appear in positions much higher than their actual positions, that is to say, when images of them appear considerably raised above their true positions. The effects of looming are very extraordinary, and I have some slides to show you which I have prepared from examples recorded by Commander William Scoresby, who went on his third voyage in his ship the *Baffin* to the Greenland whale fishery in the spring of 1822. The first of these views includes several large irregularly-shaped icebergs, which must cause very unusual distributions of air density, and gave rise to quite remarkable vertical and lateral refractions. In the second there are images of ice which was quite out of sight or quite beyond the horizon. There was extraordinary vertical magnification; small hummocks of ice were drawn out into spires, sometimes of a castellated shape and sometimes having the appearance of naked trees; at other times there appeared to be a city of ice, with public edifices, spires, &c., and Commander Scoresby states in his book that these effects were constantly changing, and were never the same for two minntes together. The first of these drawings, which you saw on the screen, showed a curious inverted image of a ship in the sky, raised considerably above the horizon; that ship was so distant that it could not be seen with a powerful telescope.

During the Crimean War observers on one occasion saw the whole of the British Fleet inverted at a considerable height, an illustration of which appeared in *The Illustrated London News* at the time. Some very interesting cases were recorded by Dr. Vince in the Bakerian lecture of 1798, read before the Royal Society, some of which are delineated in the succeeding slides. He remarks upon these curious phenomena that he thinks that in cases of national emergency certain people should be told off with telescopes to look out for the enemy's ships, and to search the horizon to see if they could detect any ships looming. Dr. Vince mentions another remarkable instance in which he saw Dover Castle from Ramsgate, at a point from which the whole of the keep of the castle cannot be seen, the four turrets only being visible. The most curious case of lateral refraction that I have been able to discover was observed at Geneva in 1818, by M. Jurine; a barque was seen approaching on the left bank of the lake, and at the same time an image of the sails was observed above the water, which, instead of following the direction of the barque, separated from it and appeared to approach Geneva by the right bank of the lake, the image moving from east to west while the barque moved from north to south. This case was brought to the notice of Biot, the physicist, and he, in one of the scientific journals, gave a very long explanation. He came to the conclusion, from the geographical features, and climatology, and the direction in which the sun's rays were passing at the time of the observation, that there would be considerable lateral difference in the temperature, quite sufficient to produce this phenomenon of lateral refraction.

Another case of curious refraction has been noticed by many people—I have seen it myself particularly on the coast of Norway. Low lands, and the extremity of headlands, or points forming an acute angle with the horizon of the sea, and viewed from a distance beyond it, appear elevated above it, with an open space between the land and sea, the effect being proportional to the amount of evaporation taking place at the surface.

Fata Morgana is a name given to an optical phenomenon sometimes seen in the Straits of Messina between Sicily and the Italian coast. Minasi says: "When the rising sun shines from that point whence its incident ray forms an angle of about 45° on the sea of Reggio, and the bright surface of the water is not disturbed either by wind or current, the spectator being placed on an eminence of the city with his back to the sun and his face to the sea, on a sudden there appear in the water various multiplied objects, namely, numberless series of pilasters, arches, castles, columns, towers, palaces with balconies and windows, valleys of trees, plains with herds and flocks, &c., in their natural colours and proper action, passing rapidly in succession along the surface so long as the above-mentioned causes exist. If, in addition, the atmosphere be highly impregnated with vapour and dense exhalations not previously dispersed by the action of the wind and waves, or rarefied by the sun—in this vapour, as in a curtain, to a height of 24 or 25 feet, and nearly down to the sea, the observer sees the same objects not only reflected from the sea, but likewise in the air, though less distinct. Lastly, if the air be hazy and slightly opaque and dewy, the objects appear only at the sea surface, but with prismatic colours." He endeavours to prove that they are representations of objects on the two coasts. He considers the sea an inclined speculum, on account of the rapid current which runs through the Straits, and divided into different planes by contrary eddies, and he ascribes the *aerial morgana* to the refractive and reflective power of matter suspended in the air.

