have made already, though not nearly sufficient to clear up many highly important questions, are still sufficient to give very great encouragement ; and I therefore feel anxious to induce others to turn their attention to this branch of research, being convinced that it cannot but yield a bountiful harvest of facts, when studied with perseverance and zeal.

ON THE FLAGSTONES OF FORFARSHIRE.

By HUGH MITCHELL, of Craig.

THERE is a close resemblance between the fossil contents of the "Upper Ludlow Tilestones," as described by Mr. Roberts, of Kidderminster, in the last number of *THE GEOLOGIST*, and those of certain strata developed in this neighbourhood. The rocks of the southern districts of Forfarshire have been described by Fleming and Miller, and their fossils have attracted the attention of the scientific world. I am acquainted with sections in the north-eastern division, an account of which has not yet appeared in print, and it may be of interest to indicate their organisms.

Among our fish-remains I have twice met with heads of the *Cephalaspis Lyellii* ; but the fossil is more common in other localities. The Pteraspides, which seem to be so frequent in the English beds, I do not know, unless some of the fragmentary remains, like pieces of skin or shell, and to which I shall hereafter refer, belong to the genus. From one of our sections I have collected several specimens of at least two species of fishes, entire and beautifully preserved. They are small creatures, and have all their fins armed with spines. One of my specimens is a very tiny fish, scarce an inch in length, but with its every spine in its place, and, so far as regards its dermal covering, a complete picture. We have also a considerable variety of Ichthyodolulites. Some of them resemble the *Onchus*-spines figured in the first edition of Sir Roderick Murchison's "Siluria." Others are larger and have more the appearance of true fish-defences. Mostly all our fossils are mere impressions in the stone ; but the bony matter of the

Ichthyodorulite seems occasionally preserved, and there are also other indeterminate fragments of bone.

Not having had access to Mr. Salter's monograph, I am not able to pronounce upon the species of crustaceans found in these beds. We have at least several very large Pterygoti, judging from the sculptured rings of the abdomen, their curious jaw-feet and prehensile limbs; and I should think both *Himantopterus* and *Eurypterus*. I have carefully treasured all the crustacean remains that I have found, in the hope of light yet reaching us in this remote region as to their generic and specific character. All that I can affirm is, that we must have had an abundant development of the family in the era when our rocks were laid down, of all sizes, from half an inch to many feet, and with various styles of ornamentation. There also occur numerous pieces of shell or skin, sometimes torn, but at other times bounded by straight lines, drawn in black in the stone, and which an humble friend of mine compared to the pieces—of course, in miniature—of which a black cloth coat on the back of a human subject is composed. We must not omit to mention a very peculiar form, which has been named the *Kampecaris*, from its resembling the impression in the stone of a butterfly-caterpillar, and which I have often thought might be the larval form of some of our crustaceans.

Our plant-remains, like those of Kidderminster, are for the most part badly preserved, although in some layers they are very abundant. Our most common and characteristic organism is the *Parka decipiens*, which, occurring over three counties in Scotland, viz. Kincardine, Forfar, and Fifeshire, has now also been detected in England. I do not know on what ground it can be spoken of as Pterygotean ova. It is true, our quarrymen, in their rude northern phrase, call it "pud-dock crud," or the spawn of frogs, but they are chiefly familiar with the fossil as it occurs in the more micaceous beds, known in commerce as "Arbroath pavement," where it is always much broken and dispersed. I still believe it to be vegetable. I have several specimens with the seeds (?) inclosed in a sort of spathe, the sides of which radiate from a base or disc, to which is attached apparently a stem. There are also several distinct bodies which might correspond with the spores of *Lycopodiaceæ*, besides many other obscure vegetable forms. On the whole, therefore, there is a striking similarity between

our fossils and those of the "Upper Ludlow Tilestones," if, indeed, they are not identical. Hugh Miller, in his classic work, the "Old Red Sandstone," assigned our Forfarshire strata to a middle formation of the Old Red or Devonian system. Murchison, on the other hand, places our "Cephalaspis-beds" at the base of the system; and the fossil evidence which I have briefly related seems to decide in favour of the latter view. This point is of great value in the arrangement of our rocks, as in the grits and conglomerates, and even in the underlying and highly metamorphosed slate-rocks, we are to recognise the equivalents of the Silurian system as known in the south of Scotland, or better still in Shropshire and Wales.

So far as I know, no fossil has been disinterred in this part of the country from any strata beneath the flagstones; but perhaps the discovery, some day, of a graptolite or other characteristic Silurian organism will reward the researches of the geologist along the flanks of the Grampians.

ON THE TILESTONES OF FORFARSHIRE.

By JOHN ANDERSON, D.D., F.G.S., ETC.

THE March number of THE GEOLOGIST contains, I observe, a notice of the "Upper Ludlow Tilestones," and the author invites descriptions of their equivalent beds in other districts. Now, so close are the resemblances, lithologically and palæontologically, between these deposits and those of Forfarshire, that they may be regarded as part of one and the same series. I have been induced, therefore, to throw together the following observations upon our northern Scottish system.

The rocks to which I refer occupy a narrow but extended trough-line along the central district of Forfarshire, commencing on the east near Montrose, and terminating at Babruddery and Rossie Den on the west. They trend in a south-westerly direction, across the river Tay, into Fifeshire at Parkhill, Newburgh, and along the northern slope of