VISUAL ILLUSION AND FIXATION.

A REMARKABLE new visual illusion is described by Dr. James Fraser in the *Journal of Psychology* for January. In the first form of the illusion a word (such as "LIFE") is printed in capital letters on a chequered background of black, grey, and white squares. The double outline of the letters is not traced in continuous lines, but is constituted by a band consisting of short lines, alternately black and white, slightly inclined to the direction of the limbs of the letter. This band may conveniently be regarded as representing a cord made of two strands, black and white, twisted together. In these circumstances the letters appear, in general, to be inclined several degrees from their actual directions, the sense of the deviation varying with the direction of the constituent lines of the

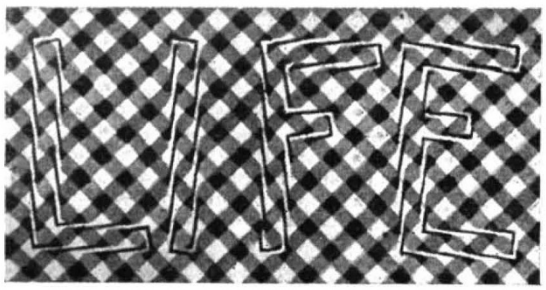

FIG. 1.

illusory band (see Fig. 1). A number of figures are given illustrating variants of this form of the illusion, and facilitating a study of the limits within which it persists.

In a second form of the experiment concentric circles or ellipses made of the "twisted cord," and laid upon a chequered surface of peculiar construction, are shown to suffer apparent distortion of an extraordinary character (see Fig. 2).

The paper (which is excellently illustrated) concludes with a short discussion in which the author points out the factors which appear to him to determine the presence and disappearance of the illusion.

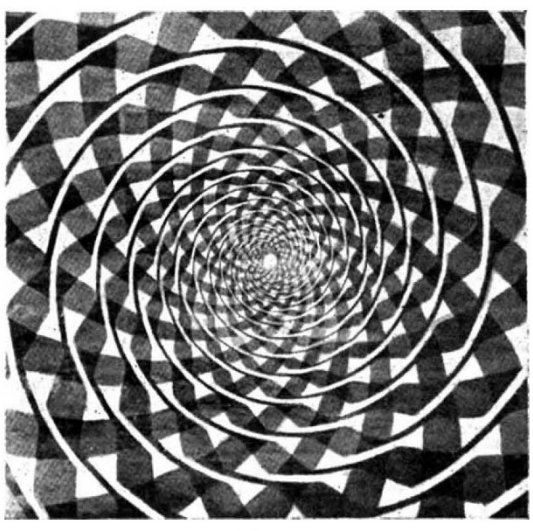

FIG. 2.

Upright letters of appropriate size and concentric circles of appropriate diameter, drawn on tracing paper and superimposed upon the figures, will demonstrate the character of the illusion in each case.

The *Psychological Review* has published, as a monograph supplement (November, 1907), an account of an experimental study of visual fixation conducted by Prof. Raymond Dodge in the psychological laboratories of Wesleyan University. The main result of this careful and interesting work is to render untenable the traditional assumption of an identical anatomical and functional centre of the retina, to which all visual processes are referred or referable. Prof. Dodge shows (following, in part, Delabarre and McAllister) that during supposed fixation there is continuous movement of the point of regard over a variable area of appreciable extent. This is the result of uncompensated disturbances produced by the pulse and respiration, and by irregular head and body movements. On the other hand, the investigation has brought to light a number of eye-movements compensatory of movements of head and trunk, the perfection of which (since the reaction time of the eye is relatively slow) points to the existence of highly organised motor systems embracing both ocular and somatic muscles. The discovery that there is, strictly, not a fixation point, but merely a fixation area, renders improbable the current hypothesis that assumes a tendency to transfer every peripheral stimulus to the centre of the fovea. Actual experiment shows, in fact, that when a given word is read the point of regard may rest indifferently in many situations. These observations have, obviously, an important bearing upon the question of retinal space-perception, and Prof. Dodge uses them to discredit the theory that the motor-impulse by which a peripheral object of regard would be brought to a supposed constant intra-foveal fixation point is a "local sign" differentiating the retinal point stimulated from every other. He proposes to substitute for it the conception of a differentiated organisation of the retinal groups, and shows how such an organisation might be brought about by the agency of the fixation movements.

