

ground mines. On the Mesabi range, however, some of the largest mines are worked as open quarries, the ore being obtained by steam shovels at a cost of $7\frac{1}{2}d.$ per ton. The accompanying illustration shows the steam-shovel method of mining at the Oliver Mine on the Mesabi range. The face of iron ore is 50 feet high, and the 90-ton steam-shovel with a $2\frac{1}{2}$ cubic yard digger shown, is capable of loading 500 tons of ore per hour. It is difficult to over-estimate the value to the United States of the discovery of ore in the Mesabi Range. A producer for only four seasons, this district has in sight to-day nearly 400,000,000 tons of better ore than the average used in the United States, and perhaps 200,000 tons of ore containing 60 per cent. of iron, 0.06 per cent. of phosphorus, and 10 per cent. of moisture. Indeed, Mr. Winchell thinks that it is not unreasonable to assert that the range will produce 500,000,000 tons of ore before it is abandoned.

At the present time the cost of a ton of Mesabi ore laid down at a Lake Erie dock is made up of the following items:—

	s.	d.	to	s.	d.
Royalty	0	0	to	1	5½
Mining cost	0	7½	to	3	1½
Railway freight	1	4	to	4	2
Lake freight	2	6	to	3	4
Insurance, commission, and loss	0	2½	to	0	10
Totals	4	8		12	11

There is probably no mine which has all the minimum costs, and it is evident that prices may go still lower without shutting up enough mines to produce a scarcity of ore. Mr. Winchell appends to his valuable paper a carefully compiled bibliography, tables of analyses, and statistics of shipments for the past forty-one years.

BENNETT H. BROUGH.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following is the speech delivered on March 10 by the Public Orator, Dr. Sandys, in presenting, for the honorary degree of Doctor in Science, Prof. Wilhelm Pfeffer of Leipzig, Croonian Lecturer of the Royal Society, 1898:—

Veris adventu iam propinquo, dum terra gaudet, dum caelum avet nitescere, et arbores frondescere, nihil auspiciatius ducimus quam veris quasi praeunantium quandam trans maria advectionem verbis bene ominatis salutare. Salutamus praeceptorem insignem, qui rerum naturae pulcherrimam nactus provinciam, discipulis ex omni orbis terrarum parte affluentes docet, qua lege lilia crocique calyces suos explicant; quo admonitu flores, alii solis calore, alii solis lumine adducti, se aperiant; arte quali mimosa tactum etiam mollissimum reformidet frondesque teneras in sese contrahat; artificium quam admirabili etiam vites, natura caducae, claviculis suis adminicula quaedam tamquam manibus complectantur, et quasi animantes a terra sese altius erigant. Quam dilucide demonstrat, quicquid terra gignit, secundum ea quorum in medio vivit, velut ipsos animantes, naturam suam sensim variare ac mutare. Idem neque per membranam tenuissimam aquae sorbendae rationem, quae osmosis dicitur, neque cellularum motum, qui chemotaxis nuncupatur, inexploratum reliquit. Etiam animalium minutissimorum quae bacteria nominantur motus varios quam subtiliter moderatur, et in ipsum exitium quam insidiosae pellicit. Nuper a Societate Regia Londinensi in Britanniam vocatus, propediem (nisi fallor) ostendet, in eis rebus quas terra gignit, quinam sit ipse motus fons et origo; quo potissimum modo succus ipse quem e terra trahunt, spiritus ipse quem e caelo hauriunt, quasi vim quandam mittat liberam, unde motuum inter se diversorum varietas tam magna exoriatur. Quid est in his omnibus, Academici, (ut Ciceronis utar verbis) "quid est, in quo non naturae ratio intellegentis appareat?"

Praesento vobis scientiae botanicae praeceptorem illustrem, Professorem Lipsiensem, WILLELMUM PFEFFER.

MR. WILLIAM HOULDSWORTH, Rozelle, Ayr, has just intimated his intention of presenting to the University of Glasgow a sum of 5600*l.*, so invested as to yield an annual income of 150*l.*, in order to endow a research studentship in connection with the Faculty of Science. The sum of 120*l.* is to be paid annually to the research student on the foundation, the remainder to be used

to defray laboratory expenses and materials in connection with his work, and the fees of such science classes as he may attend. To be eligible for appointment candidates must have studied at least two years in the University of Glasgow, and the appointment is to be made in the manner laid down by the ordinance regarding research students and fellows. The period of tenure is to be two years, during which the holder must prosecute research studies in the Natural Philosophy department with diligence and regularity. Mr. Houldsworth has taken this method of showing his interest in the welfare of the University and the advancement of science, and his recognition of the distinguished services rendered to scientific research by Lord Kelvin during a professorship of fifty years.

