British Central Africa, presented by Captain C. F. Beeching; a Raven (*Corvus corax*) British, presented by the Rev. F. C. A. Barrett; a European Pond Tortoise (*Emys orbicularis*), European, presented by Miss W. Fenwick; a Common Marmoset (*Hapale jacchus*) from South-east Brazil, a Burchell's Zebra (*Equus burchelli*), born in the Menagerie, deposited; two Red Foxes (*Canis fulvus*) from Canada, a Black Woodpecker (*Picus martius*), a Hoopoe (*Upupa epops*), four Little Ringed Plovers (*Ægialitis curonica*), European, purchased.

OUR ASTRONOMICAL COLUMN.

THE CAUSE OF THE PROPER MOTIONS OF STARS.—When the parallax of the star 1830 Groombridge is considered in connection with the large proper motion of seven seconds of arc per annum, the conclusion is arrived at that the star is moving through space with a velocity which probably exceeds two hundred miles per second. In his "Popular Astronomy," Prof. Simon Newcomb briefly discussed the problem of stellar dynamics involved in this enormous velocity. He showed that if the universe be considered of such an extent that light would take 30,000 years to cross it, and if it contained one hundred million stars, having, on the average, a mass five times the mass of the sun, the gravitational attraction of a universe thus constituted would only be sufficient to give a velocity of twenty-five miles per second to a body drawn from infinity to the centre of the system of masses. The calculated limit is thus only about one-eighth the velocity deduced from the observed proper motion and parallax. Prof. Newcomb therefore concluded: "Either the bodies which compose our universe are vastly more massive and numerous than telescopic examination seems to indicate, or 1830 Groombridge is a runaway star, flying on a boundless course through infinite space with such momentum that the attraction of all the bodies of the universe can never stop it."

A new contribution to this inquiry was read recently before the American Philosophical Society by Mr. Luigi d'Auria. The object of the investigation was to determine whether, assuming the interstellar ether to possess the virtue of gravitational attraction, the force exerted by it would be sufficient to account for the proper motions of stars, and especially of the flying star 1830 Groombridge. In this paper it is shown that, "given the ether the density as estimated by Maxwell, and the power of attracting matter by gravity, a body placed within the sphere of ether containing all the stars of the visible universe, and at a distance from the centre of such sphere equal to that passed over by light in 2200 years, would pass this centre with a velocity equal to that of the star 1830 Groombridge, taking into account the attraction of the ether alone; and such body would oscillate about the same centre, rectilinearly, with a period of a little over *seven million* years, which would be also the period of oscillation of every other star." Mr. d'Auria recognises that some other, and unquestionable, cause may eventually prove to be responsible for stellar proper motions, nevertheless he thinks his results are worth putting on record.

NEW DETERMINATION OF THE SOLAR CONSTANT.—A fresh contribution to our knowledge respecting the sun's heat appears in the *Memorie della Società degli Spettroscopisti Italiani*, vol. xxvi., 1897, where Dr. G. B. Rizzo describes a series of observations for determining the solar constant, made at the station "Regina Margherita" on Monte Rosa. The apparatus used was a slight modification of Ångström and Chwolson's; the sun's rays being received on two brass discs attached to thermometers, which were alternately exposed and protected by two aluminium screens so arranged that when one disc was covered the other was exposed. To determine the quantity of solar heat absorbed per unit area per unit time, the formula of Chwolson was employed. Owing to the unsettled weather in September last, when the observations were made, the results were found at times to fluctuate considerably. In determining the solar constant or quantity of heat (measured in calories per minute) incident normally on a square centimetre at the earth's distance from the sun, it is necessary to assume some law for the effect of atmospheric absorption at the place of observation. Dr. Rizzo finds that the formulæ of Forbes and Crova for this purpose, when applied to his present observations, give for the solar constant the respective values 3·133 and 4·934. Both these values are somewhat in excess of the average of previous observations, but the divergence between them renders further investigation desirable.

THE DIAMETERS OF JUPITER AND HIS SATELLITES.—Herr Leo Brenner communicates to the *Astronomische Nachrichten* (No. 3444) the results of recent measures, made by him at the Manora Observatory, of the widths of the various bands and belts on Jupiter, and the angular diameters of the planet and its four large satellites. The following are the results of the measurements of diameters, reduced to mean distance:—

	Equatorial diameter.	Polar diameter.	Oblateness.
Jupiter	38″·539	36″·134	1 : 16·024
Satellite I.		1·060	
Satellite II. ...	1·063	0·958	1 : 10·123
Satellite III. ...	1·704	1·504	1 : 8·52
Satellite IV. ...	1·550	1·345	1 : 7·568

ACTION OF JUPITER AND SATURN UPON ENCKE'S COMET.—In a memoir which will shortly appear, M. A. Lebeuf gives formulæ for calculating secular inequalities when the mutual inclinations of orbits, and the eccentricity of the orbit of the disturbed body, are known. The formulæ are applied by M. Lebeuf, in the *Bulletin Astronomique*, to determine the secular inequalities of the elements of the orbit of Encke's comet in consequence of the action of Jupiter and Saturn. The values obtained are tabulated below:—

Elements of orbit.	Secular inequality due to Jupiter.	Secular inequality due to Saturn.	Simultaneous action of Jupiter and Saturn.
$\frac{de}{dt}$	+ 1″·38	+ 0″·2	+ 1″·40
$\frac{di}{dt}$	− 25·6	− 0·45	− 26·1
$\frac{d\Omega}{dt}$	− 35·9	− 0·85	− 36·8
$\frac{d\omega}{dt}$	+ 28·3	+ 0·66	+ 29·0
$\frac{d\epsilon}{dt}$	− 133·6	− 3·04	− 136·6

It is pointed out that the large eccentricity of Encke's comet, and the small distance of the comet from Jupiter, makes the use of the formulæ difficult in the case of Jupiter; but the results seem to justify their application to the case of Saturn.

PHASE-CHANGE OF LIGHT ON REFLECTION AT A SILVER SURFACE.

A LIGHT wave, when reflected[1] at the surface of separation of two media, may be altered in amplitude, or wave-length, or phase. Whilst, however, a change of amplitude or wave-length produces an obvious difference between the incident and reflected light, the existence and nature of a change of phase can only in general be inferred from the result of some kind of interference experiment. Thus the fact that a very thin transparent film is black when viewed by reflected light leads to the conclusion that a light wave is altered in phase by half a wave-length on reflection, either at a denser or at a rarer medium. Mechanical analogies suggest that the change probably takes place at the denser medium; and an experiment of Lloyd's, in which coloured fringes with a black centre were obtained by the interference of two beams of light, one directly transmitted, and the other reflected from a glass mirror, led to the same conclusion.

Jamin's experiments on metallic reflection showed that when light is reflected from a silver surface a phase-change is produced, and, moreover, that this change is different according as the light is polarised in, or perpendicular to, the plane of incidence. His experiments led to the determination of the

[1] The term "reflection" is here used in its most general sense, to include such phenomena as phosphorescence, &c.