

a coil and suspended needle-mirror, forming a galvanometer, and a ball contact or "coherer," or else a tube of filings, in circuit with the other two. Electric surgings in the air, or in a scrap of wire pegged into the lid, increased the conductance of the circuit. A light tap on the cylinder reduced it again. A handy lamp and scale enabled the deflexion of the needle to be seen. The surgings could be excited by giving sparks to an insulated sphere not far off, especially if the knobs supplying the sparks are well polished.

The exhibit of Dr. E. C. Stirling, C.M.G., F.R.S., was a series of fourteen photographs, with two maps and a geological section illustrating the researches carried on at Lake Callabonna, in South Australia, for remains of *Diprotodon* and other extinct animals, in 1893. A description of the work to which these photographs refer is given in another part of this number.

Gold leaf made by electro-deposition was exhibited by Mr. J. W. Swan, F.R.S. This exhibit illustrated an attempt to produce gold leaf by electro-chemical instead of mechanical means. The leaves were prepared by depositing a thin film of gold on a highly polished and extremely thin electro copper deposit. The copper was then dissolved by perchloride of iron, leaving the gold in a very attenuated condition. The leaves were approximately four millionths of an inch thick, and some of them mounted on glass showed the transparency of gold very perfectly when a lighted lamp was looked at through them.

Miss Edna Walter and Mr. H. B. Bourne had on view a projective goniometer. By means of this instrument, devised and constructed by the exhibitors, the projection of a crystal on a sphere is actually accomplished, realising in practice the fundamental assumption of the theory of crystallography; the instrument is thus of value in demonstrating the axioms of the science. If necessary, angular measurements could be made from the image, but these only attain an accuracy of about $40'$ in $60'' =$ one per cent., which is inferior to that attained with a goniometer.

Lord Kelvin showed a model illustrating the molecular tactics of a quartz crystal. The crystalline molecule was represented by a regular hexagonal prism of wood, the long diagonal of the hexagon being $\frac{1}{2}$ of the length of the prism. This gave in the assemblage representing a quartz crystal of regular form, the correct angle ($38^\circ 13'$) between the faces of the prism and the faces of the terminal six-sided pyramid. Each crystalline molecule was marked on alternate sides with slips of blue and red paper, to show the orientational difference between the alternate sides of the prism and the absolute difference between the alternate faces of the pyramid. The coloured slips were placed obliquely to give the chiral quality of the crystalline molecule and of the assemblage. Right-handed and left-handed molecules were shown. All the piezo-electric and pyro-electric properties of the crystal (including the chiral piezo-electric property discovered by Voigt) would be actually produced in the model, if copper and zinc were substituted for the red and blue paper, and the individual prisms separated by elastic insulating material. The model showed the well-known orientational macting on two faces of the prisms, and the contiguous pair of faces of the terminal pyramid.

Dr. Isaac Roberts, F.R.S., showed original negatives and enlarged photographs of the spiral nebulae Messier 74 Piscium, Messier 101 Ursæ Majoris, Messier 65 and 66 Leonis, Herschel I. 168 Ursæ Majoris, Herschel I. 56 and 57 Leonis. These photographs revealed the forms and structures of the spiral nebulae with much greater detail and accuracy than had previously been known. They also clearly showed that the spirals were almost perfect geometrical figures, but broken up into numerous stars, or star-like condensations of the nebulosity, or of the meteoric matter, of which they are probably composed, and thus furnish strong evidence of the truth of the nebular or of the meteoric hypotheses.

A number of specimens illustrating locomotion phases in decapod crustacea were exhibited by Prof. Stewart, who also showed mummy cloth, of not later than 4000 B.C., compared with finest Irish linen of to-day. The piece of mummy cloth, made not later than 6000 years ago (14th Egyptian Dynasty), was shown by the side of a piece of finest Irish linen 140×140 of to-day. The strands of the mummy cloth were 300×150 per inch.

