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XIV. *John Henderson.* By J. G. GOODCHILD of the Geological Survey, F.G.S., F.Z.S., Custodian of the Collections of Scottish Geology and Mineralogy in the Edinburgh Museum of Science and Art. PRESIDENT.

(Read December 21st, 1899.)

It is certainly a fact, as many persons have remarked, that the list of men who have done good work in the geological world includes a by no means small percentage of those who may fairly be regarded as self-educated. It is curious that it should be so, and in reflecting upon the fact one cannot help looking about for a reason for it. That reason is not very easy to find. Possibly there may be several causes, which combine to bring about this result. One of the most obvious, though, perhaps, it may not account for them all, is that it is open to almost any one to contribute something towards the general stock of this kind of knowledge. I remember very well that my former much admired chief, Sir Andrew Ramsay, used to say that any one might become a geologist, if he possessed three requisites, which were, according to him, "A GOOD PAIR OF LEGS, A GOOD PAIR OF EYES, AND A CONSCIENCE." This may be taken as an expression on his part that a self-educated man, having the requisites in question, might do just as well in the long run as another who had spent much time at school. For my own part I am inclined to attribute the fact partly to two additional causes. The first of these is connected with the very nature of geological work, which, while giving every one an opportunity of collecting facts, at the same time admits of a certain amount of speculation. That line of study, furthermore, is of such a nature that a given set of data often admit of more than one interpretation. Now, the man who has received his training in

the ordinary way has usually had the tendency to give rein to his speculative faculties quite knocked out of him. Moreover, much of what passes for education consists only too often of an endless round of cramming for bursaries or their equivalents. So the unlucky student, while acquiring the art of passing examinations, has had his wits dulled to such an extent that it often takes him years to recover. Furthermore, the habit of being constantly drilled into conforming to other people's views, as these are conveyed through the medium of books, lessens his powers of observation more and more, until in the end he becomes a mere machine, fit for nothing better than work in the cabinet or the study. A man with that history can never hope to become a geologist. On the other hand, the student who goes direct to Nature for his facts, and, while doing so, constantly endeavours to find an interpretation for these facts, educates himself *pari passu* with the extension of his knowledge; and if he has any ability in him, may end by leaving those who had what would usually be regarded a better start far behind him. Be the reason what it may, there cannot be much doubt about the fact; or, if further proof were needed, many persons would be inclined to think it could be found in the career of John Henderson.

I shall drop the custom usual in a notice like this of giving full biographical details, and will add what is necessary in a short paragraph at its end. It will befit the man and his work much better if, instead of that, I give a summary of *what he did*, stating it in the order of the geological formations described:—

In the first volume of our Transactions, p. 21, is a Short Notice of Three Species of Trilobites from the Silurian Rocks of the Pentland Hills. These were *Phacops stokesii*, *Calymene blumenbachii* and *Encrinurus expansus*. In all probability these came from the well known exposure at Deerhope Burn, from the beds which yield *Leptaena transversalis* in so great abundance. Maclaren had announced the discovery of fossils in the Silurian Rocks of the Pentland Hills as far back as 1839, at Deerhopefoot. The Survey Memoir on Sheet 38 was published in 1867. Then followed a joint paper by John Henderson and D. J. Brown "On the Silurian Rocks of the Pentland Hills"; *Trans. Edin. Geol. Soc.*, i. p. 21 (published in 1869), which was particularly valuable as containing the results of these authors' joint examination of the Silurian inlier of the North Esk. They gave long lists of fossils, accompanied by proper references to the various horizons; and the paper was further illustrated by a very useful map. The important fact

connected with this communication was that it gave expression to views by no means in accordance with those stated in the Survey Memoir; and, as it eventually turned out, these views were, in the main, correct, and, as such, are now generally accepted. The paper dealt with a number of questions which have even yet not lost their interest. Amongst these was the position of the base of the Ludlow Rocks.¹ Another point was the upper limit of the same rocks. Previously the red beds at the head of the Lyne Water had been classed with the Lower Old Red (a view which many geologists hold to even yet). But our authors say (*op. cit.* p. 23):—

“Firstly, we think (taking the section of the Esk as our guide) that from the base of the section up to the bed *F* we have beds of Wenlock age; from bed *F* we pass into the Ludlow, and all the remaining Silurian Rocks in the North Esk Section are included in this subdivision.”

