absence of macles appear to indicate the variety of chalcocite called *cuprein* by Breithaupt.

All these coins were buried in a dark brown mud, containing numerous shells, many of which have been involved in the sulphurated deposits. From analysis of a sample of the water obtained at 6·70 m. depth, it appears that, as in the thermal springs above referred to, there are no sulphides, but merely sulphates, which organic matters reduce to the state of sulphides.

The novelty in production of the chalcocite in question arises from its occurrence apart, seemingly, from thermal springs, and at a lower temperature than in the cases hitherto known.

OUR ASTRONOMICAL COLUMN

THE GREAT COMET OF 1861.—The long series of observations of this splendid comet has been very ably discussed, with the view to the determination of the most probable orbit, by Heinrich Kreutz, a pupil of Prof. Schönfeld of Bonn, and the investigation is made the subject of an inaugural dissertation in July, 1880.

The comet was discovered on May 13 by Mr. John Tebbutt of Windsor, N.S.W., but the first accurate observations for position were made at the Observatory of Sydney on May 26. On June 10 it was observed at Santiago di Chile, and on the following day at Rio de Janeiro. European observations commenced on June 30, and were continued until May 1, 1862, the later places being obtained by M. Otto Struve with the 15-inch refractor at Pulkowa: the comet was not followed at other observatories beyond February 3, when Prof. Julius Schmidt last observed it at Athens. The number of separate observations collected for the determination of the orbit exceeds 1150, and these extend, as will be seen, over a period of 11½ months, in which the comet traversed an orbital arc of more than 155°. Seeling's ellipse (period 419⅓ years) is adopted in the calculation of an accurate ephemeris for the whole extent of visibility, and the observations, freed from the effects of parallax and aberration, are compared with this ephemeris for the formation of normal places. The best available positions of the comparison-stars were previously brought to bear upon the observations, so that they have received at the hands of M. Kreutz a general revision and rectification, proportional weights being applied after a criticism of the observations at the different observatories, forty-one in number. Thus thirty-one normal positions between 1861, May 28, and 1862, April 23, were formed. The next step was the calculation of the planetary perturbations for the whole interval, and it was found that the attraction of Venus, the Earth, Jupiter, and Saturn were alone sensible; June 12 was taken for the commencement of the perturbations. The normal places being corrected for their effect, sixty-two differential equations were formed, and their solution by the method of least squares gave the definitive corrections required by Seeling's orbit, which it may be stated proved sufficiently near the truth to render provisional correction unnecessary. The orbit which the comet was describing on June 12, or about the perihelion-passage in 1861, is thus found to be as follows:—

DEFINITIVE ELEMENTS OF THE GREAT COMET OF 1861.

Perihelion passage, 1861, June 11·543949 M.T. at Berlin.

Longitude of perihelion	249° 4′ 58″·7	M.Eq. 1862·0
,, ascending node ...	278 58 53·4	
Inclination	85 26 15·3	
Eccentricity	0·9850773	
Perihelion distance	0·8223838	
Semi-axis major	55·1096±0·0330	
Period of revolution	409·40±0·367 Julian years.	

It will be remarked that the probable error of the resulting period is strikingly small.

M. Kreutz defers for the present an examination of the possible effects of planetary perturbation during the last revolution, in view of identifying the comet amongst those observed in the fifteenth century. If, however, the perihelion passage occurred in the winter it is by no means certain that the comet would be sufficiently conspicuous and favourably placed to be remarked in Europe. The following figures will afford an idea of the difficulty that would attend observations in these latitudes during the winter season. Assuming the comet to have been in perihelion twenty days earlier we have these positions for the respective dates (Eq. of 1861):—

	R.A.	Decl.	Distance from Earth.	Intensity of light.
Oct. 20 ...	239°·7 ...	−17°·3 ...	1·53 ...	0·52
Nov. 20 ...	257°·0 ...	−20°·2 ...	1·77 ...	0·39
Dec. 20 ...	274°·1 ...	−20°·8 ...	1·88 ...	0·35
Jan. 20 ...	291°·5 ...	−19°·3 ...	1·86 ...	0·36
Feb. 20 ...	308°·5 ...	−15°·8 ...	1·70 ...	0·42

In 1861, when the comet appeared as bright as a star of 4·5 mag., the intensity of light was 1·5, and it was just perceptible to the naked eye, when the intensity had descended to 0·4, but there was still a tail of 2½ degrees to distinguish it from a star, which would hardly be the case in the winter.