Lastly, I would mention the experiments of Wollaston upon the subject of refraction and mirage. First, he says, into a square phial containing a little clear syrup put an equal quantity of water in such a way that it floats without mixing, and after a little time, by mutual penetration, you see effects; if you view through the syrup a card with a written word upon it, you see it, and also above it an inverted and erect image of the same. That is a case in which the density diminishes upwards, and the ray has its concavity presented downwards. Then, above the water he placed rectified spirits of wine, when the inverted and erect images were seen below, these appearances continuing many hours and even days, and he carried out similar experiments with water at different temperatures. Everybody knows the experiment with a red-hot poker; the effects of mirage can be seen by looking along the surface of a red-hot poker, held at a distance of about a foot from a sheet of paper, when there is perceptible refraction. Again, Wollaston looked along a horizontal plate of glass upon which he poured ether, and a line appeared instantaneously upon the opposite wall at an elevation of half a degree, this effect being due to the cold caused by the evaporation of the volatile liquid. Finally, Brewster showed that all the phenomena of unusual refraction might be observed by holding a heated iron over a mass of water bounded by parallel plates of glass, and then substituting a cold bod y for the hot iron.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE foundation-stone of the Gordon Memorial College at Khartum was laid on Thursday last by Lord Cromer, who remarked that the College would aim at diffusing knowledge of agriculture, engineering, and other practical acquirements useful to all classes.

THE New South Wales Government invite applications for the position of Professor of Physics in the University of Sydney, from University graduates under thirty-five years of age. Particulars of the conditions of appointment, duties, &c., can be obtained from Sir Daniel Cooper, Bart., G.C.M.G., Acting Agent-General for New South Wales, 9, Victoria Street, Westminster, London, S.W.

THE necessity of encouraging scientific investigation, and of providing means for training investigators, is pointed out by Prof. Cleveland Abbe in the U.S. *Monthly Weather Review* (September 1898). He remarks:—A mistaken idea has widely prevailed that the investigator is a genius, born and not made. The history of German science has, however, shown that environment and training are as important as birth and inheritance. The whole system of education in the German universities has for five generations been directed to the development of the investigator as its highest product. Those who discover important new facts, laws, or principles have been rewarded with the highest places in the intellectual world of that nation. Those who feel that they have a desire or calling for scientific research are encouraged to study for the degree of doctor of philosophy, a degree that is only granted when the candidate has, by actual observation, experiment, or exploration, made some important contribution to human knowledge. The professors under whom he studies have, in their turn, made many similar contributions, and are well prepared to judge of the value of *his* work. The German universities have, during the past seventy years, published over fifty-thousand so-called "doctors' dissertations," embodying the results of the works of fifty thousand candidates. The consequence is that to-day Germany easily leads all the world in the amount and value of her contributions to human knowledge and the energy with which her students pursue the study of nature.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, December 1898.—At the October meeting of the Society seven papers were communicated. Abstracts of the papers not to be published in the *Bulletin* are given.—Prof. Woodward's paper, on