“Secondly:—That the *red beds*, containing as they do Ludlow fossils, are only a part of that division, and are not the lower division of the Old Red Sandstone.” . . .

“Fourthly:—That the Silurian Rocks of the Geological Survey in Lyne Water lying above the [before-mentioned] red beds are the upper beds of the Ludlow.”

One may remark here that it is difficult to know which most to wonder at—the acumen of the authors, in working out this, their conclusions, which involved a by no means easy piece of work, or their temerity in advancing views contrary to those held by the Survey authorities. Whether we accept our authors' views or not—and I must confess that, for one, I do not—we cannot withhold our admiration for both the ability and the courage which these energetic and original observers displayed in working up the paper in question. I may remark here that the reader interested in wider aspects of the question under discussion will find many of them impartially and fairly treated in that most admirable monograph lately issued by the Geological Survey “On the Silurian Rocks of the Southern Uplands of Scotland.” See especially p. 17. See also Davidson's Memoir “On the Silurian Brachiopoda of the Pentland Hills” in the *Trans. Geol. Soc. Glasgow*, Part I.

Starting with this excellent paper John Henderson worked at the same subject for many after years; and it is, without doubt, very largely owing to his work, and to the enthusiasm that he infused into the minds of so many of his fellow-workers,

¹ I may, perhaps, be permitted to remark here that I should have been disposed to carry the base of the Ludlow Rocks to a much lower horizon than they did, and nearer to the Eurypertus Beds in the Gutterford Burn; in other words I should consider the Ludlow Rocks to have a much greater thickness than that usually assigned to them in this area.

that we owe much of what we know to-day regarding this difficult view of geological work.

In one of these later papers, *Trans. Edin. Geol. Soc.*, ii. p. 389., read April 30th, 1874, he gave a "Notice of some Fossils from the Conglomerate at Habbie's Howe, Logan Burn, near Edinburgh. In this, after giving a general account of the conglomerate, he specially calls attention to a number of boulders of limestone imbedded in it. These contain, amongst other fossils, some brachiopoda. He says of them:—"These I submitted to Mr Davidson, who . . . considered them to belong to the genera *Orthis* and *Strophomena*; but he could not connect them with any British forms specifically, and he thinks that one or two of them may be new. He believes them to be of Silurian age, although they may belong to either Devonian or Carboniferous" (*op. cit.* p. 390).

Later on, in May 20th, 1880, he read another paper before our Society dealing with his more mature opinion on the same subject (*Trans. Geol. Soc. Edin.*, iii. p. 353). He records in these limestone blocks "corals of the genera *Halysites*, *Heliolites*, *Favosites*, and *Petraia*; and then goes on to refer to the discovery there of *Tetradium peachi*, and to speculate as to how it came to be included in this conglomerate. Finally, so far as this question is concerned, he came to the conclusion that the parent rock exists *in situ* near to the Eurypterid Bed in Gutterford Burn.¹

Incidentally, also, he notices the fossils that occur in the section referred to as Gutterford Burn; giving special attention to the curious organism named *Dictyocaris ramsayi*, which is so common there; and to the Eurypterids, which were afterwards more fully explored by Prof. Malcolm Laurie. Amongst the fossils that occur there [exclusive of *Dictyonema*] he mentions *Lingula lewisii*, *L. crumena*, and two other species; also *Orthis polygramma*, *O. elegantula*, *Strophomena walmstedii* and *Leptaena transversalis*. "Along with these are the remains of encrinites, starfish, corals, and a graptolite which resembles *Monograptus galaensis*, Lap."

