

points, particularly in the arrangement of the 'radial plates;' as, in that now under consideration the first two bifurcations of these plates form part of the 'cup,' which arrangement expands the arms so much, before they spring from the 'cup,' as to leave space for only a very narrow plate between them.

The 'pelvis' or 'base' is hexagonal, tripartite, and very little larger than the attachment of the stem; aperture pentaphylloid; the first 'primary radial' is hexagonal, nearly half as wide again as long; the second 'primary' also hexagonal, about twice as wide as long; the third, or 'scapula,' as wide as the second, but cuneiform; and on each of its upper or bevel-faces there is another cuneiform or second 'radial plate,' carrying on each of its bevel-faces the first arm-plate. There are four sets of three 'interradial plates' and four 'anal plates,' besides the narrow plates between the arms. The above plates are attached to each other, and form the 'cup,' from which spring twenty 'arms.' The 'dome,' or visceral portion above the arms, is very lofty in comparison with the 'cup.' The plates in the first row above the arms are much longer than wide, and give an appearance very different from that of any other published species of this genus, found in the Mountain-limestone; above this row the plates are smaller, and of various shapes, except the summit-plates which are similar in their proportion and arrangement to those usual in *Amphoracrinus*,—that is, one large plate at the summit surrounded by six other plates and the 'proboscis.' In the specimen here described the proboscis is broken off, and the stem and arms are unknown.

The height is 13 lines; depth of the 'cup' not quite 3 lines; diameter at the top of the 'cup' 12 lines long from the anal side to the anterior arms; transverse diameter or width 11 lines.

From the peculiar form of this fossil I propose for it the name of *Actinocrinus* (*Amphoracrinus*) *brevicalix*.

IV. ON THE EXISTENCE OF PRE-CAMBRIAN LIFE-ERAS.

By GEORGE E. ROBERTS, F.G.S., Hon.Sec.A.S.L.

THERE has been no lack, in the history of geological science, of suggestions as to how our knowledge may be advanced upon those obscure questions which yet ask for solution, both in the physical and palæontological departments of the study. Sometimes, by a surprising intellectual endeavour, we have been carried up to the moon, and asked to discover where its missing waters are, without which our useful satellite appears to be a sort of 'house to let,'—the idea having got into the mind which originated the enquiry, that the earth had appropriated the said waters for the necessities of a supposed cataclysmal epoch. Also, we have been taken down, by speculative thinkers, at divers times, to depths beneath our terra-queous surface, and asked to pin some fundamental articles of faith upon schemes which show all existing there to be either fire, or water, or a zone of meteorite-mineral, or one of solid steel, or that, nothing existing there, the interior of our planet is a vacuum. It

certainly cannot be said that in either of these distinct departments of research,—studies whose materials appear to be as far removed from our use as are the ‘data’ derived from the hypotheses they have given birth to, from the geological laws which we at present accept, we have made any progress which can be termed ‘rapid,’ towards giving them a permanent place in the scheme of geological time. But there lies upon the nearest confines of the more immediately terrestrial study, a certain kingdom of research into which some few honest and earnest workers have been of late casting lines of scientific enquiry. And as this study, which up to a very recent date might have been designated as one quite outside the domains of palæontology, does not require the aid either of a balloon, or a diving-bell, or a chain and windlass of unknown length and power, but may be entered upon with the ordinary appliances of a geological observer, to wit, certain tools of the smithery, good eyes, and a patient temper, I may, probably, be allowed to popularize somewhat the position of the rock-material necessary to it.

Once upon a time, all granite-rocks were considered to be of the same *pre*-anything age. That idea, of course, is exploded now; but I believe that I may really say that (saving the simple acknowledgment put forth in our latest manuals, that ‘granite may be of any age’) the alteration in high geological quarters respecting the age and condition of other rocks, allied in the old text-books with granite, such as syenites, hornblendic schists, tourmaline-bearing felspars, and felspathic rocks generally, is as yet either unknown, or at least not so known that it may be turned to scientific and useful account by the majority of our field-working geologists—the source, in so many instances, of new and valuable lines of geological enquiry. When, last year, and again in the July of the present one, I examined a large series of rock-specimens obtained from the cuttings on the line of the Mid-Scottish Railway (from Perth to Inverness), I was greatly struck with the petrological value of the series of specimens of gneissic and other metamorphosed rocks so exposed. The specimens which I obtained comprised some of rocks previously unknown in Britain. Probably the best term to designate them by would be tourmaline-bearing felspars, with a tendency to become gneissoid. But it is difficult to express by any term, however complex, the aspect of a rock which, in a single hand-specimen, exhibited thirteen different minerals. As far as I know, no rock has been found presenting any natural alliance with them nearer than Norway and Finland on the east and Canada on the west. But these natural equivalents, in position and mineralogical character, are very valuable to us as indicative of relationships. And when, as the question broadens, the so-called syenites of the Malverns claim, through the investigations of Dr. Holl, a place in the scheme which I am about to draw for the pre-Cambrian age, and also the rocks, so irregularly presented, of Charnwood forest ask for recognition, I think I may reasonably draw the attention of those geologists, more happily situated than myself for purposes of investigation, to the question, *How much of life-bearing time can be con-*

*ceded to eras beyond the 'Cambrian'?** The question is not now whether any evidences of life have been found, because that has been already most satisfactorily settled by Sir W. E. Logan; nor yet does it depend on any boundary arbitrarily fixed between the Lower Silurian, Cambrian, or Huronian; it is rather a question of the extension of those or of other forms of 'Fundamental Gneiss' or 'Laurentian' life. For it cannot be supposed that the gigantic foraminifers of the Canadian Loganite-rock will long stand alone in the catalogue of what, as yet, may be termed *primæval* life.

