shows the carapace of the crustacean just before attachment with the head portion and the dorsal side downward—a rather natural position for phyllo-
pods, which, like Apus, are wont to swim on their backs, while foraging along the bottom.

The head and back being thus protected by attachment, but the ventral side open to attack, the next step will be the separation of the carapace valves along the hinge line and their movement upward towards the ventral side; and likewise the rostral and dorsal plates will have to move upward to fit in again between the valves (stage II of diagrams). Following this was the breaking up of the valves into the lateralia, owing to stresses exerted at one or other end, possibly the anterior one where the originally chitinous and somewhat flexible valve was attached. Here also, our material affords a clue to the mode of procedure. A very early growth stage of Eobalanus shows four radially arranged, subequal, oval plates, the two lateral ones of which show a suture along which a smaller part is being split off. It is thus to be inferred that the compartments were formed by successive splitting off of plates from the original valve, each fissure producing a new pair of lateralia. In this way the peculiar interlocking arrangement of the compartments in Eobalanus would finally have come about and each valve of the carapace have been divided up without leaving a useless remainder.

The scuta and terga which form the valvular carapace or operculum of the upper aperture of the later Balanidae and Lepadidae and which are of great taxonomic importance, have not been found in Eobalanus and Protobalanus, and in our view did not exist then, but are a later development to close in more completely the ventral side. They are not fundamental structures.

POSSIBLE DERIVATION OF THE LEPADID BARNACLES FROM THE PHYLLOPODS

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Mr. Ruedemann’s discovery of an elemental balanid and his constructive deduction therefrom of the origin of the acorn barnacles, sets this form of symbiotic degeneration back to an historic stage, where its phylogeny is indicated in its own structure. The degeneration is already complete and hence implies a long time for the acquirement of such adaptation, but it is also so simple as to indicate its procedure. If Eobalanus intimates the rise of the Balanidae through the decline and dependence of the Phyllopods, it is opportune to regard the evidence bearing on the phylogeny of the other great division of the barnacles, the Lepadidae or Goose Barnacles.
There is a long lapse in the time record of this line of development for we have no present knowledge of the lepid barnacles, in the marine interval between the Jura and the Devonian. Certain rare fossils known as Turrilepas and Strobilepis have been found in the rocks of the Devonian, Silurian and Ordovician; Strobilepis is a singular genus constructed of four vertical ranges of plates, two rows broadly triangular and the other two narrow and spiniform, and the fact that this Devonian genus is known in but a single specimen prevents us from going far in utilizing it in this connection, but its structure, a scaly elongated body ending in a single subcircular plate from which the vertical ranges diverge, indicates that this plate is terminal at the free end of the animal; in other words, a caudal plate. In my previous discussions of this genus I have placed Strobilepis and Turrilepas together under the family Turrilepadidae, Turrilepas being the older in time and date of description and having similar structure except that the vertical ranges are from four to six, the scales of each range being more or less interlocked with those adjoining. This fact and the absence, so far as known, of a terminal or caudal plate, has led some students to regard Turrilepas as the scaly stalk of a lepad rather than the capitulum. However this may prove, I think we may be obliged to conceive that there is a less close relation between these two genera than their gross structures indicates.

In the Silurian and Ordovician we have the genus Lepidocoleus now standing as the representative of the family Lepidocoleidae and in this the type of structure is much simpler than in the genera mentioned. Here is an elongate body consisting of but two vertical ranges of plates, which are as distinctly 'lateral' in a morphological sense as are the lateralia of the balanids. These two rows open back and front making two continuous lines of suture or dehiscence from the base of attachment to the summit, where there is a terminal axial plate. The lateral plates are subequal half-rings or bands and the Lepidocoleus was attached to the surface on which it grew by its end and obviously by its head. My recorded observations on these structures in the Palaeontology of New York, VII, the American Geologist, American Naturalist and Eastman-Zittel's Text Book of Palaeontology are sufficient demonstrations of these relations.

Mr. Ruedemann's hypothesis of derivation predicates attachment of the ancestral phyllopid by its head and back; primarily by its head, secondarily and subsequently by its back. If we limit this fixation to attachment by the head alone leaving the rest of the body entirely free and hence subject to much more frequent and pronounced lateral stresses resulting from movements, by waters or otherwise, from side to side, we call into play only such stresses as reasonably seem to have been effective in the development of the Phyllocardia into Eobalanus.

The arguments and the causes are of the same category as those which my associate has employed. It is, therefore, a matter of special and confirmatory significance that these Lepidocoleus forms appear in the Ordovician; that is
to say that so far as our present knowledge extends the metamorphoses of the Phyllopods into the two great branches of the barnacles were essentially contemporaneous.

REFRACTIVE INDEX AND SOLUBILITIES OF THE NITRATES OF LEAD ISOTOPES

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The refractive index of the nitrate of pure common lead was compared very carefully with that of the nitrate of uraniolead prepared from the Australian material already mentioned in previous reports. The two samples of nitrates were separately recrystallized with care, and finely developed crystals were measured in the Abbé-Zeiss total-reflecting crystal refractometer. A solution of sulphur in methylene iodide having a refractive index of 1.79 was used as the contact liquid, and very careful measurements were made of many crystals in varying positions. The refractometer was standardized by means of a polished glass prism possessing an exactly known refractive index which could be verified by the method of minimum deviation. The refractive index of common lead nitrate at 20° was found to be 1.7815, and that of the uraniolead nitrate was found to be 1.7814—each value being a mean of many concordant determinations. Thus the difference in atomic weight shown by the two specimens of lead (the atomic weights are respectively 207.20 and 206.41) has no appreciable effect on the refractive index of the salt—a highly interesting and newly discovered fact.

The two specimens of lead nitrate which had been purified (crystals of which had been used in the preceding investigation) were further investigated with great care as to solubility, using a method recently described, with small but convenient improvements. Greater difficulty was found in obtaining an exactly saturated solution than was the case with sodium sulphate, at least twenty-four hours at perfectly constant temperature being needed in order to obtain constant results. The weighed portions of solution saturated at 25.02° were evaporated with excess of sulphuric acid and the sulphate was gently heated at 350° until constant in weight. Four such determinations with ordinary lead nitrate gave values from 37.33 to 37.36 (average 37.342) grams of nitrate in 100 grams of solution, and nine determinations with uraniolead nitrate gave values from 37.26 to 37.30 (average 37.280) grams of nitrate in 100 grams of solution. These results are precisely proportional (within the limit of error of experiment) to the different molecular weights of the two samples of nitrate. Expressed in other terms, the molal solubilities of the two samples per thousand grams of water are respectively 1.7993 for