## SOCIETIES AND ACADEMIES

### LONDON

**Royal Society**, November 25, 1886.—"On the Dynamical Theory of the Tides of Long Period." By G. H. Darwin, LL.D., F.R.S., Fellow of Trinity College, and Plumian Professor in the University of Cambridge.

Laplace sought to show that, as regards the oscillations of long period, called by him "of the first species," friction would suffice to make the ocean assume at each instant its form of equilibrium. His conclusion is no doubt true, but the question remains as to what amount of friction is to be regarded as sufficing to produce the result, and whether oceanic tidal friction can be great enough to have the effect which he supposes it to have.

In oscillations of the class under consideration, the water moves for half a period north, and then for half a period south. Now in systems where the resistances are proportional to velocity, it is usual to specify the resistance by a modulus of decay, namely, that period in which a velocity is reduced by friction to $1 \div 2{\cdot}783$ of its initial value; and the friction contemplated by Laplace is such that the modulus of decay is short compared with the semi-period of oscillation.

The quickest of the tides of long period is the fortnightly tide, hence, for the applicability of Laplace's conclusion, the modulus of decay must be short compared with a week. Now it seems practically certain that the friction of the ocean bed would not much affect the velocity of a slow ocean current in a day or two. Hence we cannot accept Laplace's hypothesis as to the effect of friction.

This paper then gives a solution of the equation of motion when friction is entirely neglected. The method is indicated in a footnote to a paper by Sir William Thomson (*Philosophical Magazine*, 1875, vol. 50, p. 280), but has never been worked out before.

It appears in the result that with an ocean 1200 fathoms deep, covering the whole globe, the fortnightly tide has about 1/7th of its equilibrium value at the pole, and nearly a half at the equator. If the ocean be four times as deep we get analogous results, and it appears that with such oceans as we have to deal with the tide of long period is certainly less than half its equilibrium result.

In Thomson and Tait's "Natural Philosophy" (edition of 1883) a comparison is made of the observed tides of long period with the equilibrium theory.

This investigation was undertaken in the belief of the correctness of Laplace's view as to the tides of long period, and was intended to evaluate the effective rigidity of the earth's mass.

The present result shows that it is not possible to attain any estimate of the earth's rigidity in this way, but as the tides of long period are distinctly sensible, we may accept the investigation in the "Natural Philosophy" as generally confirmatory of Thomson's view as to the great effective rigidity of the whole earth's mass.

There is one tide, however, of long period of which Laplace's argument from friction must hold true. In consequence of the regression of the nodes of the moon's orbit there is a minute tide with a period of nearly nineteen years, and in this case friction must be far more important than inertia. Unfortunately this tide is very minute, and as is shown in a Report for 1886 to the British Association on the tides, it is entirely masked by oscillations of sea-level produced by meteorological or other causes.

Thus it does not seem likely that it will ever be possible to evaluate the effective rigidity of the earth's mass by means of tidal observations.

December 9.—"Note on a New Form of Direct-Vision Spectroscope." By G. D. Liveing, M.A., F.R.S., Professor of Chemistry, and J. Dewar, M.A., F.R.S., University of Cambridge.

December 16, 1886.—"Preliminary Account of the Observations of the Eclipse of the Sun at Grenada in August 1886." By Captain Darwin, R.E. Communicated by Lord Rayleigh, Sec.R.S.

The instruments allotted to me consisted of the coronagraph and the prismatic camera; the two instruments being mounted on the same equatorial stand.

The photograph obtained with the prismatic camera shows several images of the prominences, and it therefore gives every promise of yielding good results when measured and examined.

The five- and ten-second photographs of the corona show signs of a slight vibration, but they will be useful for the inner part of the corona. As my main object was to obtain instantaneous photographs, these long-exposure plates had to be obtained by working the automatic shutter by hand; it was this probably that caused the vibration.

The instantaneous photographs of the corona when developed were complete blanks, proving that the exposure was too short. It should, however, be observed that this does not prove that the light of the corona was insufficient to cause an appreciable effect on the plate if combined with other light. More light energy is necessary to start photographic action than is required to produce a visible difference of shade when once the action is started.

Many of the photographs taken during partial eclipse show what may be described as a false corona, that is, an increase of density near the sun and between the cusps, or *in front of* the moon. In none of them can the moon be seen eclipsing the corona.

