Fig. 13. Mr. Tindall's specimen of *Xylobius Sigillaria*, from Clay-ironstone band Coal-measures, Cooper's Bridge (drawn of the natural size; *h* head).

Fig. 13a. Portion of body of same magnified, showing the legs (as seen under the microscope with a 2-inch lens).

NOTE.—From a careful study of the specimen of *Xylobius Sigillaria*, from Nova Scotia, in the British Museum, I am convinced that Dr. Dawson's figures—figs. 12 and 12a—are intended to be only diagrammatical; the specimen presents much the appearance represented in fig. 11.

LXIV. *On the IGNEOUS ROCK SECTIONS at the RYE WATER, Ayrshire.* By R. WHYTE SKIPSEY.

(Read January 17, 1867.)

THE length of this stream, taking Blairpark, which is about equidistant from Largs and Kilbirnie, as a starting point, may be roundly stated as seven miles to the town of Dalry. Its course, for the first $2\frac{1}{2}$ miles to the Howrat toll-bar is south-east, from whence it runs south for about two miles, and then taking a sharp turn, almost at a right angle, shortly resumes nearly its former course of south-east into Dalry.

Its upper reaches run nearly along the line of the Largs and Kilbirnie road as far as the toll-bar above mentioned, but it has comparatively little interest for the geologist, as the ground through which it winds its course, although of igneous character, is generally covered with verdure and wanting in any marked features to attract attention. I therefore confine the description to about two miles of the stream below the toll, where the first important section of volcanic rocks occurs, to the upthrown strata of the carboniferous system, about $2\frac{1}{4}$ miles from Dalry, where it again ceases to possess any novel or more marked character.

As developed at this first section below Howrat toll-bar, water and weathering have worn out considerable cavities, and there are in succession, from the water surface, or rather a little under it, beds of hard porphyritic greenstone, trappean ash, eight feet thick, of a blackish grey colour, graduating into a plain compact amorphous greenstone, ten feet thick, capped by eight feet of dolerite, being a well-defined prismatic trap of rhomboidal form, the whole of these beds being nearly in a horizontal position.

Half a mile farther down another fine outbreak occurs. The beds from the water are successively porphyritic greenstone, and trappean ash, both these varieties being repeated, and all of them somewhat disturbed in position, although not greatly off the horizontal. But the most interesting feature is a dyke of compact blue trap 40 feet broad, vertically intersecting all these beds to the surface, its line being from west to east. It appears on one edge, cutting through the other rocks as straight as a wall, and on the other is oblique, carrying the upper deposits of greenstone and ash on its shoulder, the beds at a very short distance again resuming their natural level; and I wish the position of this intrusive rock kept in view, as I shall afterwards notice the bearing I consider it to have on the upthrow of the ironstone to the westward.

The rocks continue to exhibit this somewhat regular order of deposit, and the same characters, while at one point about a quarter of a mile lower, they are intersected by two remarkable thin beds of hard greenstone, at an angle of 25 degrees, which visibly cut the upper compact greenstone and upper ash bed; but they may not be posterior intrusive ejections, but simply the result of a disturbing upheaval, where the acting power is still invisible. The surface of the ground here distinctly shows considerable deposition of boulder drift.

About three-fourths of a mile below the last described section another occurs, and though the locality had been as barren of other attractions as it is rife of them, this spot alone is one of the finest studies the physical geologist could possibly desire. It is a bold, vertical cliff, of 80 feet in height, from the bed of the burn to the surface, exhibiting a most singular succession of alternations of trappean ash and compact greenstones. Commencing with the water line there are $2\frac{1}{2}$ feet of hard ash, $2\frac{1}{2}$ of soft and friable ash, 1 of hard, 4 of soft, $1\frac{1}{2}$ of hard, 3 of soft, these changes continuing upwards for some distance, till it is capped by a compact greenstone, the beds of harder ash in some instances assuming the character of solid trap. But an actual visit to the locality is the only way to understand this remarkable example of our igneous rocks.

There is another kindred rock found to which I cannot assign a fixed place. It is light purple, with darker spotting of same colour, similar to that found extensively in the Ochill range at Blair Logie, and was long distinguished as Porphyry, or Clay

Porphyry. Rock of this character was formerly used in the manufacture of china ware. It is now classed as Felspar Porphyry.

It is only to be found in detached pieces, often rounded by attrition; and as it occurs both in larger fragments and greater quantity in the higher parts of the stream, I regard its normal position as somewhere in the hilly ground nearer the source, where, though covered with verdure, it would likely be found in some little knolls as a posterior outburst of molten matter to the rocks round it. This appears to be the relation of the similar rock in the Ochills.

Immediately below the section I have last noticed, the stream takes the sudden and short turn to the east already referred to, and the igneous deposits become suddenly arrested by an immense vertical upthrow of carboniferous limestone beds and their concomitant shales, which abut against the trap and ash like a dead wall, as high as the igneous rocks themselves.