the mutual gravitational attraction of two bodies whose mass distributions are symmetrical with respect to the same axis, deals with certain problems in the theory of Attraction which, although fairly accessible to treatment, seem to have been overlooked (some of the equations occur in Todhunter, "History of the Theories of Attraction and Figure of the Earth," vol. ii. p. 102).—A paper by Prof. Roe, on symmetric functions, considers the matter from two standpoints. The first part deals with the functions as a whole, and is mainly critical and historical. Part ii. treats of the individual terms of a symmetric function, together with their coefficients. Prof. Chessin applies the theory (which we have noted in the abstract of a paper previously read by him) to the problem of three bodies m_1, m_2, m_3, viz. when the mass of one of them (m_3) is infinitely small compared with the masses m_1 and m_2, while the eccentricity of the orbits of m_1 and m_2 is zero, so that these bodies move uniformly in concentric circles above their common centre of gravity. Such is very nearly the case of a small planet in the presence of the sun and Jupiter, and also very approximately the case of satellites.—Prof. Lovett's contact transformations of developable surfaces discusses the determination of the contact transformations which leave invariant the partial differential equation $| p_{11}, p_{22}, \ldots, p_{nn} | = 0$ (*cf.* Lie, Darboux and Mayer. Some of the results are complete generalisations of those of a memoir of G. Vivanti, *Rend. di Circ. Mat. di Palermo*, vol. v. 1891).—Concerning a linear homogeneous group in $C_{m,q}$ variables isomorphic to the general linear homogeneous group in m variables, is a paper which was read by Dr. L. E. Dickson at the August meeting. It is chiefly concerned with continuous groups, but its results are readily utilised for discontinuous groups. An analogous isomorphism is discussed in a paper presented recently to the London Mathematical Society.—A second locus connected with a system of coaxial circles, by Prof. T. F. Holgate, read at the same meeting, is a very interesting extension of a paper, by the same author, which was communicated to the Toronto meeting, November 1897.—Prof. Emch, of Biel, Switzerland, communicates a note, entitled "Reciprocal transformations of projective coordinates and the theorems of Ceva and Menelaos." The note is illustrated with diagrams. The author confines himself to the two above-named theorems and their connection with certain transformations of plane and space. The properties admit of multiplication, some of which have been discussed by Rosace and Steiner.—The "notes," as usual, contain a good deal of information useful to mathematical students.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 15, 1898.—"Note on the Densities of 'Atmospheric Nitrogen,' Pure Nitrogen, and Argon." By William Ramsay, F.R.S.

It is concluded that the density of "atmospheric" nitrogen is correctly given as the mean of the densities of the constituents, taken in the proportion in which they occur.

Chemical Society, Dec. 15, 1898.—Prof. Dewar, President, in the chair.—The following papers were read.—The interaction of ethylic sodiomalonate and mesityl oxide, by A. W. Crossley. Mesityl oxide and ethylic sodiomalonate do not condense in the expected manner, but the product on hydrolysis yields a diabasic acid, $C_{16}H_{24}O_4$ melting at 148–148°·5; derivatives of this acid are described.—The interaction of ethylic malonate and acetylene tetrabromide in presence of sodium ethoxide, by A. W. Crossley. Ethylic disodiomalonate and acetylene tetrabromide react with evolution of acetylene and formation of tribromethylene and tetrethylic acetylenetetracarboxylate.—Derivatives of camphoric acid: Part iii., by F. S. Kipping. A number of compounds obtained from π-bromocamphoric acid are described.—Synthesis of $\alpha\beta\beta$-trimethylglutaric acid, by W. H. Perkin, jun., and J. F. Thorpe. Ethylic sodio-α-cyano-$\beta\beta$-dimethylglutarate is obtained by the interaction of ethylic cyanacetate, ethylic dimethylacrylate and sodium ethoxide; methylic iodide converts it into ethylic α-cyano-$\alpha\beta\beta$-trimethylglutarate which on hydrolysis gives $\alpha\beta\beta$-trimethylglutarimide. This imide yields $\alpha\beta\beta$-trimethylglutaric acid, $COOH.CHMe.CMe_2.CH_2.COOH$, when heated with hydrochloric acid.—Hydrolysis of methylic and ethylic γ-cyanoacetoacetates and their derivatives, Part i., by W. F. Lawrence. Methylic γ-cyanodimethylacetoacetate is hydrolysed by hydrochloric acid with formation of $\alpha\alpha$-dimethyl-β-hydroxyglutaconic acid, $COOH.CH:C(OH).CMe_2.COOH$; this, on reduction with hydriodic acid, yields $\alpha\alpha$-dimethylglutaconic acid.

