articles likely to be interesting and useful both to beginners in photography and to advanced practitioners.

THE Severn Fishery Board has issued an Almanac for the year 1887, which is intended to show the law as to fishing in the Severn fishery district, and to indicate to water-bailiffs, fishermen, and others interested in fishing, what they may look for in different months of the year. The information on which the statements in the Almanac are based was collected by the Board's officers.

THE seventh volume of the Transactions of the Sanitary Institute of Great Britain, 1885-86, presents a full report of the proceedings of the Congress of the Institute held at Leicester from September 22 to 26, 1885. The papers read at the Congress were divided into three sections—(1) Sanitary Science and Preventive Medicine; (2) Engineering and Architecture; (3) Chemistry, Meteorology, and Geology. Mr. John F. J. Sykes, Honorary Secretary for the first section, recommends that a special day, or part of a day, should be devoted to the consideration of domestic sanitation and ambulance. In both of these subjects ladies take great interest, and Mr. Sykes is of opinion that his suggestion, if adopted, would add immensely to the success of future Congresses.

THE amount of the rainfall at Ben Nevis Observatory during 1886 was 107·85 inches, the greatest monthly fall being 14·57 inches in November, and the least 2·84 inches in February. In 1885 the annual rainfall was (see vol. xxxiii. p. 347) 145·50 inches, the largest monthly fall being 24·33 inches, and the least 4·97 inches, the rainfall of 1886 being thus very much less.

WE understand that complaints have been made to the Fishery Board for Scotland that steam-vessels have been recently prosecuting beam-trawling overnight in the waters closed by the Board's by-law against this mode of fishing. Some time since the Board instituted legal proceedings against parties who had infringed the by-law, some of whom were fined, and they also posted placards at the different harbours and creeks in the prescribed waters giving notice of the terms of the by-law, and it was hoped that the illegal practice would have been thereafter discontinued. The Board's cruiser *Vigilant* has done what she could to protect these waters, but owing to her being a sailing-vessel she cannot do this so effectively as a vessel with steam power. In the circumstances the Board have instructed H.M.S. *Jackal*, at present cruising on the west coast, at once to proceed to the east coast and protect the inclosed areas there, as well as to take a general superintendence of the fisheries. The prescribed waters include the Firth of Forth, St. Andrews Bay, and Aberdeen Bay. The present *Jackal* is a new, powerful, and swift vessel, and is provided with the electric light, which will enable her to sight vessels at a considerable distance on dark nights. The Board's cruiser *Vigilant* will at once proceed to the west coast and take up fishery duty there, assisted by H.M.C. *Daisy* tender.

THE Report of the Swiss Commission for the Reform of Gymnasial Instruction has just been issued. The Commission recommend that the teaching of Latin shall begin in the fifth class, and shall be continued, for five hours weekly, up to the highest class; that instruction in Greek shall depend upon the expressed desire of parents or guardians, and shall begin in the fourth class; and that all scholars who do not learn Greek shall learn either English or Italian. Two spare hours gained by pupils in English or Italian are to be spent in the study of natural science and mathematics.

MR. EDISON, the electrician, of New York, is reported to be seriously ill.

THE additions to the Zoological Society's Gardens during the past week include two Barn Owls (*Strix flammea*) from South Africa, presented by Mr. E. Hume; a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. W. S. Rawlinson; two Eyed Lizards (*Lacerta ocellata*), European, deposited; four Bramblings (*Fringilla montifringilla*), British, purchased.