SOME RECENT PETROLOGICAL PAPERS.

A DETAILED study of the granite of Brixen has been contributed by Herr Bruno Sander to the *Jahrbuch der k.k. geologischen Reichsanstalt*, vol. lvi. (1906), p. 707, which involves many interesting questions of the intimate penetration of sediments by igneous rocks, and directs fresh attention to the marginal facies known as tonalite-gneiss (pp. 726–34). The author shows that a foliated structure existed in this rock before deformation by pressure occurred. Dr. Trener, on the other hand (*ibid.*, pp. 415 and 458), in a paper on the Presanella group, containing many petrographic details, treats tonalite-gneiss as a product of pressure, and the basic inclusions in it as segregations. One of Sander's most suggestive observations is the finding of amphibolites, closely resembling the tonalite-gneiss, in the old limestone series that has been invaded by the granite; and he is led to ask (p. 734) whether the occurrence of tonalite-gneiss does not in some way depend on the horizon selected by the granite for its intrusion continuously from Meran to Mauls.

Dr. Trener's paper, just referred to, contains (p. 484) a valuable appendix on graphite, in which Luzi's "graphitite" and Sauer's "graphitoid"—a graphite in metamorphic rocks—are both opposed as mineral species.

Mr. Joseph Barrell's "Geology of the Marysville Mining District, Montana" (U.S. Geological Survey, Prof. Paper No. 57, 1907) is also "a study of igneous intrusion and contact metamorphism," dealing particularly with a great batholithic inflow of granite among pre-Cambrian strata at the opening of Cainozoic times. Various igneous rocks, from gabbros to aplites, appear as subsidiary intrusions. The contact-phenomena have been studied to advantage in mine-sections down as far as 1300 feet. A strong case is made out for the occurrence of "stoping," by the falling in of blocks "10 to 200 feet or more in thickness and of considerably greater length" (p. 172), and the consequent rise of the granite into its former cover of Algonkian rocks.

Mr. R. A. Daly, another strong advocate of "stoping," in a paper on the Okanagan composite batholith of the Cascade Mountain system (Bull. Geol. Soc. America, vol. xvii., 1906, p. 329), urges that this batholith actually replaces an equal or approximately equal mass of the older solid rock. Those of us who have been maintaining this somewhat natural view from field-observations on batholiths in our own islands must join with Mr. Daly in hail-

ing its growing acceptance, though many will still hesitate before his conclusions (p. 373) as to the profound modification of a gabbro-magma by absorption of pre-existing acid masses. He admits, with other writers, a "gravitative differentiation of the compound magma of assimilation," and urges that at each stage in the intrusion of the Okanagan batholith a magma more basic than the average of the rock invaded became enriched with silica by assimilation, and also by this gravitational draining away of the denser material. Dynamic and accompanying hydrothermal actions are said to have produced gneisses from the intrusive Okanagan "granodiorite," and it is held that in many places mineral material, especially from the more basic constituents, "has been leached out from the granulated rock and has re-crystallised in strong shear zones to which the solutions have slowly travelled" (compare pp. 345–6). This would seem in accord with Lehmann's view of the development of biotite along shear zones; and, as even a tentative explanation of the formation of a strikingly banded gneiss out of a homogeneous "granodiorite," it has considerable petrographic interest.