THE SATELLITES OF MARS.—In No. 2934 of the *Astronomische Nachrichten*, Prof. Asaph Hall has given data for ephemerides of the satellites of Mars at the opposition of 1881. The N.W. elongations take place with the following values of *u*, corresponding to the argument of latitude:—

Nov. 22 ... 331°·7	Dec. 4 ... 330°·3	Dec. 16 ... 327°·1
26 ... 331·4	8 ... 329·4	20 ... 325·8
30 ... 331·0	12 ... 328·3	24 ... 324·5

From Prof. Hall's values of *u* it will be found that true N.W. elongations of *Deimos* occur Nov. 26·4411, Dec. 1·4886, Dec. 6·5350, and S.E. elongations Nov. 24·5480, Nov. 28·3340, Nov. 29·5957, and Dec. 3·3793 Greenwich times. On November 26 the distance of *Deimos* from the centre of the primary at elongation is 48″·7.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The last report of the Higher Local Examinations shows that in Group E (Natural Science subjects) there was a falling off of ten candidates and of two first classes this year. The examiners in Geology and Zoology give a generally favourable report. In Chemistry the practical work done was inferior, and common simple salts were not known by sight. Physiological Botany was little known; and the same remarks applied to Histology in the paper on Animal Physiology. In Group D, Political Economy showed much success, especially among some of the better candidates.

Dr. Latham and Mr. D. McAlister have been appointed members of the State Medicine Syndicate; and Mr. McAlister has been also appointed a member of the Board of Medical Studies.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 17.—Sir J. Lubbock, Bart., in the chair.—Sir John Kirk, K.C.M.G., was elected a Councillor, and Mr. Frank Crisp Treasurer, in place of Mr. F. Currey, deceased.—Mr. George Murray exhibited (for Col. Turberville), a bough of *Pinus pinaster*, with suppressed internodes of the lateral branches, the result of injury to the axis from which they sprang.—De Francis Day showed examples of the stomach of the pilchard, with special reference to points in their digestion. Within the pyloric division of the stomach a membranous envelope incloses the food, the latter composed of the Zoëa stage of crustaceans. What peculiar function the sausage-shaped nerves serves in the economy of digestion is uncertain.—Mr. R. J. Lynch exhibited and read a short note on the contrivance for self-fertilisation in *Roscoea purpurea*, which to some extent resembles that of *Salvia* by modifications of anther and filament.—Sir John Lubbock, Bart., then read his ninth communication on the habits of ants, bees, and wasps. He detailed experiments proving that bees prefer blue flowers to those of other colours. But again if bees have so much to do with the origin of flowers, how is it there should be so comparatively few blue ones? Sir John suggests that all flowers were originally green, and then passed through white or yellow, and generally red, before becoming blue. Ants, he stated, may live seven or eight years.—Mr. C. B. Clarke described a Hampshire orchis not represented in English botany. This pale, flesh-coloured, or yellow orchis he demonstrates is the true *O. incarnata*, Linn., and not that figured by Syme and Babington, which is the *O. latifolia*, Linn.—Prof. Cobbold described a new entozoon from the ostrich, named by him *Strongylus Douglasii*. It is said to prove de-

structive to ostrich chicks at Grahamstown and elsewhere in South Africa. The worm somewhat resembles certain free nematodes, and bears few eggs.

Mathematical Society, November 10.—S. Roberts, F.R.S., president, in the chair.—At this, the annual meeting, the treasurer read his report, from which it appeared that the Society was in a very flourishing condition. The following gentlemen were elected on the council of the present session :—President—S. Roberts, F.R.S. Vice-presidents—Dr. Hirst, F.R.S., and J. W. L. Glaisher, F.R.S. Treasurer—C. W. Merrifield, F.R.S. Hon. Secretaries—Messrs. M. Jenkins and R. Tucker. Other members—Prof. Cayley, F.R.S., Sir J. Cockle, F.R.S., H. Hart, Prof. Henrici, F.R.S., A. B. Kempe, F.R.S., Prof. Rowe, R. F. Scott, Prof. H. Smith, F.R.S., H. W. Lloyd Tanner, and J. J. Walker. Mr. W. W. R. Ball, Fellow of Trinity College, Cambridge, and the Rev. G. Pirie, Professor of Mathematics in the University of Aberdeen, were elected Members of the Society. The following communications were made :—Note on the limit to the number of different proper fractions whose denominators are less than x, where x is large, by Messrs. Jenkins and Merrifield, F.R.S.—On the oscillations of a viscous spheroid, by Prof. H. Lamb, Adelaide.—A geometrical representation of a system of two binary cubics and their associated forms, by W. R. W. Roberts.—On the infinitesimal bending of surfaces of revolution, by Lord Rayleigh, F.R.S.—On tangents to a cubic forming a pencil in involution, by R. A. Roberts.—Note on Landen's theorem, by Prof. Cayley, F.R.S.