To our knowledge of the geology of the formation chronological succeeding the Silurian Rocks here—the Caledonian Old Red (as I prefer to call it)—John Henderson contributed but little. These consist mainly of eruptive rocks, with which he was not as much at home as he was when concerned with the sedimentary formations and their fossils. I wonder whether

¹ There are many fine specimens of this fossiliferous limestone from the Loganlea conglomerate in the Geological Survey Collection in the Edinburgh Museum. I am still inclined to the belief that the blocks in question are remains of a Lower Devonian Limestone, and are not of Silurian age. J. G. G.

this reluctance to work at these rocks was due to any revulsion against the new fashion in geological work which had just begun to come in, and which had as its main object the naming of lithological varieties? Perhaps it had. A man who was interested in fossils would hardly be likely to care much for what H. B. Woodward aptly terms "lifeless geology."

In the case of the sedimentary rocks of Carboniferous age around Edinburgh, however, it is to John Henderson that we owe much of our present knowledge. For many years he made a point of visiting and examining every new section that was exposed, and as soon as possible afterwards, he placed the facts so obtained on record in our *Transactions*. These volumes contain a goodly list of papers bearing chiefly upon the Lower Carboniferous Rocks, and partly also upon the Upper Old Red Sandstone. Any impartial student of the literature relating to these rocks prior to John Henderson's appearance in the field must see that much of our present knowledge of these dates from that period.

Following the order in which the former papers have been noticed, the next that calls for remark is a paper dealing mainly with the Rock Cuttings on the Suburban Railway, read on the 15th of May 1884. This treats of the Red Sandstones (now regarded as Upper Old Red Sandstone) which are exposed on the Morningside Road end of the Craiglockhart Cutting. Our author discusses several questions which arise from a consideration of the facts brought to light in this section. There is no need to abstract them here, as most of his conclusions have been generally accepted.

In a later part of the same paper he deals at some length with what we now recognise as the Ballagan Beds, and he gives a list of places in Edinburgh where at one time or another their existence had been revealed. In following out this investigation it is interesting to mark how (like many others have been since) he finds himself thrown out by the confusion caused by one or two of the large faults which traverse Edinburgh between the eastern side of the City and Arthur Seat. He makes especial reference to the borehole at Mr McEwan's Brewery in Fountainbridge, where a well was cut through black shales . . . to 100 feet, and was continued to a depth of over 1000 feet in the red sandstone series. That shows that the Upper Old Red Sandstone, with the Cornstone Beds, all counted, is not less than 900 feet. I have elsewhere shown that it must considerably exceed that thickness. See p. 45 of the present volume.

The paper referred to in the last paragraph was one of the first, and one of the most important of those dealing with the

rocks next higher in the series. It was read before our Society on the 20th of March 1884. Its full title was: "On Rock Sections in Cuttings from the Suburban Railway: with Observations on the Geology of the District around Edinburgh." John Henderson saw the cuttings referred to while they were still fresh, and therefore had many advantages over those who went later into the field. He describes first the equivalents of the Hailes and Redhall Sandstones (with the mass intruded into them). Then follows a description of the Wardie Shales (which, by the way, were again exposed, exactly as John Henderson describes them, when the last Edinburgh Exhibition was held at Meggatland). After that he gives details regarding the Granton Sandstone. I have independently measured these beds, and can confirm almost every statement the author has made about these exposures. My own estimates are given again in the present volume of the Transactions, p. 50. One of the chief questions raised in John Henderson's paper under consideration was with regard to the position of the Wardie Shales, which had been confused with the Abbey Hill Shales. These, it is now well known, do really underlie the Granton Sandstone, and therefore do not overlie that rock, as John Henderson showed was the case with the Wardie Shales.

