

escaping for ages into the upper air, was condensed, and fell in the shape of snow and hail. By this mass of snow and hail the temperature of the earth's climate was reduced from the comparative warmth which preceded it, even in Arctic regions, and the world entered on 'the cold period,' which it was the object of the lecturer to describe and to account for while describing. Professor Agassiz said that *this was the winter which preceded man's advent in the world.*"

Is not my point made out? Is not the *thohu* and *vohu* of Moses identical with *the cold period, the winter of the world*, of Agassiz? Surely there can be only one answer.

It seems almost superfluous to refer to the boulders which are found in Norway and on the coasts of north-western Europe, which evidently belong to the period of the Drift, and which have been borne to the spots where they are now found on moving ice.

I think, Sir, your readers must allow that my point is clearly made out, namely, that Moses and the geologists are of one mind as to the deplorable condition of the earth at the time when the Mosaic record and geology come in contact.

I have the honour to remain, Sir,

Your obedient servant,

FREDERICK FISH.

Walgrave, April 7, 1864.

P.S. I take the meaning of the fourth day's creation to be, that the sun, moon, and stars, which had been previously obscured, then became visible. Henceforth the earth was to receive light from those luminaries, and not to be supplied with miraculous light, as on the first day.

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### *The Scottish Pteraspis.*

Dear Sir,—If not occupying too much space, I would feel obliged by your inserting in an early number the following remarks on the communications in your numbers for March and April from the Rev. H. Mitchell and Mr. E. R. Lankester; these I have the less hesitation in offering, as, while fully appreciating the value of the criticisms of one who has done so much towards adding to our knowledge of this genus as Mr. Lankester, I can at same time fully corroborate the correctness of Mr. Mitchell's restoration, in his interesting letter, in almost every particular.

In a former letter (Geol. Feb. 1863) I had occasion to remark that Mr. Lankester, in a notice (Dec. 1862) of a former and much less correct restoration of our Scottish *Pteraspis* by Mr. Mitchell (Nov. 1862), had not made sufficient allowance for probable specific difference of form. I must here state my belief that the same mistake has again occasioned some of Mr. Lankester's remarks in his last letter. I had recently an opportunity of inspecting Mr. Mitchell's series of specimens of this fish, and of comparing them with my own. They all undoubtedly belong to the same species, and are in my opinion distinct from *Pteraspis rostratus* and other English species.

The only points in Mr. Mitchell's latter restoration which appear to me scarcely correct are, that the breadth seems rather exaggerated, and that the posterior margin is represented as formed of straight lines, while it consists of a double curve, concave posteriorly. The lateral posterior angles are produced, forming well-marked but very short cusps, pointing backward and slightly outwards. From this and also from the well-marked

and finished lateral outline of the posterior head-plate, I think it extremely improbable that this species ever possessed the lateral small plates forming the cornua of *Pteraspis rostratus*; certainly none of the many fragments in our collections show any vestige of these. One of my specimens has the occipital spine *in situ*, and in several of Mr. Mitchell's the spine is shown detached; thus differing from the occipital crest of *Cephalaspis*, which forms an integral portion of the head plate. This spine is short, stout, striated longitudinally, and is deeply inserted in the substance of the head plate, in which it seems to have been immovably fixed. In their composition the head-plates are quite similar to that of the English species, some of Mr. Mitchell's specimens having, as noticed by him, the exterior striation, the internal reticulated markings, and the inner nacreous plates or lamellæ well preserved. From his specimens I have little doubt that the perforations at *b*, in the figure given in your number for March last, are indeed the eye orbits; while those at *a* are too distinctly marked to have been the result of accidental fracture, whatever may have been their nature. As drawn in Mr. Mitchell's latter restoration, and in my figure (*Geol.* Feb. 1863), the test consists of only two distinct plates, an anterior and posterior, with a distinct spine.

No light has yet been thrown on the nature of the under surface of the head, some of our many fragments may possibly belong to this part of its body; to me, however, they all seem mere broken fragments of the upper cephalic plates.

