the best specimens for the Museum. Few men have such opportunities, but it was extremely fortunate for Scottish palæontology that they fell to a man whose methods of studying the

collections under his charge revolutionised our knowledge of palæozoic ichthyology.

In order to form some idea of the thoroughness of his methods we may recall his conception of palæontology as a branch of science. He maintained that scientific palæontology is essentially a part of zoology or botany, and that without a thorough knowledge of recent biology no one can hope to produce work of any value in palæontology. He went further, and contended that, if additional light is to be thrown on the question of evolution, it is through palæontology, working hand in hand with recent morphology and embryology, that the light must come.

In his own sphere of fossil ichthyology his work was of the highest value both to the zoologist and the geologist. As a zoologist he studied the osteology and phylogenetic relationships of the fossil fishes. But his investigations did not rest there. He next tried to ascertain their vertical range and lateral distribution with the view of aiding the geologist in working out the stratigraphy of the rock formations. At the same time he examined closely the relation between the fish remains and the sediments in which they occurred, in order to throw light on the physical conditions that prevailed during their deposition. A scheme of research so comprehensive demanded from Dr Traquair patient, continuous, and minute investigation. He was slow and deliberate in his work, he was frequently accused of being dilatory; but this trait was largely due to his reluctance to commit himself to definite conclusions until he had exhausted all available evidence.

When Dr Traquair began his researches in Edinburgh in 1873, the study of fossil ichthyology had assumed a critical phase. Agassiz had laid its foundations in his classic work, *Recherches sur les poissons fossiles*, which was begun in 1833 and completed in 1843. He therein established a new classification of fishes according to their scales, arranging them in four orders—*Ganoidei*, *Placoides*, *Otinoidei*, and *Cycloidei*. In 1844 Müller pointed out the unsatisfactory nature of this system and advanced an independent one which was adopted by some zoologists. But the classification of Agassiz held the field. It was widely accepted by geologists and palæontologists on the ground of its convenience. A few years of detailed study of the osteology of several Carboniferous fishes led Dr Traquair to reject this classification altogether. In 1879 he thus expressed his views. He frankly admitted that the name of Agassiz would go down to posterity as that of one of the greatest naturalists of the nineteenth century. "But," he added, "it is hardly possible for the zoologist of the present day to suppress some feelings of wonder that a man so well versed in general

zoology and anatomy as Agassiz should have based his classification of fishes upon characters so trivial as the mere external aspect of their scales, or that he should have distinguished many of the families into which he divided the order of the Ganoids by characters equally superficial." He maintained that it could not stand the test of anatomical inquiry.

The detailed researches which enabled Dr Traquair to give the death-blow to this classification are embodied in two classic memoirs, viz. his "Monograph on the Ganoid Fishes of the British Carboniferous Formations: Part I., Palæoniscidæ," published by the Palæontographical Society in 1877, and his memoir "On the Structure and Affinities of the Platysomidæ," which appeared in the *Transactions* of this Society in 1879. Until the publication of these researches, the Palæoniscidæ and the Platysomidæ had been compared with the existing North American bony pike, *Lepidosteus*. But Dr Traquair showed that the affinities of *Palæoniscus*, as indicated by the skeleton, point most strongly not to *Lepidosteus*, to which its angular scales and fulcrated fins give it superficial resemblance, but to *Polyodon*. Hence it followed that this sub-family ought to be grouped with the Acipenseroidæ. In short, they were closely related to the modern sturgeons. He further showed that the Platysomidæ were merely a specialised offshoot from the Palæoniscidæ. Traquair founded his conclusions on the fundamental characters of the skeleton, which since that time has been recognised as the proper basis of a scientific classification.

Another series of researches of extreme zoological interest, showing Dr Traquair's powers as an original investigator, is associated with the new fish fauna found by the Geological Survey in the Downtonian rocks of the south of Scotland. Previous to this discovery the family of the Cœlolepidæ of Pander, represented by the genus *Thelodus*, was known only by scattered scales in strata of like age in England and other parts of the world. From their shagreen-like scales the Cœlolepidæ were considered to be sharks. But the beautiful specimens of *Thelodus* and *Lanarkia*—two genera of the Cœlolepidæ—in the Survey collection led him to place them with the Ostracodermi and in the order Heterostraci, of which the only family previously recognised was that of the Pteraspidæ. He enlarged the order of the Heterostraci, and included in it four families, the Cœlolepidæ, the Psammosteidæ, the Drepanasidæ, and the Pteraspidæ. He pointed out that the armour plates of the last three of these families had been formed by the fusion of the Cœlolepid scales with each other and with hard tissue developed in a deeper layer of the skin.

The geological aspects of Dr Traquair's researches are well illustrated in his paper on "The Distribution of Fossil Fish Remains in the Carboniferous

Rocks of the Edinburgh District," published in the *Transactions* of this Society in 1903. This paper contains the results of his work in this field extending over a period of thirty years.

By means of the fish remains he arranged the Carboniferous rocks in two divisions—an upper and lower, drawing the boundary line about the horizon of the Millstone Grit. He found that the fish faunas varied in accordance with the type of sedimentation. Thus the fish remains occurring in the limestones of open sea origin are essentially different from those met with in the estuarine beds. The marine limestones of the Lower Carboniferous rocks yield mainly Elasmobranch forms; Dipnoi and Ganoids being rare. On the other hand, the estuarine strata from the bottom to the top of the Carboniferous system are characterised not only by Dipnoi and Ganoids, but by a set of Elasmobranchs differing generically and specifically from those of the marine limestones. Every geologist must recognise the extreme importance of this deduction.