Still following his publications rather in the order of the formations treated of than chronologically, the next to be considered is one which was read prior to the last. This was entitled "On the Wardie and Granton Series of Sandstones and Shales." *Trans. Edin. Geol. Soc.*, vol. iii. p. 24. In this he gives an excellent little map, accompanied by some illustrative sections showing the succession of the subdivisions of these rocks, and the areas where he considered that they were exposed at the surface. The map and sections reappeared in an enlarged and improved form in a later publication. But those now under consideration undoubtedly added much to our knowledge concerning the geological structure of the district to the west and southwest of Edinburgh. The succession he gave may profitably be reproduced here, especially as there has been for some years past a tendency to make out the thickness of the beds between the Burdiehouse Limestone and the Edinburgh Volcanic Rocks to be very much less than John Henderson thought. I have seen it lately set at not much more than the thickness of one of the subdivisions!

Leaving out the Abbey Hill Shales, as not forming a part of the rocks under consideration in his paper, he begins with the Granton Sandstone. Then, above this, he places the Wardie Shales. Next a thick bed of shale with some sandstones, and with abundant plant remains. Above these fossiliferous shales

he puts the sandstones of Hailes and Red Hall, and above them the shales one may see in the quarries at Kingsknowe, from which Mr Ritchie has obtained so many fine specimens of *Rhacopteris inæquilatera* and *Sphaenopteris affinis* (now called *Calymmatotheca bifida*), etc. I cannot understand how any unprejudiced observer, going carefully over the evidence, can well doubt the general accuracy of John Henderson's reading. The thickness may, possibly, be somewhat less than he thought; but it most certainly is not anything like as small as the two recently published sections I referred to would lead one to suppose.

Another paper bearing upon the structure of Edinburgh so far as the outcrops of the lower subdivision is concerned is one read on the 17th of February 1887, entitled, "On Sections exposed in making a Drain through the Queen's Park at Holyrood. The chief conclusion to be drawn from this communication is that between the north end of Salisbury Crags and the fence around the Holyrood grounds there occurs "brown, blue, and greenish shales, and thin beds of cherty sandstone, dipping east-north-east at about twelve degrees." These yielded bands containing *Cythere superba* and *Beyrichia subarcuata*, and with them were remains of *Cosmoptychius striatus*, and fragments of undetermined species of *Elonichthys* and *Rhadinichthys*. He also records the evidence for the former existence there of part of an old loch.

So far as the Lower Carboniferous Rocks are concerned it is clear that we are dealing with the evidence for a fault of considerable magnitude. The fact of the Edinburgh Volcanic Rocks being found deep down (350 feet) beneath similar shales in the borehole at St Ann's (Abbey Hill Borehole, No. 1) renders it highly probable that these shales observed by John Henderson belong to the same set, as he, indeed, thought was the case, and that the Volcanic Rocks lie beneath the surface at the point where John Henderson's observations were made. At p. 48 of this volume I have stated what I suppose to be the general trend of this fault, which is one of the most important in its relation to the geological structure of the whole district.

Leaving, for the present, John Henderson's paper on Arthur Seat, we may notice one read on the 21st of March 1889, "On the Succession of the Lower Carboniferous Series to the West of Edinburgh, with special Reference to the District around Cramond." There is no need to discuss this in any detail, as it may be said to contain many additional arguments in favour of the great thickness he had elsewhere assigned to the rocks between the Burdiehouse Limestone and the Edinburgh Volcanic Rocks. He also gives further evidence bearing upon the existence of a great fault passing southward along the west face of Craiglockhart Hill and thence past Slateford and Colinton,

which he considered to be the most powerful fault in the district. He announces his intention, in this paper, of giving further details regarding the succession and thickness of the beds which lie between the Redhalls and Hailes beds, and what he terms the Queensferry Limestone. This, as we now know, through Mr Cadell's valuable papers on the Oil Shales of the Lothians, includes the Pumpherston Oil Shales, which lies 800 feet below the Limestone referred to. There are some reasons for believing that this Pumpherston Oil Shale lies not very far above the highest shale seen at Kingsknowe already mentioned, and indeed, the possibility of this being the case appears to have been present in our author's mind when he wrote the paper under notice. Doubtless the series is one that is very variable in thickness, as it is well known that in some parts of Fife it is altogether absent, which is also the case in some areas even within the Lothians. But that fact by no means tells against the possibility of this subdivision reaching a considerable thickness around Edinburgh itself.