Chemical Society, November 17.—Dr. Gilbert, F.R.S., in the chair.—It was announced that a ballot for the election of Fellows would take place at the next meeting, December 1.—The following papers were read :—Aluminium alcohols, Part II. Their products of decomposition by heat, by J. H. Gladstone and A. Tribe. The authors have studied the bodies formed when aluminic ethylate, aluminic phenylate, aluminic paracresylate, aluminic thymolate, aluminium, α naphthylate, and aluminium β naphthylate are decomposed by heat. The $CnH2n+1$ series yields the corresponding ethers, alcohols, and olefines, the $CnH2n-7$ series yields the corresponding ethers and alcohols, together with some new crystalline bodies which are probably ketones.—On the chemical action of decomposing vegetable matter on the rock-forming sediment of the Carboniferous period, by E. Wethered. The author points out that the rocks immediately overlying the coal are in nearly all cases argillaceous, and that in the few cases where arenaceous rocks occupy that position they have a well-marked tendency to become more argillaceous as they come into contact with the coal. He proves by analysis that the chief difference in chemical composition between the two rocks is that the argillaceous rocks contain much more alumina, and concludes that this difference in chemical composition is due to the carbonic acid evolved by the decaying vegetation, decomposing all the silicates but that of alumina.—On α and β amylam, by C. O'Sullivan. The author has exhausted various grains, barley, wheat, rye, &c., with alcohol. The residue was then treated for some time with water at 40°, and the process repeated until nothing further was dissolved. The solution was filtered, evaporated, and precipitated with alcohol. The precipitate consisted of α and β amylam. These bodies were very carefully purified; the latter is soluble in cold, the first only in hot water. They have the composition of starch, but furnish apparently dextrose at once when treated with acid, without the previous formation of dextrin or any other substance. Their optical and chemical properties are fully given in the paper.—On the action of oxides on salts, Part IV. Potassic chlorate and ferric oxide, by E. J. Mills and G. Donald. The authors conclude that the action of ferric oxide on potassic chlorate resembles its action on potassic carbonate to a certain extent, that the chemical change has nothing abnormal or peculiar in its features, and that the name catalysis ceases to have any reason for its existence.—On the steeping of barley, by E. J. Mills and J. Pettigrew. The authors have compared the effects produced by steeping barley in water, and in water containing gypsum and calcium carbonate. The general effect of a calcium solution is to retain the nitrogenous matter in the grain, but to increase the total amount of extract. They attribute the value of the Burton water to the nitrates which it contains, and the consequent stimulating effects it produces in germination.

Zoological Society, November 15.—Prof. W. H. Flower, F.R.S., president, in the chair.—Prof. Newton, F.R.S., exhibited a specimen of *Emberiza rustica* recently shot on the coast of Yorkshire.—The Rev. Canon Tristram exhibited and made remarks upon skins of a darter and a pigmy cormorant procured in June of this year on the Lake of Antioch.—Mr. Sclater exhibited a specimen of the glossy ibis (*Plegadis falcinellus*) belonging to Sir Henry Mildmay, Bart., which had been shot in Hampshire in September last.—A communication was read from MM. L. Taczanowski et J. Stolzmann on the habits and various plumages of the rare humming-bird, *Loddigesia mirabilis*.—Communications were read from M. L. Taczanowski, C.M.Z.S., on two nearly allied species of humming-birds of the genus *Steganura* from Peru, and on a new species of *Mustela* from North-eastern Peru, which he proposed to call *Mustela Stolzmanni*.—Mr. W. A. Forbes read notes on the structure of the palate in the trogons (*Trogonidæ*), and on the systematic position of *Eupetes macrocercus*.—A communication was read from Mr. E. P. Ramsay, C.M.Z.S., containing an account of the true habitat of *Pycnoptilus floccosus*, Gould.—A communication was read from Mr. E. L. Layard, F.Z.S., containing a note on the South African mollusk, *Cœliaxis Layardi*, of Angas.—A communication was read from Mr. Edgar A. Smith, F.Z.S., containing notes on the shells of the genus *Chilina*, with a list of the known species.—Mr. Arthur G. Butler, F.Z.S., read a paper on some butterflies from Japan, with which were incorporated notes and descriptions of new species by Montague Fenton.—Mr. H. J. Elwes, F.Z.S, read a paper on the butterflies of Amoorland, Japan, and Northern China.