OUR ASTRONOMICAL COLUMN

THE SIX INNER SATELLITES OF SATURN.—Appendix I. to the volume of Washington Observations for 1883 contains an important memoir by Prof. Asaph Hall on the orbits of the six inner satellites of Saturn. Of these, the two innermost have been known to us about 100 years, but the other four for more than 200. Owing, however, to the difficulty of making accurate observations of them, their orbits were but rough approximations until the publication of Bessel's work on the orbit of Titan, which appeared in vols. ix. and xi. of the *Astronomische Nachrichten*, and from which that value of the mass of Saturn was derived which has been generally used up to the present time in computing the perturbations produced by this planet. Bessel likewise commenced, but did not live to complete, a memoir on the "Theorie des Saturns Systems," of which Prof. Hall justly remarks that it "is still the most comprehensive investigation we have of the differential equations of this system, and of the various forms of the perturbative function arising from the figure of the planet, the ring, the action of the satellites on each other, and the action of the sun." M. Tisserand has shown, however, in a short but important paper, "Sur le mouvement des absides des satellites de Saturne et sur la détermination de la masse de l'anneau," that Bessel's determination of the mass of the ring from the motion of the line of apsides of the orbit of Titan was seriously in error, since he neglected the influence of the figure of the planet. We were, therefore, ignorant of the true value of the mass of the ring, but if the inner satellites moved in orbits which were decidedly eccentric, so that the motions of the lines of apsides could be accurately determined, the mass of the ring and figure of the planet could be deduced. It was therefore a matter of great interest to determine these orbits as accurately as possible; and Prof. Hall therefore undertook the observation of those satellites with the great refractor of the Naval Observatory, Washington. The observations of Titan, given in Prof. Hall's paper, were made at Washington during the eleven years, 1874 (in which year Prof. Newcomb observed the satellite) to 1884. During the years 1875, 1876, and 1877, Prof. Hall observed differences of R.A. and declination of Saturn and Titan at the same time and in the same manner as he observed Iapetus, to which satellite he found the method well adapted. Rhea, Dione, and Tethys were observed by Prof. Newcomb in 1874 and by Prof. Hall in 1875, whilst for Mimas and Enceladus observations extending over the years from 1874 to 1879 have been used. In the reduction of the observations of Rhea, Dione, and Tethys, the observed places have been compared with places computed from the elements for these satellites given by Dr. W. Meyer, of Geneva, and corrections to his elements are deduced therefrom. The corrected orbits show in each case a practically insensible eccentricity, and the observations of Mimas and Enceladus also can be satisfied within the limits of their probable errors by circular elements. Prof. Hall, however, draws attention to the fact that for the three innermost satellites the eccentricity of the orbit, and consequently the position of the line of apsides, cannot be determined with any certainty from the observations at his disposal. Some more accurate method of observation than that of the filar micrometer should be adopted; possibly observing the conjunctions of the satellites with the ends of the ring, the Cassinian division, and with the sides of the ball, might prove more efficient. A heliometer, if one existed of sufficient aperture, would probably furnish the most satisfactory means of all.

The orbits of the five inner satellites being thus sensibly circular, any consideration of the motions of their lines of apsides is placed out of the question. These five satellites also appear to move in the plane of the ring. It is therefore easy to furnish tables of their motions, and Prof. Hall supplies them for the period 1875-1950, together with the elements of the ring, at the close of his paper. For the mass of Saturn, from the motions of Titan, Rhea, Dione, and Tethys, he finds the reciprocal to be $3478{\cdot}7 \pm 1{\cdot}10$. The best previous determinations have been

as follows:—Bessel 3501·6, Leverrier 3529·6, Meyer 3487·45, and Prof. Hall, from the motion of Iapetus, 3481·3 ± 0·54.

Prof. Hall carefully searched for additional satellites moving in the remarkable gaps between Rhea and Titan, and Hyperion and Iapetus, but without result.

STELLAR PARALLAX.—The second Appendix to the Washington Observations for 1883, contains a second memoir by Prof. Asaph Hall, not less interesting and valuable than the above. It will be remembered that Prof. Hall published a volume in 1882, containing determinations of the parallaxes of Vega and 61 Cygni from observations made by himself with the great 26-inch refractor at the Washington Observatory. Prof. Peters, of Clinton, U.S.A., has since pointed out to Prof. Hall that the temperature correction to his observations had been applied with the wrong sign. Prof. Hall has therefore now reduced his observations afresh, and given a new solution of the equations of condition. For 61 Cygni, Prof. Hall now finds a parallax of 0″·270 ± 0 0101 from 101 observations extending from October 24, 1880, to January 26, 1886. This value is notably smaller than he obtained before, viz. 0″·4783, or than most other investigators have deduced. Thus Sir R. S. Ball had found 0″·4756, Auwers 0″·564, and Struve, Woldstedt, and others values closely according. Prof. Hall appears, however, satisfied with his results, and it should be remembered that Dr. C. A. F. Peters obtained 0″·349 for his absolute value of the parallax, the others being only relative parallaxes. Prof. Hall's value for Vega is also rather small, viz. + 0″·134 ± 0·0055 from 128 observations, but agrees very much better with other modern determinations; Brünnow in 1869 from the same comparison-star, but by measures of distance and position, and not of differences of declination only, having obtained $\pi = 0''\cdot212 \pm 0''\cdot0098$. Prof. Hall also attacked the parallax of two other stars, 6 (Bode) Cygni, the parallax of which has recently been determined at Dunsink, being one, and the curious star 40 (o^2) Eridani the other. For the former he finds a negative value, whereas Sir R. S. Ball gave $\pi = + 0''\cdot422 \pm 0''\cdot054$, but only as a "merely provisional" value. The parallax obtained for 40 Eridani, $\pi = + 0''\cdot223 \pm 0''\cdot0202$ is in fairly close agreement with Dr. Gill's, viz. $\pi = 0''\cdot166$. In the early part of this important paper Prof. Hall gives a full discussion, in his usual thorough and painstaking manner, of the value of a revolution of the micrometer-screw employed in the observations.