John Henderson did not live to carry out his intention of giving us his views upon the thickness and succession of the rocks between his Queensferry Limestone and the shales of Kingsknowe; and indeed, no one else has even attempted the work.

The next paper, so far as the stratigraphical order is concerned, dealt with "Some Marine Beds underlying the Gilmerton Limestone," which was read on the 4th of May, 1882. To understand the importance of this it is necessary to bear in mind the fact that for many years prior to the reading of the paper referred to erroneous ideas were current regarding the relationship of the Scottish Lower Carboniferous Rocks to the Lower Carboniferous Rocks of England. The group of beds of which the Gilmerton Limestone forms the base was supposed to represent the Mountain Limestone, while the so-called "Calcififerous Sandstones" were regarded as the equivalents of the English Lower Limestone Shale¹ and of strata older than that and unrepresented in the southern part of the Kingdom. In 1874 I endeavoured to show that the "Calcififerous Sandstone Series" was really the equivalent of the lower two thirds of the English Mountain Limestone—a view which, after the lapse of more than a quarter of a century, is gradually being recognised as the correct one. Not only was there a prevalent error in regard to that point, but it was believed that the "Calcififerous Sandstone" was in great part a fresh-water deposit, with, at the most, only a few thin bands of estuarine origin. So deeply rooted, then, was this idea, that even yet are to be found a few backward persons

¹ The Ballagan Beds are really the equivalents of these English Rocks.

who still persist in believing it, in the face of an overwhelming mass of evidence to the contrary.

So when John Henderson found "several beds containing the remains of true marine brachiopoda" . . . "between 300 and 400 feet below the Gilmerton Limestone" . . . in the Burdiehouse Burn for about 300 yards above the mill at Stenhouse," he naturally regarded the discovery as worth recording—which it certainly was. Perhaps, however, we might add that it would have been still more worth recording if he had found any unequivocal evidence of strata of *fresh water* any where in the "Calceiferous Sandstones." My colleague Mr Gunn's recent papers on the Lower Carboniferous Rocks of the Berwickshire Coast, have, it is to be hoped, finally cleared away any doubt that might remain regarding the equivalents of these "Calceiferous Sandstones"—although my own paper just referred to is thought by many unprejudiced persons to have done that already. (See *Quarterly Journal of the Geological Society*, London, for November 1874, p. 394.)

Lastly, so far as the Carboniferous Rocks are concerned, we find John Henderson, with characteristic originality and fearlessness, attacking some of the many problems suggested to the minds of those who refuse to be guided by mere authority regarding the structure and the age of Arthur Seat.

Regarding the paper referred to one may safely remark that it well illustrates a few of John Henderson's most characteristic methods of work. He went straight to look at the facts for himself—at the same time disregarding the opinions that had been put forward by others as their interpretations of those facts. He was, as might be expected of such a man, led to take a view different from any that had been held by others who had preceded him over the ground. I venture to think that no one who traverses Arthur Seat with John Henderson's paper constantly in mind will be inclined to question a single one of his facts. Whether they will accept all his conclusions, or not, is quite another matter. Whatever they may think of them, they will at least come away with the firm conviction that the paper referred to is a real honest attempt at finding out the truth—and as such it merits much higher praise as a piece of geological work than it seems to me to have yet received. No one has yet published a really satisfactory account of the geology of Arthur Seat; nor will any one do so until he casts aside every preconceived idea, and systematically and patiently goes about the work, carefully mapping even the most minute details, on a very large scale.¹

¹ Since this was put in type a re-survey of the geology of Arthur Seat is being carried out for the Geological Survey by Mr B. N. Peach.