Specimens of metallic chromium, manganese, tungsten iron, &c., free from carbon, also fused alumina, obtained during reduction of the metallic samples, were exhibited by Mr. Claude Vautin. The specimens of metallic chromium, manganese, &c., had been reduced from their oxides by means of metallic alu-

minium. The oxide of the metal to be reduced was intimately mixed with finely divided aluminium, and heated in magnesia-lined crucibles. The heat produced by the oxidation of aluminium during the operation was sufficient to fuse alumina, specimen of which was exhibited.

Prof. A. M. Worthington, F.R.S., and Mr. R. S. Cole exhibited photographs of a splashing drop. The photographs shown were obtained by allowing a drop to fall in absolute darkness, and illuminating it at any desired stage of its splash by a suitably timed Leyden jar discharge taking place between magnesium terminals. The exhibit comprised (1) shadow photographs obtained when a drop of mercury fell on the sensitive plate itself, which was laid horizontally and illuminated from above; (2) objective photographs, showing much more detail than has usually been obtained in such instantaneous work, and illustrating the exquisite sensitiveness of the very rapid modern plates. To obtain these photographs the spark was produced at the focus of a deep, silvered watch glass subtending an angle of nearly 180° , and was brought very near to the place of impact. A single quartz spectacle lens was substituted for the usual lens of the camera, and thus the absorption of photographic rays by glass was avoided.

Mr. W. Kurtz (New York) exhibited photographic prints in the natural colours, obtained by printing in the three primary colours only (Dr. Vogel's process). The prints shown were all of them printed in three colours only, some by surface-printing, the others by lithography; but in all cases the printing blocks were produced by photography. The process employed is as follows:—By the intervention of suitable media, three photographs are obtained, severally appropriate to the three primary colours composing the original picture or view required to be reproduced. From these three photographs, respectively due to the chemical action of the red, yellow, and blue rays of the spectrum, printing blocks are prepared, which being printed from in red, yellow, and blue ink, give the multi-coloured effects shown by the specimens.

Prof. Elisha Gay exhibited the telautograph, an instrument for transmitting intelligence by electricity. The writer at one station using a lead-pencil, attached mechanically to the apparatus, and writing upon ordinary paper, transmits to the distant station a facsimile of his handwriting, at his ordinary writing speed. Sketches, sketch-portraits, diagrams, plans, trade-marks, and the like, as well as the characters of hieroglyphic alphabets may also be transmitted.

The following exhibits, with demonstrations by means of the electric lantern, took place in the meeting room of the Society:—

The magic mirror, by Mr. J. W. Kearton. It was shown that the English magic mirror owes its peculiar properties to curved elevations and depressions in the polished metallic face, the elevations producing figures in shade by scattering of light, and the depressions, figures in light by condensing rays reflected from the mirror on to a screen. The figures in relief and intaglio are first produced by the action of any suitable acid on the metal plate, and are then polished down until they disappear to direct vision. The figures of the Japanese type of mirror are by-products in the process of manufacture, and arise from local yieldings of the face and back during polishing: the more rigid parts of the face, which correspond to raised metallic figures on the back, suffer a somewhat greater reduction from opposing greater resistance to the polishing tool.

As at the previous conversation, Prof. E. B. Poulton gave illustrations of recent work upon the influence of environment upon the colours of certain lepidopterous larvæ.

Mr. D. Morris, C.M.G., exhibited and described a series of views illustrating the leading features of tropical vegetation.

A CHEMICAL METHOD OF ISOLATING FLUORINE.

