6. *If the discharge is irregular and the strata indistinct, an alteration of the amount of current makes the strata distinct and steady.* Most frequently a point of steadiness is produced by the careful introduction of external resistance; subsequently the introduction of more resistance produces a new phase of unsteadiness, and still more resistance another phase of steady and distinct stratification.

7. *The greatest heat is in the vicinity of the strata.* This can be best observed when the tube contains either only one stratum, or a small number separated by a broad interval. There is reason to believe that even in the dark discharge there may be strata, for we have found a development of heat in the middle of a tube in which there was no illumination except on the terminals.

8. *Even when the strata are to all appearance perfectly steady, a pulsation can be detected in the current; but it is not proved that the strata depend upon intermittence.*

9. *There is no current from a battery through a tube divided by a glass division into two chambers, and the tube can only be illuminated by alternating charges.*

10. *In the same tube and with the same gas, a very great variety of phenomena can be produced by varying the pressure and the current. The luminosities and strata, in their various forms, can be reproduced in the same tube, or in others having similar dimensions.*

11. *At the same pressure and with the same current, the diameter of the tube affects the character of the discharge and the form and closeness of the stratification.*

THE ROYAL SOCIETY OF EDINBURGH

THE goodly volume of the proceedings of this Society for the session 1877-78 witnesses to the zeal and success with which scientific problems, whether of general or of more specially local interest, are attacked by our northern *savants*.

The fascination in which the public mind has been held by those remarkable instruments, the telephone, phonograph, and microphone, here matures in fruitful study of them. Prominent among the researches referred to are those of Prof. Fleeming Jenkin and Mr. Ewing on the wave-forms of articulate sounds, as obtained from the phonograph (already described in our columns), and the thoughtful investigations of Dr. Ferguson on the indications of molecular action in the telephone, leading to the conclusion that at the sending-station the evidence of molecular action, though suggestive, is by no means conclusive, whereas at the receiving-station, the existence of molecular as well as mechanical action amounts to demonstration, and it is shown to be considerable in amount. Several striking observations in the same field are recorded by Professors McKendrick, Tait, and Forbes, Mr. Blyth, and others. In a paper on beats of imperfect harmonies, Sir William Thomson develops the theory of the phenomenon, and affirms (as a result of experiment) that in every case the ear distinguishes the two halves of the period of each beat, represented respectively by a sharp-topped and flat-hollowed curve and by a flat-topped and sharp-hollowed curve.

The Fourth Report of the Boulder Committee communicates many instructive facts, especially as regards transport of boulders. In his appended remarks Dr. Home shows reason for thinking that two notable spherical balls of marcasite found in the boulder clay at Leith, came from the westward, one from Campsie or Kilsyth (not less than thirty miles), the other from Humbie, nine or ten miles due west of Edinburgh. A geological study of the district indicates the agency of deep-sea currents loaded with ice, which flowed upon the Campsie Hills from the west-north-west, scooping out the present valley and breaking up, to a large extent, the coal strata in it. Thus some of the nodules in these strata would find their way to Leith, where they were embedded Several cases are noted in which boulders, to reach their present sites, must have crossed arms of the sea (*e.g.*, boulders in Staffa, at Appin, and in Loch Creran, from Mull, and others in Nairn, from Ross-shire). The high position of many boulders is explained by Prof. Judd's supposition, that in pliocene times there were mountains in Skye, Mull, Ardnamurchan, and even in Rum, some of which reached a height of at least 14,000 feet. In another geological paper Prof. Geikie traces out the limits of the different basins in which the old red sandstone of the British Islands was deposited, distinguishing the basins as Lakes Orcadie, Caledonia, Cheviot, Lorne, and the Welsh Lake. Dealing with the first alone, he examines the evidence for Murchison's three-fold arrangement of the old red sandstone (finding the middle division only in the north of Scotland), and describes the various districts of Lake Orcadie *seriatim*.

From experiments on suspension, solution, and chemical combination, Mr. William Durham concludes that these phenomena differ only in degree, and are manifestations of the same force. The attraction of chemical affinity is not, in all cases at least, exhausted when a definite compound is formed, but has sufficient power left to form solution or suspension compounds. The same force operating in chemical combination and solution, explains the powerful effects of solution in promoting chemical reaction and electric conductivity. Among chemical subjects treated, are the action of heat on some salts of trimethyl sulphine (Brown and Blackie), the action of chlorides of iodine on acetylene and ethylene (McGowan), and the crystallisation of isomorphous salts (Robinson).