Physical Society, November 12.—Prof. Fuller, vice-president, in the chair.—Mr. W. D. Niven was elected a Member.—Mr. Lewis Wright then read a paper on some spirals observed in crystals, illustrating the relation of their optic axes. After remarking that the relation of the axes in uni-axial and bi-axial crystals had always been an interesting subject, he observed that if we took any uni-axial and a single axis of any bi-axial which had little or no axial dispersion, and polarised and analysed each circularly, we ultimately got similar phenomena. This is illustrated by calcite and a single axis of sugar, each giving, when thus treated, unbroken circular rings. From this it might be hastily inferred that a single axis of a bi-axial resembled in character the axis of a uni-axial, but this was not the view of those who framed the theory of double refraction in crystals. Fresnel finally framed the conception of three elasticities in three rectangular directions. If all were equal, there was no double refraction; if only two were equal, there was a single optic axis in the direction of the third; and if all were unequal, there were two optic axes. According to this theory the axis of the calcite did *not* resemble in character a single axis of the sugar or other bi-axial, but was a limiting case in which *both* such axes coincided. This was illustrated by the beautiful experiment of Prof. Mitscherlich applying heat to a crystal of selenite, and thereby altering the respective elasticities. The two axes gradually approached until they coincided and the crystal became uni-axial, after which, on heating the crystal still more, the axes re-opened in a direction at right angles to the former, thus proving Fresnel's theory. A point still to be illustrated was that the axis of a uniaxial did retain, or still embraced within itself in some visible form, characteristics of the two axes thus brought into coincidence. Sir George Airy had discovered the double spiral in quartz. Uniaxial calcite showed a double spiral; and biaxials gave a single spiral. Mr. Wright repeated Prof. Mitscherlich's experiment, with Airy's additional method of analysis; the spirals being first shown perpendicularly arranged above each other. Gradually they approached until they resembled those of the calcite, and finally opened out again horizontally. All through there was a double spiral, and a single one could only be got by separating a single axis. The axis of a uniaxial always preserved what might be called its "twin" or "double" character. This experiment was the ocular demonstration sought that the axis of a uniaxial, as a limiting case, did contain or retain elements capable of being made visible. It further showed the reason of the double spiral discovered by Sir George Airy in quartz. This crystal evidently was able to show its own spirals, which, of course, are double. It was shown that as the convergence of the rings was increased these spirals became as numerous and definite as in the calcite. There was however a crucial test of this view: for if it were correct we could combine the two properties of the quartz, artificially as it were, since many fluids also possess rotary power. If therefore we took a column of such fluid of sufficient length and an ordinary uniaxial crystal, the fluid would represent the axial proper-

ties of the quartz, and the crystal the other properties, and the two ought to give similar spirals. In fact the fluid should replace the quartz successfully in all these experiments. By means of a column of oil of lemons 200 millimetres in length, and crystals of calcite, sugar, topaz, and nitre, Mr. Wright showed this to be the case. Finally he demonstrated that the same phenomena held good through all the ordinary analogies with, or artificial substitutes for, natural crystals, the figures being produced with a circular chilled glass in parallel light, and also with an artificial uni-axial crystal made of crossed mica films, after Norremberg, and an artificial quartz made of superimposed mica films, after Reusch, in convergent light. All the figures were projected by the electric camera to a size 8 feet in diameter. All Mr. Wright's experiments went to illustrate the truth of Fresnel's theory.—Mr. C. V. Boys then read a paper on the prevention of the bursting of water pipes. Mr. Powell had proposed the use of pipes of elliptical or other round section, and Mr. Mangnal of Manchester had independently hit on the same idea. Such a pipe would become rounder in section when the water froze and expanded. A round pipe tends to become thinner at its weak parts on expanding under the pressure. With an elliptical pipe, the force required to alter the shape of its section is greater as the section is more circular, therefore the effect produced by a change of shape at any place makes that place stronger. A round pipe is in a state of unstable, and an elliptical pipe in a state of stable, equilibrium, and changes its form uniformly from end to end. Hence if a portion only of such a pipe is exposed to the cold, the whole is effective, and it will require a proportionally greater number of frosts to make the pipe round. Inspection would show if the pipes were becoming round, and then they could be squeezed back to their original shape. Mr. Boys had demonstrated these inferences by experiment with Mr. Powell. Messrs. Powell, Rigby, and Co. of Piccadilly made these pipes.—Mr. J. Macfarlane Gray drew attention to some apparent discrepancies in the constants employed by Regnault in his work on "The Physical Properties of Steam."