As to the oral appendages, until very recently I was of opinion that these were of the nature indicated in Mr. Lankester's letter, both in this genus and in *Cephalaspis*. This opinion was founded not only on negative evidence, but also on the form of the plate protecting the under surface of the head of the latter genus, and in my letter referred to (Feb. 1863) I expressed this conviction pretty strongly. During the course of last autumn, however, I had the good fortune to open out some magnificent specimens of *Cephalaspis Lyelli*, in which the position and character of the mouth and teeth are distinctly exhibited. The mouth opened immediately under the cephalic plate, the gape occupying about one-third of the entire outer margin, the upper maxillæ, or jaws, ankylosed with the cephalic plate, forming an integral part of it, and are finished with a single row of short, stout, slightly flattened teeth, which extend quite round to the cornua or cusps. In one of my specimens, a portion of the lower jaw is preserved with its single row of similar teeth. From the decided analogy between *Cephalaspis* and *Pteraspis*, it is probable that the latter had been similarly provided. One of Mr. Mitchell's specimens seems to bear this out, having, as noticed by him, the anterior margin of the anterior plate turned downwards and inwards, as in all our moderately well preserved heads of *Cephalaspis*. The analogy between these genera is further confirmed by Mr. Lankester's most interesting discovery of the scales of *Pteraspis*, stated by him to be similar to the dorsal series of *Cephalaspis*,—meaning, I presume, the bony rings covering the body of this creature. These, however, my specimens show to have been again covered externally by scales similar to those covering the cephalic plate.

It seems to me that as yet the nature of the *Cephalaspida* is very imperfectly understood. I strongly suspect the cephalic plate to consist of the various cranial bones ankylosed, while the bony rings protecting the body equally appear to represent the vertebræ and ribs; all covered externally with scales, or rather dermal scutes, thus indicating that this family may have held among the fishes a place somewhat, although by no means ex-

actly analogous to that held by the Chelonians amongst the more highly organized reptiles. Much careful investigation is necessary, and still more perfect specimens are required before this can be fully wrought out.

It is right here also to state that to Mr. Mitchell belongs the merit of first discovering *Pteraspis* in our Scottish rocks, although it is only very recently that I was aware that he had procured and recognized fragments of this fish some time anterior to my discovery of its remains. Believing our Scottish *Pteraspis* to be specifically distinct from the other species yet found, in a paper which I hope to have the honour of communicating at an early meeting of the Geological Society of London, noticing it along with some other Forfarshire fishes, I propose his name as a specific affix for it, and that it should be known as *Pteraspis Mitchelli*.

I am, dear Sir, Yours ever truly,  
JAMES POWRIE.

*Reswalla, April, 1864.*

### *Spiral Planetary Orbits.*

Sir,—Your highly suggestive article on “Spiral Planetary Orbits” (*vide* ‘Geologist’ for March) gave rise to some ideas which may prove interesting to those of your readers who are partial to speculative inquiries.

The generally accepted explanation of the planets’ translatory motion is, that those bodies were projected *once for all* into free space with great velocity, and that as they meet with no resistance they will always continue their course.

The existence of free space here assumed, is, however, very doubtful, since we can hardly reconcile a perfect vacuum with the transmission through it of light and heat, for we know of no such thing as physical force existing independently of matter. But, as you have already shown, if matter does occupy space, then, however rarefied it may be, there must be resistance, friction, and consequently retardation of planetary motion. This slackening of the speed, by destroying the equilibrium of the centripetal and centrifugal forces, would contract the orbits, and ultimately cause the planets to fall into the sun. The equilibrium of the two forces once destroyed, both the decrease of speed and the increase of attraction would tend to the same end, and the motion towards the sun would be so continuously and immensely accelerated that the final catastrophe would not perhaps be so far distant as might at first be imagined.

To such a view of planets revolving in a plenum, without any supply of motive force but that first acquired, some difficulties present themselves, not the least of which is, that if the results of retarded planetary movements are expected to evince themselves in the future, they may also be looked for at present, as phenomena indicative of such retarded movements during time past; for we know not, neither can we imagine, what proportion the past bears to the future.

But can we discern any such phenomena? Not in the planetary circuits, for the centripetal and centrifugal forces still appear to balance each other, their equilibrium remains undisturbed, and we do not find that those planets nearer the sun have a decreased orbital velocity. On the contrary, for “the angular velocity of a planet’s movement in its circuit is inversely as the square of its distance from the sun.”

How, then, can we reconcile the continued regularity of planetary motion with the existence of a resisting medium in space? Does it not appear as though we should have to discard the “projected once for all”