can never cut it in more than two. He remarks, however, that if we could conceive two poles of like kinds to exist without any other whatsoever, we might have either four points of verticity, or only two, according to circumstances; but he waves the discussion of this particular case, as being irrelevant to the purpose of his present inquiry.

Mr. Davies announces his intention of shortly laying before the Society a continuation of these researches; devoting the next series to the points of maximum intensity.

"Memoir on the Metamorphoses in the *Macroura*, or Long-tailed Crustacea, exemplified in the Prawn (*Palæmon serratus*)." By John V. Thompson, Esq., F.L.S., Deputy Inspector-General of Hospitals. Communicated by Sir James Macgrigor, M.D., F.R.S., &c.

The author gives descriptions, illustrated by outline figures, of three different stages of growth of the Prawn; the first being that of the larva immediately on its exclusion from the egg; the second, at a later period, when it has acquired an additional pair of cleft members, and a pair of scales on each side of the tail; and the third, at a still more advanced stage of development, when it presents the general appearance of the adult Prawn, but still retains the natatory division of the members, now increased to six pair. The author thinks it probable that an intermediate stage of metamorphosis exists between the two last of these observed conditions of the animal.

Feb. 11.—A paper was in part read, entitled, "On Voltaic Combinations." In a letter addressed to Michael Faraday, Esq., D.C.L., F.R.S. Fullerian Professor of Chemistry in the Royal Institution of Great Britain, &c., &c. By John Frederick Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London.

Feb. 18.—The reading of Mr. Daniell's paper, entitled, "On Voltaic Combinations," in a letter to Michael Faraday, Esq., D.C.L., F.R.S., &c., was resumed and concluded.

The author, after expressing his obligations to Mr. Faraday for the important light which his late researches in electricity have thrown on chemical science*, proceeds to state that in pursuing the train of inquiry which has thus been opened, he has obtained further confirmations of the truth of that great principle discovered and established by Mr. Faraday, namely, the definite chemical action of electricity; and has thence been led to the construction of a voltaic arrangement which furnishes a constant current of electricity for any required length of time.

For the purpose of ascertaining the influence exerted by the different parts of the voltaic battery in their various forms of combi-

* The greater part of Mr. Faraday's Experimental Researches in Electricity will be found entire in Lond. and Edinb. Phil. Mag., vol. iii., vol. v., vol. vi.; and of his other Series abstracts have been given in Phil. Mag. and Annals, N.S., vol. xi., and in the succeeding volumes of Lond. and Edinb. Phil. Mag. Mr. Faraday's Seventh Series, on the definite chemical action of Electricity, appeared in Lond. and Edinb. Phil. Mag., vol. v. p. 161; and his Tenth Series, on the construction of the Voltaic Battery, in our present volume, p. 114.—Edit.

nation, he contrived an apparatus, which he designates by the name of *the dissected battery*, and which consists of ten cylindrical glass cells, capable of holding the fluid electrolytes, in which two plates of metal are immersed; each plate communicating below, by means of a separate wire, which is made to perforate a glass stopper closing the bottom of the cell, with a small quantity of mercury, contained in a separate cup underneath the stopper, and with which electric communications may be made at pleasure through other wires passing out of the vessel on each side. The active elements of the circuit, which were adopted as standards of comparison, were, for the metals, plates of platinum and amalgamated zinc three inches in length by one in breadth; and for the electrolyte, water acidulated with sulphuric acid, in the proportion of 100 parts by volume of the former to 2·25 of the latter; this degree of dilution (giving a specific gravity of 1·0275,) being adopted, in order to connect the author's experiments with those of Mr. Faraday.