He also discussed the question of the value of fossil fishes as zonal indices of stratigraphical horizons. He admitted that it was hardly possible to establish satisfactory life zones by means of the fishes in the Lower Carboniferous rocks, but he called attention to the remarkable divergence in the characters of the estuarine fish fauna on the south side of the Southern Uplands from that in the Midland Valley; and he speculated as to the probable influence of a land barrier in accounting for this divergence. He showed that in the estuarine beds of the lower division of the system many of the species must have lived for a long lapse of time without any change in their specific characters. But above the Millstone Grit he encountered a new fauna from which nearly all the Lower Carboniferous species and a number of the genera had disappeared. He held that the cause of this remarkable palæontological break in the fish fauna was a question which specially concerned the geologist.

In 1887 Dr Traquair began the detailed study of the fish fauna of the Old Red Sandstone, which led to an extensive revision of the nomenclature. Following the classification of Murchison and Salter, he arranged the strata of this formation in Scotland in three divisions—a lower, middle, and upper; the sequence being determined by the assemblage of fish remains in each division. He pointed out the resemblance of the fish fauna in the formation south of the Grampians to that of the Lower Old Red Sandstone of the west of England and adjoining part of Wales, and to the Lower Devonian rocks of Canada. On the other hand, he showed that the Orcadian rocks north of the Grampians yield an entirely different fish fauna, which he grouped with the Middle Devonian. The third great fish fauna found in

the Upper Old Red Sandstone, with its characteristic genera, *Asterolepis*, *Psammosteus*, *Bothriolepis*, *Holoptychius*, etc., he correlated with that of the Upper Devonian of the north-west of Russia, the Fammenien of Belgium, and the Catskill of the United States.

But Dr Traquair was not content with this broad classification of the formation in three divisions. He pointed out the existence of three fish faunas in the Middle Old Red Sandstone of Caithness (Achanarras, Thurso, and John o' Groats), each with a more or less distinct assemblage of fishes. He correlated the lowest or Achanarras fauna with that near the base of the middle division at Cromarty and on the south side of the Moray Firth. When Dr Flett subsequently found a similar sequence of fish remains in the Old Red Sandstone of the Orkneys, it seemed to confirm the accuracy of Traquair's conclusions in a remarkable degree. But the recent detailed work of the Geological Survey in Caithness has demonstrated the existence of a fish fauna older than any of those recognised by Dr Traquair, yielding *Thursius macrolepidotus*, *Coccosteus decipiens*, and *Dipterus Valenciennesi*. This discovery profoundly impressed Dr Traquair, for he wondered how this fauna should appear in the lower part of the Caithness succession and yet be absent from the base of the series in the Moray Firth basin and in the Orkneys. This difficulty has been successfully overcome by Mr Carruthers, who has suggested that it points to a later submergence of the land areas in the region of the Moray Firth and the Orkneys.

With the assistance of Mr Taylor, Lhanbryde, Dr Traquair recognised three life-zones in the Upper Old Red Sandstone on the south side of the Moray Firth; the lowest being represented by the Nairn sandstones with *Asterolepis maxima*, the second by the Alves sandstones with *Psammosteus Taylori*, and the highest by the Rosebrae sandstones with *Holoptychius nobilissimus*.

Throughout his long career he published upwards of 130 papers, chiefly on fossil fishes, which have appeared in the monographs of the Palæontographical Society, the *Transactions* of the Royal Society of Edinburgh, and the *Proceedings* of the Royal Physical Society. His great monographs on the Palæoniscidæ and the Asterolepidæ, which appeared in successive instalments in the publications of the Palæontographical Society between 1877 and 1912, are still incomplete. He had begun for the Geological Survey a synopsis of his researches on the Old Red Sandstone fishes of Scotland. He was anxious to finish it for the guidance of younger men, but the infirmities of age prevented it. In the closing years of his life he prepared a memoir on the Wealden fishes of Bernissart, Belgium, published in 1911 by the Royal Museum of Natural History, Brussels.

One striking feature of Dr Traquair's work was his artistic restorations of the fossil forms, which have been largely reproduced in scientific text-books.

Honours fell to him in recognition of his work. At an early age he was elected a Fellow of the Royal Society of London, largely through the influence of Professor Huxley, who fully appreciated the value of his earliest researches. He received the honorary degree of LL.D. from the University of Edinburgh. He was awarded the Neill Medal and Makdougall-Brisbane Medal by this Society, the Lyell Medal by the Geological Society, and, lastly, the honour which he prized most of all, a Royal Medal by the Royal Society.

Dr Traquair was not a man who carried his heart upon his sleeve. He had certain idiosyncrasies which tended to repel rather than attract. But those who knew him intimately, and who were in a position to discuss with him the bearing of his work, realised that underneath this veneer there was much kindness of heart. Above all, he was a genuine lover of truth, whose great aim was to avoid reckless generalisation and to promote the study of fossil ichthyology by thorough and rigidly accurate methods.