Messrs. E. C. Andrews and J. C. H. Mingaye, assisted by the careful petrographic descriptions of Mr. G. W. Card, discuss the granites of northern New England in part iv. of their description of the New England plateau of New South Wales (Records Geol. Survey N.S.W., vol. viii., 1907, p. 196). They conclude that their granitic masses are mostly "bathyliths." At Hillgrove they find a diorite (p. 232) that passes insensibly through a fine-grained granite rich in biotite into silicified slates, which further pass into true black slates. "The biotite-granite is thus possibly a compromise between the slates and the diorite." The authors urge (pp. 234 and 237) that the "bathyliths" have occupied their present positions at the expense of the older rocks, and they are advocates of stoping as a means of carrying away derived material. In part v. of the memoir (*ibid.*, p. 239), Mr. Andrews explains the structure of the deposits of wolfram, cassiterite, and molybdenite as a "replacement of granite by [the products of] solutions and gases rising along the intersecting joints" (p. 241), and spreading at times from "an incredibly small core." Mr. Card contributes "Mineralogical and Petrographical Notes, No. 10" (*ibid.*, p. 257), referring his rocks to the American system of classification, on the basis of the thorough analyses provided by Mr. Mingaye's laboratory. We hope that some day these notes may be brought together into a general petrographic study of the colony, so that we may learn the part that each rock has played in the broad sequence of geological events.

A fine example of that rare rock, orbicular granite, is described from the Transvaal Bushveld by Mr. W. J. Gau (Trans. Geol. Soc. of S. Africa, vol. ix., 1906, p. 70).

The mining district of Pitkäranta on Lake Ladoga, in Finland, has been thoroughly investigated by Mr. Otto Trüstedt from a mineral and petrographic point of view (*Bull. de la Comm. géol. de Finlande*, No. 19, 1907). His fine memoir, written in German, of more than 300 pages, lays special stress on three zones of "skarn"—a somewhat forbidding word in Swedish—which here means a calciphyre formed from crystalline and usually dolomitic limestones. These limestones are part of an ancient amphibolitic and sedimentary series, now highly metamorphosed, into which granites and pegmatites intruded in early pre-Cambrian times, followed in much later, but still pre-Cambrian, times by the great mass of Rappakiwi-granite. The "skarn," chiefly composed of salite and garnet, is believed (p. 91) to have arisen through the influence of magmatic waters circulating from the earlier intrusive bodies. Earth-movements then broke it up in many places into blocks, round which singular modifications have taken place. Serpentinisation, acting through a long period, has spread inward from their surfaces (*e.g.* pp. 218 and 235), producing an eozoönal structure, built up of salite, serpentine, and calcite. This banded structure is well shown in the photographic plates and figures. The Rappakiwi-granite ultimately invaded the whole series of rocks, and became solid. During the last phases of the eruptive activities of which it forms the climax, metallic ores, including cassiterite, were deposited in its zone of contact. Magnetite, zinc-blende, and sulphides of iron and copper now began to replace certain layers of the "eozoön," and the outer portions of some of the lumps of "skarn," or "Salitaugen," pass into pure ore. Even garnets (p. 138) have been dissolved away along certain of their zones of growth, and these zones have been replaced by metallic minerals. The author agrees with Vogt (p. 315) that the Pitkäranta ore-deposits belong to the true contact-metamorphic type, and occupy a middle position between the iron and copper deposits of Christiania and the tin and copper deposits of Cornwall.

Mr. Curt Fircks's paper, written in English, on the occurrence of gold in Finnish Lapland (*ibid.*, No. 17, 1906), describes ferruginous veins traversing granulite as the mother-lodes of the alluvial gold; but it is not clear why they are called (p. 33) "a new type of gold veins, not yet observed in other parts of the world."

Messrs. Johnson and Warren (American Journal of Science, vol. xxv., 1908, p. 1) revive our interest in Wadsworth's "cumberlandite" in their account of the geology of Rhode Island. This rock becomes a "rhodose" in accordance with the new system of classification (p. 25); it has the high specific gravity of 4, owing to its groundmass of inter-grown magnetite and ilmenite, enclosing hyalosiderite (p. 19), an olivine rich in iron. The olivine has retained grains of the iron ore within it, and Mr. Warren suggests that these were prevented from joining the main mass by the decreasing mobility of the separating olivine; and he favours the supposition that the minerals became immiscible before their freezing point was reached (p. 22).