In physiology, we note an extension of Prof. Rutherford and Messrs. Vignals' experiments on the biliary secretion, with reference to the action of cholagogues. The effects of fifty-two medicinal agents on the liver (of dogs) have been investigated, and the great majority of the conclusions are in complete harmony with the results of clinical observation, while many new facts are given to the physician.—Mr. Newman successfully imitates in a physical experiment, the function of the kidney.—Mr. Stirling furnishes some notes of the fungus disease affecting salmon.

A sketch is given by Mr. Edward Lang, of the arrangement of tables of ballistic curves in a medium resisting as the square of the velocity, and of the application of these tables to gunnery.

Without further enumeration, we may direct attention to some interesting accounts of that rare phenomenon, a white sunbow, witnessed at Edinburgh on January 10 last year.

OUR ASTRONOMICAL COLUMN

THE SATURNIAN SATELLITE HYPERION.—Prof. Asaph Hall has investigated the elements of this satellite, first from thirty of the best observations made at Washington in 1875, and again from thirty observations by Mr. Lassell at Malta, in 1852-53. In the former case the approximate elements in *Astron. Nach.* No. 2137 were used in the calculation of equations of condition, which were solved by the method of least squares. The resulting orbit is as follows :—

Passage through perisaturnium, 1875, Oct. 27·8380 Greenwich M.T.

Perisaturnium	172 59·7	For 1875,82.
Ascending Node ...	120 12·0	Referred to the plane
Inclination	6 12·1	of the earth's equator.
Excentricity	0·11885	
Semi-axis major	216″·56	

Assuming these values for the node and inclination, Mr. Lassell's observations were discussed and gave the elements :—

Passage through perisaturnium, 1852, Nov. 17·5208 G.M.T.

Perisaturnium	... ...	240° 10′·9
Excentricity	... ...	0·12011
Semi-axis major	...	217″·05

It will be seen that the position of the perisaturnium had undergone a great change in the interval between the above epochs: the rapid motion of the line of apsides has been known for some time past to those who have attempted the determination of elements of Hyperion. Prof. Hall had at first supposed this motion direct, but he now adopts the smaller retrograde motion, and so finds for the motion of the line of apsides in a Julian year,—2°·92862. If we assume that 394 revolutions of the satellite had been performed in the interval between the epochs (8379·3172 days), the anomalistic period is found to be 21·2673026 days.

Prof. Hall thinks that the next step must be the calculation of the action of the great satellite Titan on the motion of Hyperion, a work which he hopes to be able to undertake. Not only is there a near approach of the orbits of the two bodies, but it would appear that Hyperion is moving in a larger orbit, than would correspond to the assigned period and Bessel's mass of Saturn. There is a probability that the approximation of the two satellites may be, at certain times, very close indeed. If we bring up Bessel's elements of Titan to 1875, and compare them with the above elements of Hyperion for the same year, we find an exceedingly near approach of the two bodies, when the position of the perisaturnium of Hyperion corresponds to that of maximum distance of Titan, and though uncertainty in the elements may affect the result, it is sufficiently evident that the motion of Hyperion cannot be followed satisfactorily without a knowledge of the action of Titan. Prof. Hall remarks that in 1882 it may be possible with the Washington refractor to follow Hyperion completely round its primary, as was done by Mr. Lassell at Valetta in 1852, and that from that time until 1888 it should be carefully observed.