Geological Society, December 21, 1898.—W. Whitaker, F.R.S., President, in the chair.—On a Megalosauroid jaw from Rhætic beds near Bridgend, Glamorganshire, by E. T. Newton, F.R.S. The specimen which forms the subject of this communication was obtained by Mr. John David of Porthcawl, and it has been presented to the Museum of Practical Geology. It was derived from beds low down in the Rhætic series, which may eventually have to be included in the upper part of the Keuper. The specimen does not admit of exact comparison with *Megalosaurus*, and it is named as a new species of *Zanclodon*—a genus in which the author is also inclined to place some forms described under the names of *Palaeosaurus*, *Cladyodon*, *Avalonia*, and *Picrodon*.—The torsion-structure of the Dolomites, by Maria M. Ogilvie [Mrs. Gordon]. The paper opens with a general account of the work of Richthofen, Mojsisovics, Rothpletz, Salomon, Brögger, the author, and others on the Dolomitic area of Southern Tyrol. It then gives the results of a detailed survey recently made by the author of the complicated stratigraphy of the rocks of the Groden Pass, the Buchenstein Valley, and the massives of Sella and Sett Sass; together with the author's interpretation of these results, and her application of that interpretation to the explanation of the Dolomite region in general. The author concludes that overthrusts and faults of all types are far more common in the Dolomites than has hitherto been supposed. The arrangement of these faults is typically a *torsion*-phenomenon, the result of the superposition of a later upon an earlier strike. This later crust-movement was of Middle Tertiary age, and one with the movement which gave origin to the well-known Judicarian-Asta phenomena. The youngest dykes (and also the granite-masses) are of Middle Tertiary age, while the geographical position of both is the natural effect of the crust-torsion itself. This crust-torsion also fully explains the peculiar stratigraphical phenomena in the Dolomite region, such as the present isolation of the mountain-massives of dolomitic rock. After discussing in detail the structure of various areas, the author applies her results to the interpretation of the complexities of the Judicarian-Asta region of the Dolomites in general, and also to the explanation of the characteristic structural forms of the Alpine system as a whole.

Royal Microscopical Society, December 21, 1898.—Mr. E. M. Nelson, President, in the chair.—The President exhibited a new objective by Carl Zeiss, called a "Plankton-searcher," a low power water immersion objective, designed for use in examining living objects in water, the definition of which was exceedingly sharp. He also exhibited an erecting eye-piece fitted with Porro's prisms, another new appliance produced by the same firm, which would be found useful for dissecting and other purposes.—Mr. Keith Lucas exhibited and described a new model microscope, the design of which was to effect the coarse and fine adjustments by means of a single slide, thereby reducing the expensive work of planing.—The President directed attention to some of the various types of binocular microscopes that were exhibited: among those referred to were Ahrens' binocular eye-piece, in which both tubes were equally inclined, and a microscope by Murray and Heath, one tube only being inclined, the other lying in the optical axis of the instrument, the construction being similar to that of Nachet; these two instruments were exhibited by the Society.—There was a new binocular dissecting microscope by Leitz, exhibited by Messrs. Watson and Sons, consisting of two Brücke lenses fitted on a bar by jointed attachments so that the distance between the tubes could be adjusted to suit the eyes. This was likely to prove valuable for examination of objects, or for dissection under low power.—Attention was directed also to a form exhibited by Carl Zeiss, made with Porro's prisms, giving an erect image; this microscope is provided with two objectives of equal power, one for each tube, the stereoscopic effect being greater than that obtained by a divided image from one objective.—Messrs. Powell and Lealand exhibited their high-power binocular prism in conjunction with a 1/20-inch apochromatic objective.—A Mojinie's portable binocular, a Nelson model, Wenham's binocular with a high power objective, a binocular microspectroscope, were exhibited, besides various patterns of Stephenson and Wenham binocular microscopes by Messrs. Chas. Baker, R. and J. Beck,