ASTRONOMICAL PRIZES OF THE ACADEMY OF SCIENCES. The Paris Académie des Sciences have decreed the Lalande Prize to M. O. Backlund for his labours on the motion of Encke's comet; the Valz Prize to M. Bigourdan for his researches on personality in the observation of double stars; and the Damoiseau Prize, for the revision of the theory of the satellites of Jupiter, to M. Souillart, with an *encouragement* to M. Obrecht of a thousand francs from the Damoiseau fund.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 JANUARY 16-22

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 16

Sun rises, 8h. 1m.; souths, 12h. 9m. 58·8s.; sets, 16h. 19m.; decl. on meridian, 20° 56′ S.: Sidereal Time at Sunset, 0h. 2m.

Moon (at Last Quarter) rises, 23h. 47m.*; souths, 5h. 41m.; sets, 11h. 24m.; decl. on meridian, 4° 14′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	7 23	11 13	15 3	23 55 S.
Venus	8 39	12 55	17 11	19 54 S.
Mars	9 4	13 42	18 20	16 24 S.
Jupiter... ...	1 23	6 27	11 31	11 42 S.
Saturn... ...	15 29	23 35	7 41*	22 1 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

Jan.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
16 ...	65 Virginis ...	6	2 5	3 5	61 193
16 ...	66 Virginis ...	6	2 48	3 57	44 221
16 ...	l^2 Virginis ...	5	7 44	8 35	44 318
16 ...	21 ...	Mars at least distance from the Sun.			
17 ...	3 ...	Jupiter in conjunction with and 3° 40′ south of the Moon.			
17 ...	4 ...	Mercury at greatest distance from the Sun.			

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
U Cephei	0 52·3	81 16 N.	... Jan.	16, 23	2	*m*
			,,	21 22	40	*m*
Algol	3 0·8	40 31 N.	... ,,	16, 2	41	*m*
		and at intervals of		2 20	48	
λ Tauri	3 54·4	12 10 N.	... Jan.	16, 22	48	*m*
			,,	20, 21	41	*m*
δ Libræ	14 54·9	8 4 S.	... ,,	20, 2	42	*m*
U Coronæ	15 13·6	32 4 N.	... ,,	20, 21	39	*m*
W Herculis... ...	16 31·2	37 34 N.	... ,,	18,		*m*
U Ophiuchi... ...	17 10·8	1 20 N.	... ,,	20, 2	44	*m*
		and at intervals of		20	8	
β Lyræ...	18 45·9	33 14 N.	... Jan.	22, 21	0	m_2
δ Cephei	22 25·0	57 50 N.	... ,,	18, 23	0	*M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers

Near γ Orionis, R.A. 72°, Decl. 4° N. From Coma Berenices, R.A. 181°, Decl. 35° N.; swift streak-bearing meteors. Near χ Cygni, R.A. 295°, Decl. 53° N.; somewhat slow meteors.

GEOGRAPHICAL NOTES

THE opinions of Dr. Junker, who is now in Cairo, as to the best route by which to reach Emin Pasha do not help us much. Indeed, Dr. Junker does not commit himself further than to suggest that by the shortest route, through Masai Land, there would be difficulties as to food. Not more, we are inclined to think, than by any other route. Mr. Thomson passed through the country at an exceptionally bad time, when the cattle of the Masai were dying by hundreds from disease. The country is one of the richest game regions in Africa, and by any route an expedition must, as far as possible, be independent of local supplies. For an expedition of hundreds of men to attempt to cross the Victoria Nyanza in boats would be extremely hazardous. Meantime it is evident both from what Dr. Junker says and from the letter of Mr. Ashe, who has just returned from Uganda, that Emin Pasha is in an exceedingly perilous condition, and that every week's delay risks his life and the lives of those who are with him, for he has no ammunition. We hear, on good authority, that Mr. Stanley has decided to go by the Masai Land route; if so, it seems a pity that the only white man who has explored this route will not be in the expedition.

IT is said that great administrative changes are about to be made in Russian Central Asia. According to the St. Petersburg Correspondent of the *Times*, the whole system of arbitrary military mixed with native government, formerly considered necessary for high political purposes of further conquest, is to be gradually modified and almost abolished by the introduction of Russian civil administration and justice, and the subordination of the various departments to the Ministers in St. Petersburg. There is a proposal that Turkestan and the new Transcaspian province should be amalgamated, the reason alleged being that they will be closely connected by the Transcaspian railway, which, after passing through Bokhara, will terminate at Tashkend. The Transcaspian province will therefore, it is considered, be nearer to Turkestan than to the Caucasus. The scheme is said to have been suggested by General Rosenbach, the Governor-General at Tashkend. It is opposed by General Shepeleff, Director of the Chancery of the Governor-General of the Caucasus, who is of opinion that it would be highly inconvenient to remove the Transcaspian further from the control of the central Government, and that, if alterations are considered necessary, it would be better to make the newly-acquired territory an independent province.

ACCORDING to the *Novoe Vremya*, the trading caravan lately despatched by the Central Asian Commercial Company Koudrine has passed through Kashgar and entered Tibet. This company is likely to play an important part in Central Asia. It has established permanent agencies at Merv and Askabad and in the Persian cities of Kutchan and Meshed, and now it proposes to do the like in Tibet. It has received from the Ameer of