He wrote several other papers of more or less interest and value; amongst them being one dealing with the various dykes and other eruptive masses which rise through the sedimentary rocks in and around Edinburgh. Like his other papers this one was a valuable record of facts, to the truthfulness of which those who have followed in his footsteps as I have can abundantly testify.

He also wrote some papers dealing with the later chapters of the geological history of the country around Edinburgh, each of them containing some addition to our stock of facts, and all characterised by the powers of careful observation which mark all his other contributions.

John Henderson, with all his undoubted ability as a geologist, and notwithstanding the efforts of his many admirers, did not get on well in the world: *he had not learnt to reserve his attentions for those who could give him good things.* So he lived, and died, amongst the lowly: not, however, without his career as a geologist having won for him the admiration and esteem of a wide circle of men of Science.

The following is a list of the papers published by John Henderson. It is probably not as complete as it should be:—

Short Notice of Three Species of Trilobites from the Silurian Rocks of the Pentland Hills. T.G.S.E., i. p. 21.

(D. J. Brown and) John Henderson on the Silurian Rocks of the Pentland Hills. T.G.S.E., i. p. 23.

On Certain Fossils found in the Rocks underlying the South side of Edinburgh. T.G.S.E., ii. p. 138.

On some Silurian Fossils found in the Pentland Hills p. 373.

Notice of a Fault in the Carboniferous Rocks of the Water of Leith above Currie. T.G.S.E., ii. p. 144.

On the Evidence of the Existence of an Old River Course previous to the Deposition of the Boulder Clay at the Water of Leith above Colinton. T.G.S.E., ii. p. 196.

On Glacial Phenomena in the Pentland Hills and at Tyne-castle, near Edinburgh. T.G.S.E., ii. p. 360.

Notice of some Fossils from the Conglomerate at Habbie's Howe, Logan Burn, near Edinburgh. T.G.S.E., ii. p. 389.

On some Sections of Boulder Clay, Peat and Stratified Beds exposed in a Quarry recently opened at Redhall, Slateford, near Edinburgh. T.G.S.E., ii. p. 391.

On the Wardie and Granton Series of Sandstones and Shales. T.G.S.E., iii. p. 24.

On the Structure and Arrangement of the Rocks of Arthur's Seat. T.G.S.E., iii. p. 222.

On a recently discovered Fossiliferous Bed in the Silurian Rocks of the Pentland Hills. T.G.S.E., iii. p. 353

Notice of a Bore section at Abbey Hill, and its Relation to the Rocks of the Calton Hill. T.G.S.E., iv. p. 34.

On some Marine Beds below the Gilmerton Limestone. T.G.S.E., iv. p. 217.

On Rock Sections exposed in Cuttings from the Suburban Railway: with Observations on the Geology of the District around Edinburgh. T.G.S.E., iv. p. 262.

On a Calcareous Deposit at Starly Burn, Fifeshire. T.G.S.E., iv. p. 346.

On Reindeer and other Mammalian Remains from the Pentland Hills. T.G.S.E., v. p. 302.

On Sands and Gravels containing the Remains of Drifted Trees at Olive Bank, Musselburgh, and at Stockbridge. T.G.S.E., v. p. 350.

On Sections exposed in making a Drain through the Queen's Park at Holyrood. T.G.S.E., v. p. 407.

On the Succession of the Lower Carboniferous Rocks to the West of Edinburgh, with special Reference to the District around Cramond. T.G.S.E., vi. p. 29.

On Sections exposed on the Line of the Barnton Railway. T.G.S.E., vi. p. 297.

Notice of Recent Fossiliferous Sandstone and Clay at Granton. T.G.S.E., . p. 255.

Report of an Excursion to Inchkeith (1881).

On the Calton Hill and its Relation to the Rocks in the Neighbourhood. T.G.S.E., vii. p. 139.