An unusual group of rocks, for which ultra-basic intrusive masses seem primarily responsible, is described from the Vizagapatam district of Madras by Messrs. T. L. Walker and W. H. Collins (Records Geol. Survey of India, vol. xxxvi., 1907, p. 1). The ultra-basic igneous border of a mass of granulites and garnetiferous granites (charnockite series) is believed to have mingled with sillimanite-schists. Rocks rich in green spinel and magnetite thus pass into others where the spinel is largely replaced by sapphirine, and sapphirine is regarded (p. 11) as a product of the interaction of spinel and sillimanite. A mineral hitherto described as hypersthene in the charnockite series, with a pleochroism "sky-blue to red or red-brown" (p. 14), is shown to have frequently oblique extinction. The authors seem to throw doubt on the existence of "a rhombic pyroxene with the properties usually assigned to hypersthene"; but surely they mean merely to ask whether rhombic pyroxene ever has a "sky-blue" axis-colour.

Before leaving ultra-basic igneous rocks, it may be mentioned that Dr. Corstorphine further defends his view, criticised in South Africa and elsewhere, as to the concretionary nature of the eclogite masses in the diamond-pipes of Kimberley (Proc. Geol. Soc. of S. Africa, 1907, p. lxi). The tenth volume of the Transactions of the Geological Society of South Africa, which these Proceedings accompany, contains contributions by Messrs. Voit, Merensky, and J. P. Johnson on the same subject, and an interesting rejoinder by Prof. T. G. Bonney to Messrs. Corstorphine and Voit, all being included in the part for July to December, 1907.

Mr. L. L. Fermor, in describing rhyolites and basalts from Pávágad Hill, Bombay Presidency (*ibid.*, vol. xxxiv., 1906, p. 148), points out differences between the former and the Maláni rhyolites of Rájputana described by Mr. La Touche, in spite of some points of striking resemblance. In consequence, he is able to suggest that the Pávágad rocks, both basic and acid, were poured out as differentiation-products from one caldron in Cretaceous times, the alternative being that the basalts form intrusive sills in a far older rhyolitic series. A vertical section of 2400 feet of rock is exposed, to which Mr. Fermor invites the attention of future visitors who can undertake its detailed exploration.

From five weeks' study in the field, Mr. James Currie has drawn up an illustrated list, arranged topographically, of the minerals in the basaltic Færöes, which will especially appeal to students of zeolites (Trans. Edinburgh Geol. Soc., vol. ix., 1906, p. 1).

Coming now to sedimentary deposits, Herr Meigen has continued his researches on calcium carbonate, which have

been so practically fruitful (*Ber. naturforsch. Gesell. zu Freiburg i. Br.*, Bd. xv., 1907, pp. 38–74). His precipitates of aragonite globules or needles from various solutions pass for the most part into calcite, with characteristic rhombohedral forms, in periods varying from twenty-four hours to three months. A few, from dilute hot solutions, remain unaltered, at any rate for the period of observation, which in one case is as long as four months. Experiments to determine the composition of the coloured deposits produced by the action of calcium carbonate on salts of cobalt showed (p. 57) that calcite assumes a violet colour *when in the form of an impalpable powder* and treated in a distinctly dilute solution of cobalt nitrate. Ordinary fragments remain uncoloured, or become blue on continued boiling in a concentrated solution, while aragonite under all conditions becomes, as is now well known, violet. Though the violet colour arises in powdered calcite more slowly than in aragonite, this new discovery serves as a warning to be regarded in the application of Meigen's test. The author determines (p. 74) the violet precipitate on aragonite from a concentrated solution of cobalt nitrate as $2CoCO_3+3Co(OH)_2+H_2O$, and the blue one on calcite as $CoCO_3+3Co(OH)_2$.

