held at 3, St. John's Terrace, Buckhurst Hill, at seven o'clock on Saturday next, the 28th inst. The paper and the discussion thereon will have special reference to the Club's projected explorations at Grays, Purfleet, and Tilbury. Archæologists and others interested in these mysterious relics are invited to attend the meeting.

THE *New Zealand Times* of September 1 contains an account of the presentation of degrees at Wellington in connection with the New Zealand University examinations. The chair was occupied by Dr. Hector, Vice-Chancellor, who said it had been decided by the Synod of the New Zealand University that the presentation of degrees should in future be made in public. The Chancellor being unable to be present, the duty of presenting the degrees had been deputed to him. The New Zealand University had been in operation since 1870, and there had been 155 graduates, of whom forty-nine had taken degrees. This might appear a small result, but the object of the University was to raise the standard of education, and this had been done. The system of scholarships had been continued with the University course, and a large portion of the funds had been spent in this way. For some time past the examiners had been appointed in London, and the degrees granted had a value, in the eyes of the outer world, equal to those granted by the London University. Owing to its charter, the New Zealand University could not grant degrees for science, but there was every prospect that the barrier would soon be removed. Dr. Hector then referred to the disaffiliation of Wellington College, which has been converted into a high school for secondary education. The step, he said, was necessary in order that they might get a University College.

A CURIOUS project in the way of recreation, by M. Joyeux, is published in *La Nature*. Suppose a large circular wooden chamber, lit from above, but giving no view of outer objects from within, and rotated smoothly and rapidly on a vertical axis. A person standing in it would have to bend his body towards the centre, by reason of centrifugal force, and the more so the further he might be from the centre and the higher the speed. M. Joyeux supposes he would be subject to the illusion that the floor was inclined upwards from his position to the centre; if he had to place himself at an angle of 45°, the floor would seem inclined at this angle, and a person standing in the corresponding place on the opposite side would seem horizontal, for he, too, would have to make an angle of 45°. Only at the centre would the floor seem horizontal; and if a number of persons were in the chamber, it is only there one would see them in their real positions. A person walking round the circumference would seem to be at the outside of the base of a cone, which turned under him. To facilitate the position of persons, M. Joyeux would make the floor, not horizontal, but inclining upwards at a certain distance from the centre. M. Tissandier does not feel certain that the illusions described would actually occur, but regards the scheme as an attractive curiosity. The apparatus is named a *plagioscope*.

IN a recent paper to the Belgian Academy, M. van der Mensbrugghe seeks to explain the calming influence of oil on rough water, in accordance with the principle he has laid down, that whenever a liquid mass in motion acquires rapidly a free surface, more or less, there is developed a growing quantity of potential energy at the expense of the kinetic energy of the mass; and reciprocally to a rapid diminution of free surface corresponds always an increase of kinetic energy. Oil hinders the successive superposition of liquid layers, and so, the increase of the kinetic energy of the liquid mass. Floating bodies of various kinds (branches, sea-weed, ice-crystals, &c.) have a like action; immediately after the gliding of a very small number of liquid layers over them they obey the thrust that brings them to the surface, and so render impossible the increase of kinetic energy corresponding to loss of potential energy of a large number of superposed layers.

IT has been observed by M. Fredericq (*Bull. Belg. Acad.*) that the blood of crabs and other crustaceans at Ostend has the same strong and bitter taste as the sea-water, and proves to have the same saline constitution. Crabs in brackish water, on the other hand, have a less salt blood, and the crayfish of rivers have very little of soluble salts in their blood. An exchange of salts seems to take place, in these animals, between the blood and the outer medium, producing approximate equilibrium of chemical composition. This probably occurs through the respiratory organ, and is according to the simple laws of diffusion. On the other hand, the blood of sea-fishes has an entirely different saline composition from that of the water; it is more or less isolated, presenting herein an evident superiority over the invertebrates referred to.

A USEFUL complement to M. Marey's recent method of applying photography to physiological experiments (in which a bright body moving before a dark screen is photographed several times in quick succession) has been supplied by M. Ch. Petit in a process which he calls *similigravure*; whereby the photographic picture is easily reproduced for insertion in a text. Two specimens are given in *Comptes Rendus* of October 2; one of them, showing the successive attitudes of a man marching at the parade step, the other, those of a white horse, with rider, leaping over an obstacle. The process is not described; but those pictures present at a glance (M. Marey points out) much that is instructive, showing, in the former case, *e.g.* the position of different parts of the body during the step (which was executed in 6-10ths of a second).