THE OXFORD UNIVERSITY OBSERVATORY.—The report of the Savilian Professor of Astronomy, as Director of the University Observatory at Oxford, has been issued, for the year ending on the 4th of the present month. The 12½ inch refractor has been in constant use in the determination of accurate positions of about 40 stars in the Pleiades, partly with the view of ascertaining the proper motions by comparison with the observations of Bessel half a century ago, and partly with the intention of comparing the micrometrical measures with those of the costly heliometer. The results will appear in Part II. of the Oxford Observations, and we may remark that the Savilian Professor will have a recent standard for comparison in M. Wolf's elaborate work on the Pleiades, (*Description du Groupe des Pleiades* in the Paris *Annales*, t. xiv.), to which he has not made allusion in the report. The De la Rue reflector has been employed in taking photographs of the moon, and nearly three hundred have been secured. With the view of ascertaining how far these photographs can be relied upon for accurate measurements, micrometrical measures of the shadows of several prominent lunar mountains were made with the refractor, simultaneously with the taking of photographs with the reflector; the latter being then measured in the De la Rue engine, it was found that the telescopic and photographic results were in close accordance, indeed within the limits of the unavoidable errors of observation. The Professor adduces a still further proof of the reliability of celestial photography in this direction, in the close accordance of the moon's semi-diameter, as measured and computed from sixteen of the Oxford photographs with Hansen's value adopted in the *Nautical Almanac*; the difference is only 0″·12. Amongst the other miscellaneous work of the Observatory during the past year, the periodical comets of Tempel (1873 July) and Brorsen have been well observed. In the Lecture Room discourses have been delivered on the Astronomy and Astronomical Instruments of Ptolemy and Hipparchus, on the Physical Libration of the Moon and on Solar Physics.

The obligation under which this institution remains to the great liberality and scientific spirit of Dr. De la Rue is well known. The salary of the photographic assistant has been defrayed by him during a period of four years, this subsidy, a most important one to the rising Observatory, terminating in December next. The necessary provision for the future effective conduct of the Observatory is under the consideration of the University Commissioners, subject to the final judgment of Convocation. It is suggested by the Savilian Professor in his report, that for the next few years a sum of 600*l.* annually may suffice to cover all necessary expenses. The desirability of an early publication of results, in the actual state of Astronomical Science, appears to be fully appreciated in the Oxford establishment: part I. of the Observations containing the work to December 1877 was published in the spring of 1878.

A NEW COMET.—A pretty bright telescopic comet was detected, apparently on the 16th inst., by Mr. Lewis Swift, of Rochester, N.Y. Prof. Winnecke observed it at Strasburg on June 21, and found its position at 11h. 38m. 46s. mean time in R.A. 2h. 47m. 31·1s., Decl. 64° 29′ 5″; daily motion in R.A. trifling, that in Decl. about one degree towards the north; diameter about three minutes.

GEOGRAPHICAL NOTES

AT the meeting of the Royal Geographical Society on Monday evening, after a feeling allusion by the Earl of Northbrook to the loss sustained by the Society by the death of Mr. R. B. Shaw, British Resident at Mandalay, who was well-known for his excellent geographical work in Eastern Turkistan, &c., some reports were read which had recently been received from Mr. Keith Johnston, the leader of the East African Expedition. The first was an exceedingly interesting account of his preliminary trip from Zanzibar to the Usambara Hills, and the second was a memorandum of information obtained regarding routes between Dar-es-Salaam and the north end of Lake Nyassa. It is no exaggeration to say that the latter document contained more real geography than many travellers contrive to collect in the course of a long journey, and it confirms the impression that Mr. Johnston, if he be spared, will, on his return from the interior, furnish us with a most admirable and accurate account of the country traversed, the greater part of which is at present absolutely unexplored. The Secretary afterwards read letters from Mr. Johnston and Dr. Kirk, H.M.'s Consul-General at Zanzibar, announcing the final start of the expedition for the interior, under the most favourable circumstances. Mr. Johnston has with him one European assistant and 138 porters, who have been carefully selected with the aid of Chuma, Livingstone's old follower, who also accompanies the party.

THE last sitting of the Geographical Society of Paris, was devoted to a lecture given by M. Cosson to prove (1) that M. Roudaire's contemplated Algerian sea would not improve the climate of the Sahara; (2) that in case any alteration were possible it would be detrimental to the health of the inhabitants; (3) that it would create dissatisfaction amongst the Tunisian and Algerian tribes, and even Algerian colonists; and (4) that it would have no effect in attracting to Algiers the trade of the Soudan. Commander Roudaire not having been invited to answer the charges proffered against his scheme the discussion was adjourned, but several members warmly protested against the assumption brought forward by M. Cosson, and tried to rebut his assertions.

CAPTAIN R. H. NAPIER, R.N., has communicated some useful hydrographic notes to the Hong Kong