A NEW salt of exceptional interest, the first member of a series of fluorplumbates, is described by Dr. Brauner, of Prague, in the June issue of the *Journal of the Chemical Society*. Dr. Brauner is well known in this country, having been Berkeley Fellow of the Owens College, Manchester, previous to his appointment to the chair of chemistry in the Bohemian University. Twelve years ago he described two compounds very rich in fluorine, $CeF_4 \cdot H_2O$ and $3KF \cdot 2CeF_4 \cdot 2H_2O$, and showed that when heated they first gave up their water and subsequently evolved a gas which possessed an odour similar to that of hypochlorous acid, and which exhibited the

chemical properties expected of free fluorine. The compound now described is a fluorplumbate of the composition $3\text{KF} \cdot \text{HF} \cdot \text{PbF}_4$. It may be obtained by three methods. The first consists in treating the freshly precipitated hydrated oxide of lead, $\text{Pb}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$, a substance described by Dr. Brauner in the year 1885, with a mixture of hydrogen potassium fluoride and hydrofluoric acid. The fluorplumbate is separated from the lead difluoride simultaneously formed by crystallisation from hydrofluoric acid. The second method consists in substituting fluorine for oxygen in the plumbates of Fremy. Peroxide of lead and caustic potash, in the proportions of the compound $3\text{KOH} \cdot \text{PbO}_2$, are fused in a silver crucible; the product is moistened with water, and then added gradually to excess of pure hydrofluoric acid. The filtered solution is evaporated to the crystallising point in a current of air, and as soon as crystals commence to form is placed in a vacuum desiccator. Crystals of the salt are then deposited. The third method consists in displacing the acetic acid in lead tetracetate by fluorine. One molecular equivalent of lead tetracetate is added to three equivalents of hydrogen potassium fluoride, $\text{HF} \cdot \text{KF}$, dissolved in hydrofluoric acid; crystals of potassium fluorplumbate are formed upon evaporation, either in the air or *in vacuo*. Analyses of the crystals prepared by all three methods indicate the composition $3\text{KF} \cdot \text{HF} \cdot \text{PbF}_4$.

The needle-shaped crystals, which frequently attain the length of a centimetre, and are grouped radially, have been found to be in all probability monoclinic in symmetry, and isomorphous with the analogous fluorstannate described by Marignac.

Potassium fluorplumbate is permanent in dry air, but becomes brown in moist air, being decomposed by water, with formation of hydrated peroxide of lead, hydrogen potassium fluoride, and free hydrofluoric acid. The effect of heat upon the salt is most interesting and important. The experiments should be carried out in a platinum tube. At 100° - 110° the crystals remain unaltered. At 200° hydrogen fluoride commences to be evolved in small quantity. When subjected to a much higher temperature, after previous heating for several hours at 230° - 250° , a gas commences to be evolved endowed with the odour ascribed by Moissan to fluorine. This occurs much below a red heat. The gas liberates iodine in such large quantities from iodised starch paper as to cause it to be deposited in crystals, and small crystals of silicon held in the open end of the tube not only burn with a vivid incandescence, but even with explosive violence. There can, therefore, be no question that the gas is free fluorine, and it would thus appear that Dr. Brauner has discovered a trustworthy purely chemical process of isolating the element. Potassium fluorplumbate loses its hydrogen fluoride almost completely at 230° , without losing more than a trace of fluorine from the lead tetrafluoride. Any small traces of hydrogen fluoride subsequently evolved along with the fluorine at the higher temperature may be readily removed by Moissan's method of passing the gas over potassium fluoride.

Dr. Brauner has already obtained evidence of the existence of a whole series of fluorplumbates, analogous to Marignac's fluorstannates, and is now engaged in studying the sodium salt.

A. E. TUTTON.

A SURVEY OF THE ENGLISH LAKES.

AT the last meeting of the Royal Geographical Society a paper was read by Dr. Hugh Robert Mill, on the Lake District of North-western England, of which the following is an abstract:—The lake district is a remarkably definite and symmetrical geographical unit. It may be roughly described as a circular mass of elevated land, highest in the centre, and furrowed by a series of valleys running from the centre toward the circumference like the spokes of a wheel. Most of these valleys contain long narrow lakes of considerable size, and of a different type from the small round mountain tarns which also occur in the district.