The results, therefore, are adverse to the possibility of obtaining photographs of the corona in sunlight; it is, however, I consider, by no means proved that the method is impossible. But at present I am inclined to consider that the result tends to show that a *practical* method of obtaining photographic records of the corona during sunlight is not likely to be obtained. The trial was not conclusive because the conditions were very unfavourable. In order to reduce the air-glare to a minimum, so that the light of the corona shall not be overpowered, the following points must be observed:—

(1) The air should be clear and dry.

(2) The sun should be near the zenith.

(3) The station should be at a considerable elevation above the sea.

(4) The corona, if it does vary in intensity, should be at its maximum brightness.

Now every one of these conditions was unfavourable. The air was saturated with moisture, the sky was of a hazy blue, the sun was low, the station was near the sea-level, and the corona, according to the general impression, was not so bright as on other occasions.

I hope, however, to deal more fully with these considerations on another occasion.

**Mathematical Society**, January 13.—Sir J. Cockle, F.R.S., President, in the chair.—Prof. G. B. Mathews was elected a Member.—The following communications were made:—Conjugate "Tucker" circles, by R. Tucker.—On the incorrectness of the rules for contracting the processes of finding the square and cube roots of a number, by Prof. M. J. M. Hill.—On the complex angle, by J. J. Walker, F.R.S.—Shorter communications were also made by Messrs. Heppel, Macmahon, and S. Roberts, F.R.S., in the discussion of which several members took part.

**Victoria Institute**, Jan. 3.—Dr. Wright read a paper describing the Hittite monuments which he had examined in the East, and giving an account of the present position of the question as to the age and extent of the country of the Hittites. Many afterwards joined in the discussion. Thirty members and associates were elected, and it was announced that 100 had joined during the past year, making 1200 members the Institute's strength.

### EDINBURGH

**Mathematical Society**, January 14.—Mr. W. J. Macdonald, Vice-President, in the chair.—Prof. Chrystal gave a paper on the generation of any curve as a roulette; and Mr. William Renton contributed some mnemonics for plane and spherical trigonometry.

### PARIS

**Academy of Sciences**, January 10.—M. Gosselin in the chair.—Note on the works of the late M. Oppolzer, Corresponding Member of the Section for Astronomy, by M. Tisserand. In this obituary notice reference is made more especially to the eminent astronomer's "Traité des Orbites," his determination of the orbits of the planets and many comets, and his theory of the movement of the moon.—On various phenomena presented by the artesian wells recently sunk in Algeria, by M. de Lesseps. The results are described of unusually successful operations undertaken in 1885 and last year in the region of the Shotts, where one well, yielding as much as 8000 litres per