PARIS

Academy of Sciences, November 14.—M. Wurtz in the chair.—The following papers were read:—Researches on electrolysis (continued), by M. Berthelot. He illustrates the "principle of minimum electromotive force in electrolyses," in virtue of which electrolytic decomposition occurs as soon as the sum of energies necessary is present. It is distinctly verified wherever there is no polarisation of electrodes.—The maritime laboratories of Banyuls-sur-Mer and Roscoff, by M. de Lacaze-Duthiers. The Roscoff station has had increasing success: 38 have worked at it this year, as against 27 in 1880 (there are 25 at present). The number of foreigners is eight. A large fish-pond has been added, and Government has provided a vessel for dredging. Banyuls-sur-Mer was fixed on for a winter station. The author gives particulars of what is to be called the *Arago Laboratory*, &c., which will be ready early next year. He has received 48,000 francs. The Mayor of Banyuls has opened a subscription for a dredging vessel.—Observations on the second volume of M. Fontaine's Universal History; the Iranians, by M. de Lesseps.—On the working zone of anæsthetic agents, and on a new process of chloroformisation, by M. Bert. With increasingly-strong mixtures of an anæsthetic vapour and air, a point is reached at which an animal in such an atmosphere is made insensible, and another point at which it is killed. The interval between these is the *zone maniable*, or working zone. M. Bert used chloroform, ether, amylene, bromide and chloride of ethyl, and the animals were dogs, mice, and sparrows. Under these conditions the fatal dose is precisely double the anæsthetic dose. (In the case of protoxide of nitrogen the ratio is one to three.) The zone is much greater for ether than for chloroform. Animals anæsthetised in the way indicated remain perfectly quiet and need no attention. In the common way of applying chloroform, with a compress, the limits of the working zone may be exceeded on either side. Chloroform acts, not by the quantity respired, but by the proportion in which it exists in inspired air. The author applies the mixture through a tube and a small mask. The anæsthetic dose for man has yet to be determined.—Synthesis of azotised colloids, by M. Grimaux. Proteic matters he defines as azotised colloids breaking up, through hydration, into amic acids, carbonic acid and ammonia, and from this his method of synthesis is derived. He combined aspartic anhydride with urea.—Crystallographic observations on a variety of natural blende, by M. Hautefeuille.—Observations of Schäberle's comet (*c* 1881) at Rio Janeiro Observatory, by M. Cruls.—On the theory of motion of celestial bodies, by M. Callandreau.—On certain series for development of the functions of a variable, by M. Halphen.—Equality of mean sinking produced by two equal loads (each at points where the other is deposited) arbitrarily distributed along two concentric surfaces on a horizontal ground, or on a horizontal circular plate having the same centre as these circumferences, and supported or secured throughout its contour, by M. Boussinesq.—On the maximum yield of which two given dynamo-electric machines are capable, when used for transport of force, by M. Lévy.—Researches on the absorption spectrum of our atmosphere at Paris Observatory, by M. Egoroff. He describes the absorption of strong electric light by the air-layer between Mont Valérien and the Observatory, observed on eleven evenings. It is probable that, after aqueous vapour, air is the only strongly absorbent substance.—On the electrolysis of water (continued), by M. Tommasi. All metals except gold and platinum, being able to combine with the oxygen of water under action of the voltaic current, are capable, when positive electrodes, of decomposing water by action of a single (zinc copper or zinc carbon) element. He here shows that the decomposition will occur if one of the two electrodes is aluminium, zinc, or carbon. He opposes some of M. Berthelot's views.—On the reversibility of the electro-chemical method for determination of systems of equipotential or discharge, by M. Guébhard.—On the magnetic properties of the nickelised iron of Santa Cattarina, Brazil, by M. H. Becquerel. There is great increase of magnetism after heating followed by cooling, and the author got a like result with pure nickel crystallised in the cold state; but not with pure iron. The native iron must have crystallised at a low temperature.—On the proportions of carbonic acid in the high regions of the atmosphere, by MM. Müntz and Aubin. The observations, made on the Pic du Midi (2877 m.) gave 2·86, which is extremely like the figure got on the plain of Vincennes, and similar figures were got in two Pyrenæan valleys.—On the post-embryonal development of Diptera, by M. Viallanes.—The pourridium of vines of Haute-Marne, produced by *Rœsleria hypogœa*, by M. Prillieux.—Bauxites, their age and origin; complete diffusion of titanium and vanadium in rocks of primordial formation, by M. Dieulafait.

VIENNA

Imperial Academy of Sciences, November 3.—L. T. Fitzinger in the chair.—The following papers were read:—A. D'Albert Adamkiewicz, on the blood-vessels of the spinal cord of man, Part II. The vessels of the spinal marrow.—E. Heinricher, contributions to the teratology of plants.—E. Tangl, on nucleus and cell division in the formation of pollen of *Hemerocallis fulva*, L.

CONTENTS