An account was given in the paper of the methods employed for ascertaining the depth and fixing the position of each sounding, and for mapping the resulting information. The lakes considered were Windermere, Ullswater, Coniston Water, Wastwater, Ennerdale Water, Buttermere and Crummock Water, Derwentwater, Bassenthwaite Lake, and Haweswater, each of which was found to have certain special characteristics which distinguished it from all the others. The soundings were

carried out by the author, assisted by Mr. E. Heawood, Mr. Shields, and others.

There are two main types amongst these lakes, the shallow and the deep. The former, including only Derwentwater and Bassenthwaite, are the broadest of all the lakes; they average 18 feet in depth, their mean depth being only 25 per cent. of the maximum depth, a smaller ratio than for any other lakes. The bed of these lakes may be roughly described as an undulating plain, grooved and ridged into shallow hollows, and low shoals running parallel to the long axis of the lake. The configuration suggests that they may have been shallowed by glacial accumulations.

The second, or deep type, the shallowest of which has an average depth of 40 feet, and in which the average depth varies from 36 to 61 per cent. of the maximum depth, comprises all the other lakes except, possibly, Ennerdale, which combines the characteristics of both types. They are long, narrow, sometimes winding like Ullswater, or slightly curved in outline like Wastwater and Haweswater. The most characteristic lie in long narrow valleys with steeply sloping sides, and the slopes are continued under water with almost equal steepness, in some cases with greater steepness, and terminate in a nearly flat floor. The typical form of this class of lake is thus a steep-sided flat-bottomed trough, diversified along the slopes by the still steeper conical mounds of debris thrown down at the mouths of streams. In Haweswater the largest example of a delta occurs, nearly cutting the lake in two; while Buttermere and Crummock, lying in one uniform valley, are entirely separated, probably by the same action, and Derwentwater is also divided from Bassenthwaite by a broad alluvial plain. Although most of the lakes show only one clearly defined trough, the two largest are divided into distinct basins. In Windermere, the shoal on which Belleisle and the other islands off Bowness, rise separates the deep and wide upper basin from the less deep and much narrower lower basin. In Ullswater each of the three reaches of the lake contains a definite basin separated from the others by broad or narrow bars. From one of these the island of Householm rises, a mass of strongly glaciated rock; but while the position of the basin to the south of it seems to confirm the glacial theory of the excavation of the hollow, the hollow to the north of the island is so situated as to make its origin by glaciation somewhat difficult to understand.

Three of the lakes have depths which descend below sea-level. In Wastwater 217 acres lie beneath sea-level, so that if drained to that extent it would present the appearance of a lake still 58 feet in depth at one point. Windermere, if similarly drained, would show a northern lake $3\frac{1}{2}$ miles long with a maximum depth of 90 feet, and 3 miles further south a narrower lake 1 mile in length and only 14 feet deep at its deepest, while south of this there would be a still shallower lagoon half a mile long. In Coniston reduced to sea-level there would probably appear one narrow lake $2\frac{1}{2}$ miles long and 42 feet in maximum depths. All the other lakes are situated at such elevations that they do not approach sea-level in their greatest depths.

Altogether, the lakes which have been sounded and mapped cover an area of 20 square miles of unexplored territory. Contoured maps of the ten lake basins under consideration have been supplied to the Ordnance Survey for incorporation on the official maps of the country.

THE RECENT DISCOVERY OF FOSSIL REMAINS AT LAKE CALABONNA, SOUTH AUSTRALIA.¹

I.

FROM time to time notices have appeared of a remarkable discovery of fossil bones at Lake Mulligan in the interior of South Australia, but so far there has been no connected statement of what has been done in the way of developing the discovery. For reasons which will be evident, it is not yet possible to announce the results with anything more than a rough approximation, which leaves many interesting questions unsolved, or even untouched. Still, in view of its palaeontological importance, it seems desirable that any available information should be given without further delay.

Necessarily a fragmentary and imperfect record, I trust the following account will, at least, afford evidence that the authorities of the South Australian Museum are fully alive to the interest of the issues involved, and that, so far as their not

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