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.

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## *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"

hypothesis, and assume the existence of a sustained or continually acting motive power?

Then, recalling to mind the correlation of the physical forces, and viewing heat and the other forces as directly or indirectly convertible into their equivalents of motion, we are induced to ask, may not force emanating from the sun be the sustaining cause of planetary centrifugal motion? Here we should have a continuous supply of force, which, by counteracting the centripetal force and the resistance of ether, would prevent any contraction of the orbits. Moreover, by such means, we could understand how it is that planets nearer the sun have a greater velocity than those more distant, for the increase of heat and consequently of velocity they received would be equal to the increase of attraction, and heat, velocity, and attraction would all be inversely as the square of the distance of the body from the sun. This we find to be the case.

According to such a view, our journey around the sun would only cease when that luminary failed to supply the necessary amount of force. But, were the sun to become dark and cold, no life could exist on our globe, no changes could take place in the conditions of matter, there could be no liquids, no gases, so that the contact of earth and sun at such a time would be the collision of two dark, gloomy, silent, lifeless masses of inert matter.

The revolution of satellites around planets, as for example that of the moon around the earth, might perhaps be accounted for by supposing the earth's motion (which we cannot believe to be wasted), converted into frictional heat at the surface, which, together with the moon's heat, might act as sufficient centrifugal force to counteract their mutual attraction. The moon's revolution, in conjunction with the earth, around the sun would be perhaps the result of that luminary's heat or force acting on planet and satellite as a connected system.

The greatest difficulty which presents itself to the view of solar force producing motion is the fact that we only know heat as a molecular force. But M. Faye, in the 'Comptes Rendus,' supposes the existence of a repulsive force exerted by the sun, not to be expressed by attraction with a negative sign prefixed, but bearing the same relation to molecular repulsion as celestial attraction does to terrestrial attraction.

Lastly, let us call the comets into the witness-box, and see what those eccentric individuals have to say on this subject. In an article entitled "Cometary Phenomena" ('Intellectual Observer,' 1863), we find the following:—"It is evident that the whole of the mass is vehemently acted upon by some influence emanating from the sun, the continuation and accumulation of which, after the perihelion passage, seem to point to a calorific rather than a more instantaneous electric or magnetic action." Again, Mr. Marsh, in writing of comets in the 'American Journal of Science and Arts,' attributes the peculiar character of cometary matter to the extreme and violent changes which it undergoes in its rotation around the sun. Halley's comet, for example, at one time approaches the sun to within 56 millions of miles, and then recedes to the enormous distance of 3370 millions of miles. At the time of its perihelion, or least distance, it passes through one heliocentric degree of its orbit in 15·7 hours, and receives in a given time 3600 times as much heat as when it reaches its aphelion or greatest distance, in which position its motion is so slow, that six years and a half are required for its passage through one heliocentric degree. Thus, it will be seen, that comets with eccentric orbits are subject to violent changes of temperature and velocity which do not affect (to such an

extent) planets whose orbits approximate more closely to the circular form.

In conclusion, it may be said that in the absence of a continuous supply of motive force, it is quite as difficult to reconcile a plenum with planetary regularity as a vacuum with the transmission of light and heat.

I am, Sir, yours obediently,

JOHN PENTECOST, F.C.S.

*London, April* 6, 1864.

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## COLONIAL GEOLOGY.

### LEAVES FROM MY AUSTRALIAN NOTEBOOK.

BY THOMAS HARRISON, OF MELBOURNE.

#### NO. I.—CAPE SCHANCK, ITS BASALTS AND CAVES.

This spot, although barely, as the crow flies, fifty miles from Melbourne, is not easy of access. Its bold, precipitous, and iron-bound coast-line offers no harbours; the district boasts of neither town nor township—an Australian name for a little village, just as a city in America may mean half-a-dozen tenements,—a few farmers till the rich soil of the neighbourhood, and some three or four squatters have stations thereabouts; the traffic between such a place and the metropolis is small, and on its not altogether bad roads coaches are unknown. To proceed thither one must take his own or hired horse or vehicle, or he must go on foot. Adopting the latter alternative, the better plan will be to land at Schnapper Point or, supposing the steamer should be running, at Dromana. This, the last township on the route, is composed of some two or three houses, as many hotels, and a long pier, built apparently to accommodate the latter. Close adjacent, and the principal landmark near, is Arthur's Seat, a hill or mountain of some thousand feet in altitude. This consists of a central granite mass, surrounded by Tertiary, Silurian, and Basaltic rocks. The ascent is easy and the height by no means great, but being situate on a sort of peninsula, the view from the mountain top is extremely fine, embracing, as it does, an extensive panorama of Western Port, Port Phillip, Bass Straits, and in one direction the vast spread of still uncleared land lying between the seacoast and the Australian Alps.

In visiting the spot I was unable, during the short time at my disposal, to detect traces of the Tertiary deposits having been in the least disturbed, so that, although the surface of the adjoining district appears to have been alternately raised and submerged several times, the changes must have been brought about by movements in which the older granite and the newer strata alike participated. Descending from the mountain, the road lies for some miles further along the coast of the adjacent bay. In this part of the journey very little of the picturesque presents itself, the student of geology may, however, see in some measure how rocks are formed, by a careful contemplation of the numerous sandbanks running along the shore; and may, moreover, chance to find, stranded upon the beach, more than one specimen of that representative of a bygone age,