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minute of pure water at a temperature of 25° C., has already developed a considerable lake 10 metres deep, by means of which from 500 to 600 hectares of waste land have been reclaimed. Similar results elsewhere give hope that large tracts now uninhabited, but which supported a numerous population in the time of the Romans, will soon be again brought under cultivation.—On the theory of algebraic forms with $p$ variables, by M. R. Perrin.—On the action of the chloride of carbon on the anhydrous oxides, by M. Eug. Demarçay. Schützenberger having shown that the tetrachloride of carbon reacts readily on the sulphuric anhydride, forming phosgene and chloride of pyrosulphuryl, the author here describes some experiments he has carried out for the purpose of ascertaining whether the same substance reacts on the oxides, and whether this reaction might not be utilised in the laboratory for facilitating the preparation of the anhydrous chlorides.—On erythrite, by M. Albert Colson. This substance should yield successively by oxidation a monobasic and a bibasic acid, the latter being tartaric acid, according to Henninger's formula. But no monobasic acid derived from erythrite has yet been described, nor has the transformation of this alcohol into tartaric acid ever given satisfactory results. The author here accordingly resumes the study of its oxidation, testing by the thermo-chemical process the formulas hitherto accepted for erythrite and tartaric acid. He also treats erythrite with the perbromide of phosphorus, obtaining a bromhydrine, $C_4H_6Br_4$, fusible at 112° C., and identical with the tetrabromide of crotonylene, described by Henninger.—On the glycerinate of potassa, by M. de Forcrand. Having already determined the heat of formation of the glycerinate of soda, and of its ethylic combination, and the conditions under which these compounds have their origin, the author here subjects the glycerinate of potassa to a similar process with analogous results.—On the substances derived from erythrene, by MM. E. Grimaux and Ch. Cloez. The object of the experiments here described is to ascertain whether erythrene and the carburet of gas oils are really identical, as supposed by Henninger. The result so far shows that the erythrene derived from the oils of compressed gas unites readily with hypochlorous acid, the product of the reaction being soluble in ether, alcohol, and water.—On the artificial production of zincite and willemite, by M. Alex. Gorgeu. The methods by which the author reproduces zincite are based on the decomposition of several salts of zinc by heat alone, or aided by the vapour of water. It is merely an application of the process by which M. Debray has obtained crystals of glucine, magnesia, &c. Willemite, $SiO_2$,2ZnO, he produces by a method based on the action of silica on a mixture of alkaline sulphate and sulphate of zinc.—Observations on fishes inhabiting very deep waters (second communication), by M. Léon Vaillant. The really characteristic types of this class of deep-sea fauna are referred to the sub-order of the Anacanthini, which yields a considerable number of species, living at great depths. There is almost a total absence of Pleuronectes, the solitary exception being *P. megastoma*, Donov., fished up from a depth of 560 metres. A striking feature of this ichthyological fauna is its great uniformity, the same genera and even closely-allied species constantly reappearing and being evidently diffused over the widest ranges.—Researches on the mechanism of respiration in the Myriapods, by M. J. Chalande. Most zoologists suppose that the breathing process is the same in the Myriapods as in insects; but the author's researches show conclusively that this hypothesis is absolutely erroneous. In them respiration is effected by the rhythmical movements of the dorsal vessel, the air also penetrating by diffusion to the most delicate tracheæ.—On the age of the Bauxite formation in the south-east of France, by M. L. Collot. This formation, which in the Ariège district occurs between the Coralline and Urgonian deposits, is referred to the successive geological epochs between the Lower Lias and the Urgonian.—On the partial results of the first two experiments made to determine the direction of the North Atlantic currents, by Prince Albert of Monaco. Of the 169 floats cast overboard 300 miles north-west of the Azores in 1885, fourteen have been recovered, showing a general south-easterly direction and a mean velocity of 3·83 miles per twenty-four hours. Of the 510 floated in 1886 much nearer to the French coast, nine have reappeared, showing nearly the same direction, with velocities of from 5·80 to 6·45 miles.—Coincidence of certain solar phenomena with the perturbations of terrestrial magnetism, by M. E. Marchand. A comparative study of the solar observations made at the Lyons Observatory in 1885-86 with the curves of the Mascart magnetic recorder shows that there exists a direct relation between the terrestrial magnetic disturbances and the displacements of certain solar elements accompanying the spots and the faculæ.—On the actual value of the magnetic elements at the Parc Saint-Maur Observatory, by M. Th. Moureaux.—Note on the recent minimum of the solar spots, by M. A. Riccò. This minimum, which occurred between October and December, 1886, was specially remarkable for its intensity, no spots or pores being at all visible twice for eleven days and once for eight days during that period.—Remarks on the geological chart of Lake Baikal and the surrounding district, by M. Venukoff. A careful study of this map, drawn to a scale of 1 : 420,000, shows that the Baikal basin is not a *crevasse* in the Jurassic beds, as had been supposed, nor a subsidence due to plutonic or volcanic causes, but that its formation dates from pre-Silurian times and is still in progress.

## BOOKS AND PAMPHLETS RECEIVED

Practical Zoology: Marshall and Hurst (Smith, Elder).—The Garner, vol. i. (Bowers, Walworth).—Massachusetts Institute of Technology—Twenty-second Annual Catalogue of Officers and Students, and President's Report (Boston).—Folk-Lore and Provincial Names of British Birds: Rev. C. Swainson (Stock).—Flora of Leicestershire (Williams and Norgate).—Journal of the Franklin Institute, January.—Transactions of the Yorkshire Naturalists' Union, Parts 7, 8, 9 (Taylor, Leeds).—Precious Stones in Nature, Art, and Literature: S. M. Burnham (Trübner).—Health at Schools: Dr. C. Dukes (Cassell).—Deviation of the Compass in Iron Ships: W. H. Rosser (Imray).—Sonnets on Nature and Science: S. Jefferson (Unwin).—Logia of the Lord; Historical Jesus; Paul the Gnostic Opponent of Peter; Devil of Darkness: G. Massey.—Report of Kew Observatory Committee for the Year ending December 31, 1886 (Harrison).—Explication des Taches du Soleil: M. Delauney (Paris).—Elementary Ideas, Definitions, and Laws in Dynamics: E. H. Hall (Cambridge, Mass.).—Studien über das Molekular-volumen einiger Körper: G. A. Hagemann (Friedländer, Berlin).

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