Let our primitive mountain-chains be examined minutely for their contained layers of altered limestone or serpentine, for I am convinced that rocks of such characters are to be met with in many hitherto unsearched parts of Britain, and who shall say that life-relics may not be obtained from them? Markings which to the unassisted eye appear but as blotches and stains, may be, by microscopical aid, resolved into evidences of life more ancient than any yet detected in Britain. Sir R. I. Murchison, whose sagacity led him to place the fundamental gneissic and other rocks of the Western Isles beneath all life-bearing rocks in Britain, has opened out a new kingdom of research; and the note of pilotage which has been sounded from the probably still more ancient kingdom of Laurentia has an assuring sound, telling us that, though unseen rocks may lie in the way of our ventures into the unknown sea, they are those which will aid us in our search, and probably reward us with the objects for which we seek. I would suggest, therefore, to those specially interested in Palæozoic geology, that it would add greatly to the success of the enterprise, if the subject were noticed monthly in the GEOLOGICAL MAGAZINE by contributions, however small, from those who are able by proximity to mountain-chains of undoubted or suspected 'Cambrian' or pre-Cambrian age, to search narrowly into the mineralogical character of the rocks composing them. Such notes should also contain the petrology of the hills thus studied, and, when possible, chemical analyses of the rocks, carried out on the plan adopted by the Rev. Mr. Timins, in his analyses of the Malvern syenites, in which range Dr. Holl has obtained clear evidence of stratal deposition. We greatly need in England the labours of men like my venerable friend Dr. Nils Nordenskiöld, of Frugard, who, with the aid of his son, Prof. Adolph Nordenskiöld, of Stockholm, has chemically and mineralogically analysed almost every Finnish and Scandinavian rock, a nearly complete series of which I had lately the pleasure of receiving from him. Such labours cannot be too highly appreciated by palæontologists, for chemically altered palæozoic rocks are very suggestive of fossils. Perhaps it is not too much to say that Sir W. Logan's discoveries have quite disposed of the term 'Azoic,' as applied to any rocks, save those erupted beyond all question from volcanic sources.

In conclusion, it may be well to offer for the refreshment of our

* I use the term 'Cambrian' in designation of certain pre-Silurian rocks described by our English Nestor, Professor Sedgwick, and to which may be referred the 'Primordial zone' of the Paradoxides-bearing rocks of St. David's.

insatiate minds, a brief statement how far back an 'ancestral' lineage has extended, zoologically and stratigraphically, in order of time. Though it is not an easy task for any geologist to arrange chronologically the sedimentary deposits between the lowest accepted Silurian and the zone at which all differences of opinion cease as to the existence of life, merely because we have, as yet, in Britain discovered no trace of its existence. But confessedly there is an enormous lapse of time between these two limits; and, as an undoubted discovery of life-remains has been made, very nearly upon the lower confines of the older series of strata, we may reasonably ask for search—a constant and active search—into rocks of ages intermediate in time.

In the Longmynd rock, suggested to be of Cambrian age, near Church Stretton in Shropshire, Mr. Salter discovered some traces of vermicular life (Worm-burrows, 'Arenicolites') and a fossil organic relic, supposed at first to belong to a Trilobite, but since discovered to be a part of the shelly covering of the extinct phyllopodous crustacean, *Ceratiocaris*. Several other endeavours have been made since to discover more, or even a correspondent fragment, of this ancient shrimp-like Crustacean; but even a pilgrimage undertaken by Prof. Morris and myself to the classical spot, to which we were guided by Mr. Marston, of Ludlow, failed; for, although we broke a few hundredweights of the shaly stone of the mountain, no remains of the ancient crustacean rewarded our labour. Still I am convinced that at some future time the swelling hills of the Longmynd will disclose, to geologists who can spare more time to their investigation, a more satisfactory account of those relics of ancient life which they undoubtedly contain.

Here, then, studies open out to us which will repay those who take them up; for what can be a grander thought for an enthusiastic field-geologist, who looks upon a mountain which he has formerly considered as of 'granitic' or 'azoic' age, than that such a monument of the world's existence contains, close-treasured within its rocky bounds, evidences of a more ancient life-light than that which had previously illumined the confines of his knowledge?

ABSTRACTS OF FOREIGN MEMOIRS.

ON BRACKISH WATERS AND THEIR DEPOSITS. By Dr. LORENZ. (Proceed. Imp. Acad. Vienna, Dec. 10, 1863.)

ACCORDING to Dr. Lorenz's observations in the Adriatic, especially at the mouth of the Fiumara, fresh water poured into a tideless sea, somewhat deep near the shore, forms a rather limited brackish stratum spreading over the salt water in form of a wedge, the lateral planes of which at first converge in a steep and subsequently in a very acute angle. At the mouth of the Fiumara, the horizontal extent of this wedge is to its initial vertical altitude as 700 to 1. The conditions at the mouth of the Elbe are quite differ-