This occurs on the north side of the stream, continuing for some hundred yards; and the same calcareous strata are thrown up to the surface on the opposite or south bank, although the lower end of the upthrow, as far as visible, is only to the extent of the sandstones and shales overlying the black band ironstone, these shales being only partially fossiliferous.

Invisible as the agent in this large upheaval is, there can be little doubt of its being an extensive trap dyke of posterior date. Some portions of the limestones and other strata show clear signs of induration and other alterations of their normal characters, and the 40 feet trapfault I have already drawn attention to, forms a good example, on a small scale, of this more extensive upthrow, as in both cases one edge cuts the superincumbent deposits clean through, or entirely disunites them, the other only uplifts them on its shoulder to the extent, at least, of the upper portions.

As this communication is intended mainly to apply to the igneous portions of the locality, there is no need for details as to the carboniferous strata, the general character of these being well enough known; but I may state that the Blackband ironstone partially appears at the lower end of the upthrow of sandstone and shale, and a pit of this metal is wrought about half a mile north-west 50 to 60 fathoms deep, while some little distance farther in the same direction the metalliferous beds (in mining language) "crop out" at the surface.

A "crop out" does not always imply a violent upthrow from

volcanic or earthquake influences, being sometimes the result of extensive denudation of a sloping or angular character, but in this case, as the rise of the ironstone beds lies to the westward, and in something like the direct line of the 40-foot fault across the burn, I regard it as one of the direct results of this intrusive and posterior trap dyke.

The simple minerals disseminated in these rocks are not very varied, and consist of the usual nodules and veins of calcareous spar and quartz, with some fair examples of white and red stilbite, small white prehnites and fine pellucid quartz, approaching in character that of hyalite. Anticipating a natural question, what are the relative positions of these various beds of trap and ash? I may state that in such deposits, as well as in the more regular stratification of our carboniferous system, it is sometimes the case, that in the same line, one class of rock, or other indurated material, is suddenly cut off, and another, in continuation, takes its place. Assuming, therefore, that the Rye Water district may not be altogether an exception to this rule, and also that disturbing forces may have caused some smaller dislocations, I am strongly inclined to the conclusion, that the whole of the often repeated deposits of thin trap beds and ash at the lowest section I have described, underlie, as their true normal position, the upper sections taken from the water's edge, or at least sections from the amorphous greenstone at this point, although the broken and denuded intervals prevent fully tracing this out; because though the stream is neither rapid, nor having much fall as a whole, yet the slope is sufficient, combined with the abrupt breaks occurring in the line of the water at different points, to render this opinion of relative position a probable one; and a closer examination than I had it in my power to make, would be both pleasant and instructive.

Judging from the levels and mineral character of the ground at and near the lime quarry, it is not improbable that the stream there, at a former period, nearly approached the level considerably higher up, that it had then been more widely spread over, with a course for a short distance partially different; and this view appears the most legitimate to account for such total denudation of all other strata at the point, the fossiliferous Limestone being to the very surface, except a few feet of alluvium.

Some of the pools at the upper sections are of a circular form and considerable depth, partly owing to the continuous action of water

on materials like trappean ash, liable to rapid waste; but this destructive process is greatly facilitated by circular masses of hard trap, occasionally enveloped in the softer rock, as well as by detached pieces of undetermined form falling away from the surrounding mass, and which, when not lying perfectly solid, are kept in motion by the water, and exercise an immense abrading power. They are occasionally seen still in these hollows, but often wear out a path at the lower ends of the pools, and are gradually carried onward by the current.

LXV. SCOTTISH GEOLOGY—its *Proofs and Problems*. By DAVID
PAGE, Esq., F.R.S.E., F.G.S.

(Read October 20th, 1867).

ABSTRACT.

THE author stated that by its *proofs* he meant what was known, or at least generally admitted, by competent geologists; and by its *problems* what was still doubtful and required further investigation. His object was not to sketch the history of Scottish Geology, which, about the beginning of the century, was a mass of theories and disputations between Wernerians and Huttonians, and which at a later period was little else than a nomenclature of rocks and minerals; but he could not avoid mentioning the names of such men as Hutton, Playfair, Ure, Sir James Hall, M'Culloch, Williams, and Jamieson, as contributing largely, even amidst these unproductive discussions, to the progress of the science. Legitimate geology could date back little more than thirty years, and during that period its advancement in Scotland was indebted in no small degree to the labours of Fleming, Smith, Cunningham, M'Laren, Hugh Miller, and especially to those of Lyell, Murchison, Nicol, Geikie, and others who were still steadily endeavouring to unravel its many complicated physical as well as palæontological problems. He then took in review the various stratified systems, from the Laurentian up to the most recent accumulations, pointing out the known from the unknown, and from the doubtful or what required more minute investigation. Admitting the existence of Laurentian strata in the Hebrides and northwest corner of Scotland, it still required investigation to determine whether these were the true equivalents of the rocks of the St. Laurence, or were merely a set of gneissic schists