THE London University Commission Bill passed through Committee of the House of Lords on Thursday last. The Duke of Devonshire announced that the names of the Commissioners were the same as those in the Bill of last year with one exception, and were as follows:—Lord Davey (chairman), the Bishop of London, Sir William Roberts, Sir Owen Roberts, Prof. Jebb, M.P., Prof. Michael Foster, and Mr. E. H. Busk (chairman of Convocation). It was agreed that the powers of the Commissioners should continue till the end of 1899 instead of 1898. With the object of securing for the Agricultural College of Wye, established by the County Councils of Surrey and Kent, the advantages derivable under the Bill, Lord Stanhope moved an amendment to the clause referring to the powers and duties of the Commissioners, and he was supported by Lord Ashcombe and Lord Thring. The amendment was not pressed on a promise being given by the Duke of Devonshire that if it were found to be possible without injuriously disturbing the compromise embodied in the Bill he would endeavour on the report to insert words to meet the claims of Wye College.

REPLYING to a question asked by Lord Norton in the House of Lords on Thursday last, the Duke of Devonshire said he hoped the Bill of the Government relating to secondary education would be introduced after Easter. He added: "It is not, and never has been, the intention of the Government to do anything in the nature of what may be called establishing secondary education all over the country. Any measure which we propose will be solely for the purpose of organising in a better way that which already exists, and, possibly, for supplementing it to a certain extent. That what is being done by county authorities, or municipal bodies, or private individuals is something to be done by the Government, is not an idea which has ever been entertained by the Government. No doubt a certain amount of the 800,000*l.* which has been given to be principally expended on technical education may have been at the outset misapplied, and perhaps a certain portion of it has been wasted; but, on the other hand, I believe that a very large portion of it is now being most usefully employed, and with very great advantage, to the various localities. It is not dependent entirely upon the will and pleasure of the County Councils. Almost every County Council has, for the purpose of administering this grant, established an educational committee, which does not usually consist solely of members of the County Council, or need not consist solely of members of County Councils. Those bodies are gradually acquiring a great deal of experience, and I believe that in a great many centres they are at present doing very valuable work."

SCIENTIFIC SERIALS.

IN the January number of the *Quarterly Journal of Microscopical Science*, Mr. E. A. Minchin gives a valuable addition to our knowledge of asconid sponge morphology in a paper on the origin and growth of the triradiate and quadriradiate spicules in the family Clathrinidae. Mr. Minchin here produces full histological evidence of his discovery of the composite origin of these two kinds of spicules; he shows that the triradiate spicules are formed by trios of dermal cells which immigrate from the epithelium to the interior; by the division of each cell a sextet is formed, and the spicule appears with each of its rays corresponding to two sister cells of the sextet. With regard to the quadriradiate spicules the three basal rays develop exactly as do the triradiate spicules, but the fourth or gastral ray is secreted by a mother cell derived from a porocyte. The spicules are crystalline as a whole, but the rays are non-crystalline so long as they are distinct from one another, and may remain so for some little time after union has taken place; the crystallisation appears

to start from the secondary deposit which unites the rays at the centre. Much skill and care have been bestowed on the beautiful drawings illustrating these researches, and they are admirably reproduced in an excellent series of plates.—Prof. MacBride, in a paper on the early development of Amphioxus, shows the similarity between the coelomic chambers of Amphioxus and Balanoglossus, and homologises the metapleural lymph canals of the former with portions of the collar pouches of the latter; in consequence of this he revives Bateson's comparison of the atrial folds of Amphioxus with the posterior collar folds of Balanoglossus.—Mr. Shipley gives an account of a new Tape-worm from a bird in the Sandwich Islands.—Dr. Willey gives the diagnosis of a new genus of Enteropneusta.—Prof. Haswell describes a Turbellarian from deep wells in New Zealand.—Prof. Ray Lankester, in a note on the development of the atrial chamber of Amphioxus, corrects Prof. MacBride's statements with regard to the well-known researches by himself and Dr. Willey on the development of the atrial chamber.

Bulletin of the American Mathematical Society, February.—The number opens with an account of the fourth annual meeting of the Society on December 29, 1897. After the election of the new Council—Prof. S. Newcomb being re-elected President—eleven papers were presented; of some of these abstracts are given, and the journals in which they have appeared, or will appear, are named.—Prof. Woodward's paper on the differential equations defining the Laplacian distribution of density, pressure, and acceleration of gravity in the earth presents an improved mathematical method for the treatment of the problem, previous methods being deemed by the author to be lacking in elegance and compactness.—The following are to appear in the *American Journal of Mathematics*—viz. on some points of the theory of functions, by Prof. Chessin; and point-transformation in elliptic coordinates of circles having double contact with a conic, by Dr. Lovett. A second paper by Dr. Lovett, entitled "Certain invariants of a plane quadrangle by projective transformation," will be published in the *Annals of Mathematics*. It is a contribution to the theory of a system of 4-coplanar points, and shows among other things how the group theory may be made to yield the details of elementary geometry.—Prof. Newcomb's presidential address, given *in extenso*, treats of the philosophy of hyperspace. "There is a region of mathematical thought," he remarks, "which might be called the fairyland of geometry. The geometer here disports himself in a way which, to the non-mathematical thinker, suggests the wild flight of an unbridled imagination rather than the sober sequence of mathematical demonstration." He defines his hyperspace as being, in general, space in which the axioms of the Euclidean geometry are not true and complete. Curved space and space of four or more dimensions are completely distinct in their characteristics, and must therefore be treated separately. Prof. Newcomb's views have already been stated in our columns, and the present address is an interesting sequel to them up to date.—Another of the papers, viz. orthogonal group in a Galois field, by Dr. L. E. Dickson, is also given here. The term *orthogonal*, in the present connection, is defined, and a remark of Jordan's shown to be not exact (*Traité des Substitutions*, p. 169, ll. 18–21).—We can merely mention that the second meeting of the Chicago Section was held on December 30 and 31, 1897, at which twenty-one papers were read. Brief abstracts are given. From the *Notes* we learn that in the year 1897 the membership of the Society increased from 280 to 301, and the total number of papers read was 88!

