sufficient grounds for regarding the *Hatteriidæ*, with the single genus *Sphenodon*, as a different family.

Dr. Credner's paper also contains, incidentally, information on *Proterosaurus*, the structure of which is still, in spite of Prof. Seeley's recent investigations, very imperfectly known. In an example preserved in Freiberg, the author has discovered the interclavicle and clavicles, the former element closely resembling the same in *Palæohatteria*, whilst the latter is distinguished by its plate-like proximal expansion, which bears special resemblance to the so-called lateral pectoral plates of certain Stegocephalians. It appears almost certain that *Proterosaurus* was a Rhynchocephalian, but in many respects more specialized than *Palæohatteria*, intercentra being present only between the anterior cervical vertebræ, and the tarsus containing only six elements—three in the proximal and three in the distal row. G. A. BOULENGER.

THE SPECTRUM OF THE RINGS OF SATURN.

AN interesting note on the spectrum of Saturn's rings was communicated to the Royal Society on February 7 by Mr. Norman Lockyer. It has long been known that the rings are considerably more luminous than the planet, and the photographs by the Brothers Henry show that this is truer for the blue light than the more visible rays. It is therefore possible that they shine partly by their own light, and since it is now universally acknowledged that they consist of small bodies in motion, their spectrum has an important bearing on the meteoric hypothesis. Mr. Lockyer suggested that the additional luminosity might be due to collisions, and in order to determine whether the collisions were of sufficient intensity to produce incandescent vapours or not, he asked one of his assistants, Mr. Porter, to obtain a photograph of the spectrum. This was done at the Astronomical Laboratory at South Kensington, with a spectroscope having two prisms of 60° attached to the eye-end of the 10-inch equatorial. The photograph was taken with an exposure of about two hours, and shows decided indications of bright lines. Mr. Lockyer says:—"It is altogether too early to announce this as an established fact, but I think it well to send this note, in order that other observers with more powerful optical appliances and a better climate than that of London may investigate the question."

It is therefore very desirable that further inquiry should be made, both by photographic and eye observations. The bright flutings of carbon at wave-lengths 517, 474, and 564 should receive particular attention, the flutings being easily obtained for comparison from the flame of a spirit-lamp or wax vesta. Brightnesses may possibly occur also in the positions of the magnesium flutings at λ 500 and 521, the lead fluting at λ 546, and the manganese fluting at λ 558, all of which may be conveniently obtained for comparison by volatilizing the chlorides of these substances in the flame of a spirit-lamp or Bunsen burner.

It may be expected that the brightenings will be very feeble, owing to the masking effects of the more abundant solar light, so that the photographic method will probably give the best results on account of its power of integration.

In the same note, Mr. Lockyer states that "other considerations point to the possibility that bright lines or bands may be found in the spectrum of Uranus." A. F.

ON THE SPEED OF THE ELECTRIC TRANSMISSION OF SIGNALS THROUGH SUBMARINE CABLES AND LAND WIRES.

ELECTRO-TELEGRAPHIC operations for the determination of differences of longitude are usually so arranged as to furnish determinations of the speed of transmission of the electric signals. Each of two stations which are telegraphically connected is provided with a clock, and usually with a chronograph also; thus the clock-times at either station may be registered at will on the chronographs at both stations. The difference between the times indicated by the two clocks at any moment is thus readily ascertained, and two values of it will be obtained, one with the current transmitted in one direction, the other with it transmitted in the opposite direction. The difference between these two values indicates the sum of the speeds in both directions; and half the difference is usually called the "retardation on the line," as it indicates the amount by which every signal, on arrival at its destination, is slow on the time of its inception.

This method of determining the velocity is very simple and very exact; it does not require a knowledge of the errors of the clocks, or even of their rates, for the rates cannot sensibly alter in the brief interval between the signals with reversed currents, which need never exceed a few minutes.

The operations of two officers of the Indian Survey, Lieut.-Colonel Campbell, R.E., and Major Heaviside, R.E., for determining the differences of longitude between Bombay, Suez, and Aden,[1] furnish measures of the speed through two submarine cables which happen to be practically identical, though one cable was 355 knots, or as much as one-fourth, longer than the other cable. I gave the figures to Mr. W. H. Preece, of the Postal Telegraph Department, and he has found that they are very closely accordant with the theoretical speeds, calculated with due recognition of the different electrical conditions of the two cables. This is shown in the following table, in which Mr. Preece also gives the corresponding values by calculation and observation for the French Atlantic cable:—

Cable.	Length (knots).	Resistance (R) per knot.	Capacity (K) per knot.	KR per knot.	$L^2 \times KR$ per knot.	Thomson's constant, $a = 0.2332 \times KR$.	Apparatus time const. $a \times 1.55$.	Observed speed.
						sec.	sec.	sec.
Suez-Aden ...	1464	10·26	·358	3·67	7865162	·1809	·280	·280
Aden-Bombay ...	1819	6·60	·361	2·38	7874851	·1811	·281	·284
French Atlantic..	2584	2·93	·43	1·26	8413090	·196	·303	·3

For the speed of electric transmission through land lines, German geodesists have constructed an empirical formula on the assumption that the speed $= xl + yl^2$, l being the length of the line, and x and y two constants to be determined by observation. It is shown in the *Astronomische-geodätische Arbeiten* for the years 1883-84 and 1885-86, that, expressing l in kilometres,

the speed = 0·0000208s. l + 0·00000002065. l^2

on the evidence of seventeen longitudinal arcs; and that on employing this formula to calculate the corresponding speeds in six arcs subsequently measured, the values obtained were found to differ 38 per cent. on the average from the observed speeds, and were generally quicker. This formula, however, takes no account of any differences in the electrical conditions of the lines. It gives 0·206s. and 0·302s. as the speeds of transmission through land lines 2700 and 3360 kilometres long, the lengths of the cables Suez-Aden and Aden-Bombay. The formula, however, cannot be legitimately applied to such long lines, for the longest of the seventeen on which the speeds were determined by observation, that from Berlin to Paris, was only 1230 kilometres. J. T. WALKER.

13 Cromwell Road, London, April 3.

[1] See vol. ix. of the "Account of the Operations of the Great Trigonometrical Survey of India." (Dehra Dun, 1883.)