This dilute acid exerts scarcely any local action on amalgamated zinc; because the surface of the metal becomes covered with bubbles of hydrogen gas, which adhere strongly to it; and this force of heterogeneous adhesion appears to have an important influence on the phænomena both of local and of current affinity, and soon puts a stop to the decomposition of the water by the zinc. When a small quantity of nitric acid is added to the acidulated water, the same plate which in the former experiment resisted the action of the diluted sulphuric acid, is, in a few hours, entirely dissolved, without the extrication of any gaseous matter. This result is explained by the author on the supposition that the elements of the nitric acid enter into combination with the hydrogen as it is evolved, and that the opposing attraction of this latter substance is thus removed. The author finds, in like manner, that nascent hydrogen deoxidates copper, and precipitates it from its solutions upon the negative plate of the voltaic circuit.

A series of experiments performed with the dissected battery is next described; illustrating, in a striking manner, the difference of effects with relation to the quantity and the intensity of the electric current, consequent on the different modes of connecting the elements of the battery: the former property being chiefly exhibited when the plates of the respective metals are united together so as to constitute a single pair; and the latter being exalted when the separate pairs are combined in alternate series. The influence of different modifications of these arrangements, and the effects of the interposition of pairs in the reverse order, operating as causes of retardation, are next inquired into.

In the course of these researches, the author, being struck with the great extent of negative metallic surface over which the deoxidating influence of the positive metal appeared to manifest itself, as is shown more especially in the cases where a large sheet of copper is protected from corrosion by a piece of zinc or iron of comparatively very small dimensions, was induced to institute a more careful examination of the circumstances attending this class of phenomena; and was thus led to discover the cause of the variations

and progressive decline of the power of the ordinary voltaic battery, one of the principal of which is the deposit of the zinc on the platina [or copper] plates ; and to establish certain principles from which a method of counteracting this evil may be derived. The particular construction which he has devised for the attainment of this object, and which he denominates the *constant battery*, consists of a hollow copper cylinder, containing within it a membranous tube formed by the gullet of an ox, in the axis of which is placed a cylindrical rod of zinc. The dilute acid is poured into the membranous tube from above by means of a funnel, and passes off, as occasion requires, by a siphon tube at the lower part; while the space between the tube and the sides of the copper cylinder is filled with a solution of sulphate of copper, which is preserved in a state of saturation by a quantity of this substance suspended in it by a cullender, allowing it to percolate in proportion as it is dissolved. Two principal objects are accomplished by this arrangement ; first, the removal out of the circuit of the oxide of zinc, the deposit of which is so injurious to the continuance of the effect of the common battery ; and, secondly, the absorption of the hydrogen evolved upon the surface of the copper, without the precipitation of any substance which would lead to counteract the voltaic action of that surface. The first is completely effected by the suspension of the zinc rod in the interior membranous cell into which fresh acidulated water is allowed slowly to drop, in proportion as the heavier solution of the oxide of zinc is withdrawn from the bottom of the cell by the siphon tube. The second object is attained by charging the exterior space surrounding the membrane with a saturated solution of sulphate of copper, instead of diluted acid ; for, on completing the circuit, the electric current passes freely through this solution, and no hydrogen makes its appearance upon the conducting plate ; but a beautiful pink coating of pure copper is precipitated upon it, and thus perpetually renews its surface.

When the whole battery is properly arranged and charged in this manner, it produces a perfectly equal and steady current of electricity for many hours together. It possesses also the further advantages of enabling us to get rid of all local action by the facility it affords of applying amalgamated zinc ; of allowing the replacement of the zinc rods at a very trifling expense ; of securing the total absence of any wear of the copper; of requiring no employment of nitric acid, but substituting in its stead materials of greater cheapness, namely, sulphate of copper, and oil of vitriol ; the total absence of any annoying fumes ; and lastly, the facility and perfection with which all metallic communications may be made and their arrangements varied.

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April 5.—A paper was read, entitled, "On the Ovula of *Santalum album* ; by William Griffith, Esq., Assistant Surgeon in the Madras Medical Service : communicated by R. H. Solly, Esq., F.L.S."

In this paper are detailed minute observations on the fecundation of *Santalum album*, carried on through all the stages of that process,