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 27.—"On the Zoological Evidence for the Connection of Lake Tanganyika with the Sea." By J. E. S. Moore, A.R.C.S.

The results of the morphological examination of the animals obtained during the author's recent expedition to Lake Tanganyika have made it evident that the fauna of this lake must be regarded as a double series, each half of which is entirely distinct in origin and nature from the other. The remarkable Molluscan shells which were brought home by Burton and Speke, form but a small part of the Molluscan section of the more abnormal of these fresh-water stocks. Besides Molluscs,

the lake was found to contain fishes, Crustacea, Cœlenterata, and Protozoa, all of which, like Speke's shells, present the most curious marine affinities, and for distinctive purposes the individual members of this unique assemblage of quasi-marine fresh-water organisms are described as members of the Halolimnic group.

The distribution of the aquatic faunas occurring in Lakes Shirwa, Nyanza, Kela and Tanganyika, all of which were visited and dredged during the expedition, shows (together with what is already known respecting the Victoria Nyanza and the more northern lakes) that the Halolimnic animals are exclusively restricted to Tanganyika. It is thus rendered inconceivable that the Halolimnic forms can have arisen through the effect of ordinary conditions operating upon the population which the lake originally possessed. For the same reasons, it becomes equally clear that the Halolimnic animals cannot be regarded as the survivors of an old fresh-water stock. Since, if we accept either of these suppositions, we are bound by the facts of distribution to believe, also, that the Halolimnic animals have been destroyed in every African lake but one; a supposition which may be ingenious, but which, when the number of lakes existing in the African interior is fully realised, becomes grotesque.

Apart from the physical difficulties which the present effluent of Tanganyika presents to the ingress of organisms from the sea, it is impossible to regard the Halolimnic forms as having recently transmigrated thither from the ocean, since none of these animals are exactly similar to any marine organisms at present known. They must, therefore, have been in Tanganyika long enough to modify into their present condition from the living oceanic species which we know, or they retain the characters of a sea-fauna that has elsewhere become extinct.

The delicate nature of the lake Medusæ, and the fact that most of the Halolimnic Molluscs are exclusively deep-water forms, renders it impossible that these organisms can have made their way into Tanganyika at any time under the physical conditions which now exist.

The facts of distribution and the general characters of these forms, as well as the geographical conditions of the lake in which they are now found, lead then to the conclusion that the Tanganyika region of Central Africa must have approximated to a deep arm of the sea in ancient times.

This view is finally confirmed by the details of the anatomy of the Halolimnic animals themselves. For some of the individual Molluscs of this group combine the characters of several of the most modern marine genera. The Halolimnic fauna of Tanganyika, therefore, cannot represent an extinct fresh-water stock, since the characteristic fresh-water organisms of the present day (which would in such a case have to be regarded as their linear descendants) possess the anatomy of vastly older types.

To the Halolimnic animals there thus attaches the unique interest that they themselves constitute the few surviving indications of an old sea which once extended far into the African interior, and which, judging from the characters of the animals it left behind, must have retained its connection with the ocean at least as late as Tertiary times.

These conclusions, it will be observed, are directly in opposition to the views which were originated by Murchison, and which depict the African interior as never having been below the sea at least since the New Red Sandstone age.

February 17.—"On the Magnetic Deformation of Nickel." By E. Taylor Jones, D.Sc.

The experiments were made with a view to further testing a result arrived at on a former occasion by the author, viz. that the magnetic contraction of a long nickel wire was approximately proportional, when allowance was made for the effects of Kirchhoff's system of stresses, to the fourth power of the magnetisation.

In order to vary, if possible, the conditions of the experiments some preliminary measurements were made to find out whether temperature had any marked influence on the magnetic contraction. The temperature of the specimen was raised by allowing warm water to flow through the water-jacket of the magnetising coil. It was found that at low field-strengths (up to about 90 C.G.S.) the magnetic contraction was greater at 56° C. than at 19° C.; at higher fields the contraction was greater at the lower temperature, the difference being about 6 per cent. at the field 330 C.G.S.

Repeated measurements showed that the contraction at any