IN the October number of *Petermann's Mittheilungen* are two papers of scientific interest: one on the Geology of the Balkan Peninsula, with map, by Prof. Franz Toula; and the other on the Distribution of the Aurora Borealis in the United States, by Prof. H. Fritz.

M. LISCH, inspector of historic monuments, has recently discovered a whole Gallo-Roman town in the environs of Poitiers. It includes a temple, 14 m. long, and with 70 m. of facade, a thermal establishment covering 2 hectares, and still possessing its piscinæ, hypocausts, pipes, flagging, &c., a theatre, the stage of which is 99 m. in width; entire streets, and more than 7 hectares of buildings (the excavations are not yet finished). "It is," he says, "a small Pompeii in the centre of France." The sculptures are in the best style, and thought to date from the second century.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Mr. H. T. Hardcastle; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Miss Katie Thomason; a Common Paradoxure (*Paradoxurus typus*) from India, presented by Mr. J. Wood; a Naked-eared Deer (*Cariacus gymnotis* ♀) from Ecuador, presented by Miss Lake; an Oyster-catcher (*Hæmatopus ostragelus*), British, presented by Mr. W. R. Temple; a Maholi Galago (*Galago maholi*) from South Africa, deposited; a Ruff (*Machetes pugnax*), a Redshank (*Totanus calidris*), British, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

COMET 1882 *b* (FINLAY, SEPTEMBER 8).—The following ephemeris is deduced from the same elements as that given last week:—

At 18h. Greenwich M.T.

	R.A. h. m.	N.P.D. ° ′	Log. distance from Earth.	Sun.
Nov. 2	9 52·7	110 23	0·1700	0·1509
6	9 45·8	111 47	0·1716	0·1749
10	9 38·3	113 9	0·1728	0·1970
14	9 30·1	114 27	0·1739	0·2176
18	9 21·1	115 40	0·1751	0·2368
22	9 11·3	116 47	0·1766	0·2549

At the time we write a sufficient number of observations before perihelion passage to allow of a reliable determination of the orbit prior to the close approach to the sun, is not available.

By the way it strikes us it is about time that M. Crul's name was disassociated from this comet; if personal names are to be attached to naked-eye comets, a practice which to say the least, is inconvenient, Mr. Finlay, so far as is known at present, has the prior claim. The system generally adopted for some years, of assigning letters, *a*, *b*, *c*, &c., to comets discovered in a particular year, until their order of perihelion passage is definitely known, was, we think, an advantageous one, and its discontinuance in some quarters is a retrograde step.

COMET 1882 *c* (Barnard, September 10).—From the first observation at Harvard College on September 14, and observations by Prof. Millosevich, at the Collegio Romano in Rome, on September 22 and October 7, Mr. Hind has calculated the following elements of this comet:—

Perihelion passage 1882, November 13·0067 G.M.T.

	° ′
Longitude of perihelion	354 47·6
,, ascending node	249 8·9
Inclination	83 43·1
Logarithm of perihelion distance	9·97998

Motion—retrograde.

From these elements it appears that the comet will be observable in the southern hemisphere for some weeks after it descends below the horizon in Europe. At perihelion passage on November 13, its right ascension will be about 199°·4, with 66½° south declination, which places it near η in the constellation Musca; on December 10 it will be situate between the stars γ and η in Ara, with 58° declination, and an intensity of light one-third greater than at the first Harvard observation, and on January 9 its place will be near ε Telescopii, with one-half the intensity of light of September 14.

PONS' COMET OF 1812.—MM. Schulhof and Bossert have published a continuation of their extensive ephemerides to facilitate the search for this comet from October 28 to February 4, and for equal intervals of true anomaly from −97° 30′ to +82° 30′. By their new and complete discussion of the observations, including a series by Blanpain at Marseilles, which they discovered in the original, and which they consider the best of all, the most probable elements in 1812 were found to be as follows:—

Perihelion passage, 1812, September 15·33210 Paris M.T.

	° ′ ″	
Longitude of perihelion	92 19 48·2	Mean Equinox, 1812·0
,, ascending node	253 0 43·7	
Inclination	73 57 35·8	
Excentricity	0·9555842	
Logarithm of perihelion distance	9·8904903	

The corresponding period is 73·18 years, but the probable error of this period of revolution is ± 4·5 years. Notwithstanding this large amount of uncertainty, MM. Schulhof and Bossert have calculated the effect of the action of the planets Jupiter, Saturn, Uranus, and Neptune during the actual revolution, and find the most likely epoch of the next perihelion passage to be 1884, September 3·65, M.T. at Paris.

THE TRANSIT OF VENUS.—Mr. Marth, who has charge of the proposed station at Montague Road, Cape Colony, left for Cape Town in Messrs. Currie and Co.'s mail steamship *Conway Castle* on the 13th inst., and Mr. Talmage, of Mr. J. Gurney Barclay's observatory at Leyton, proceeded in the R. M. steamship *Nile* on the 17th for Barbados, with Lieut. Thomson, R.A., as his colleague. Mr. J. Plummer, in charge of Col. Tomline's observatory at Orwell Park, Ipswich, with Lieut. Neate, R.N., have also left for New York, on their way to Bermuda. All the British expeditions are therefore *en route*.

Brazil will furnish four stations, with similar instrumental equipment, including equatorials of 6 inches aperture. M. Cruls proceeds to a point in the Straits of Magellan, and Baron de Jeffé, of the Brazilian Navy, to St. Thomas. The other stations will be Pernambuco, and the Imperial Observatory at Rio Janeiro. M. Faye, who made a communication to the Paris Academy of Sciences on the 16th inst., in the name of the Emperor of Brazil, who takes a lively personal interest in his observatory, mentions that it is in contemplation to effect a chronometric connection of the station in the Straits of Magellan with Montevideo, an important undertaking, as viewed with reference to the telegraphic determination which the Board of Longitudes is about to execute across the American continent, from Montevideo or Buenos Ayres, to Santiago and Lima.

A SPECTROSCOPIC STUDY OF CHLOROPHYLL[1]

THE study of chlorophyll has great fascination; it also has its difficulties. We did not propose adding to the many elaborate attempts to isolate and purify this body; but the beauty and definite character of the spectrum which it gives induced us to try whether some insight into its character and constitution could not be obtained from the study of the spectroscopic changes which it can be made to undergo; and as one of us has already shown that in the case of the cobalt salts, the spectroscope enables us to follow many chemical changes, we thought that it might be possible to interpret the spectroscopic changes of chlorophyll, and so gain some knowledge of the properties and nature of this body.

The extraction of the green colouring matter from leaves was effected in most cases by breaking up the leaves in a mortar with a mixture of two parts of alcohol and one of ether. The colour of the liquid thus obtained is of a dark green, varying in shade according to the nature of the leaves used, and the solution always has the well-known red fluorescence. This liquid, when examined spectroscopically, gives what is known as the chlorophyll spectrum. According to Krauss, it consists of seven bands; the three at the most refrangible end of the spectrum are difficult, as Krauss says, to observe, and with our source of light, a gas-flame, we could see in an ordinary chlorophyll solution little or nothing of them; but under special circumstances, which will be described further on, the least refrangible of the three becomes very visible. We have confined our observations principally to the four least refrangible bands. Other solvents, such as chloroform, disulphide of carbon, benzene, &c., were used occasionally; they give a similar spectrum, but in most cases they do not dissolve the colouring matter so readily as alcohol and ether do. The ethereal solution appears always to give a clearer and more brilliant spectrum than the alcoholic solution. Fig. 1 shows the spectrum of the solution obtained as above described from the majority of the leaves we have examined.

Among common outdoor plants, the vine and the Virginian creeper may be cited as apparent exceptions, giving a different spectrum. (Fig. 2.) The second band in this case has moved towards the more refrangible end of the spectrum, the band from 589 to 573 has disappeared, and now there is a very marked band from 545 to 532. The cause of this change in the spectrum we shall explain further on.

Fig. 1 then, as far as it goes, represents the spectrum given by the alcohol and ether extract of most leaves. It is important at once to give a definite meaning to the term chlorophyll, and we would therefore state that we mean by it the body or bodies capable of giving this particular spectrum, and of course we found our conclusions on the assumption that a particular absorption-spectrum is a complete identification of a substance.

As is well known, the exact position of these bands alters with the solvent used; in all cases, when no mention is made to the contrary, a mixture of alcohol and ether is the solvent we have used. Apparently the statement that the higher the specific gravity of the solvent, the nearer are the bands to the red end of the spectrum, is not in all cases true, for we find that the chlorophyll bands are nearer to the red in carbon disulphide than in chloroform. All our observations have been made with a Dasaga's spectroscope having a single heavy glass prism, and the position of the bands is given in millionths of a meter, reduced from the observations by graphical interpolation. Capt. Abney has also been kind enough to take photographs of the different spectra, and these agree with our eye observations. They also prove that there are no bands in the ultra-red.

The first point we would note with regard to chlorophyll is

[1] By W. J. Russell, Ph.D., F.R.S., and W. Lapraik, F.C.S.