Prof. R. B. Young, in describing the calcareous rocks of Griqualand West (Trans. Geol. Soc. of S. Africa, vol. ix., 1906, p. 59), shows how oolitic dolomites have been converted into granular quartzites, and supports the late Mr. Rutley's views as to the origin of certain "metasomatic quartzites." Mr. G. Abbott illustrates many of the well-known forms of concretion in the Durham dolomite in a general paper on concretions (Trans. South-Eastern Union of Sci. Societies, 1907).

Messrs. T. M. Reade and Philip Holland continue their researches on our much-neglected sedimentary rocks with the analysis and discussion of a series collected near Ludlow. A full analysis of the Titterstone Clee dolerite is also given (Proc. Liverpool Geol. Soc., 1907).

Lastly, Mr. R. A. Daly's paper on the limeless ocean of pre-Cambrian time (Amer. Journ. Sci., vol. xxiii., 1907, p. 93) raises many important questions as to the mode of origin of pre-Cambrian sedimentary rocks. The author holds that the land-areas of Eozoic times were of insufficient extent to supply enough lime to the ocean for the demands of shell-forming organisms. The continuous decay of abundant soft-bodied animals precipitated, moreover, as calcium carbonate what little lime entered the seas; the magnesian limestones so frequently found in pre-Cambrian sediments were also deposited as inorganic rocks by the prolonged action of the ammonium carbonate after the lime salts had been dealt with. It was only when, in Cambrian times, land-areas became more pronounced that shell-forming animals could become common; hence the rather abrupt transition from beds almost devoid of fossils to those with an abundant fauna. All this gives the reader food for meditation, and brings the petrographer, as is fitting, into the field of evolutionary geology.

G. A. J. C.

THE INSTITUTION OF MINING ENGINEERS.

THE forty-eighth general meeting of the Institution of Mining Engineers was held on June 4 and 5 in London in the rooms of the Geological Society. Mr. C. E. Rhodes read his presidential address, in which he stated that steps were being taken to transfer the headquarters of the institution to London. The main portion of his address was devoted to a consideration of some of the problems with which the rising generation of mining engineers will have to deal, namely, the sinking of deep shafts through water-bearing strata, the depth to which tubbing can be put in, improved methods of splitting the air which will be required at great depths for cooling down the working places, and the method of dealing with dust, which in all probability will be abundant in deep mines.

The first paper read described the mineral resources of Trinidad. The author, Mr. John Cadman, gave a brief account of the gold ore, iron ore, graphitic schist, limestone, and coal known to exist, and dwelt more fully upon the bituminous minerals, which are of great economic importance. In a mine of the bitumen known as manjak an explosion occurred in 1904, causing the death of seventeen miners. A sample of gas examined by the author contained 14·00 per cent. of oxygen, 11·10 per cent. of carburetted hydrogen, 1·60 per cent. of hydrogen, and 73·30 per cent. of nitrogen. It is suggested that the deficiency in oxygen is due to the absorptive properties of the manjak. During the meeting several other papers of scientific interest were read. Mr. J. B. Tyrrell described the recently discovered mineral veins of cobalt in Ontario. Mr. Greville Jones gave an account of the various types of calcining kilns for iron ore. Mr. C. B. Wedd and Mr. G. C. Drabble described the occurrence of fluor-spar in Derbyshire. The longest paper read was by Mr. S. L. Thacker, on winding-engine tests. He recorded the results of his own experience, pointed out some sources of loss, and suggested the lines on which winding-engine tests should be carried out.

In connection with the meeting, excursions were arranged on June 4 to a diving demonstration at Lambeth under the supervision of Dr. J. S. Haldane, on June 5 to the mining and metallurgical section of the Franco-British Exhibition under the guidance of Mr. Bennett H. Brough, and on June 6 to the South Metropolitan Gas Company's tar works. A new self-contained diving apparatus suitable for work in mines was exhibited for the first time. The supply of oxygen is automatic, and is furnished to the diver mixed with 60 per cent. of air. At the Franco-British Exhibition Sir Hugh Bell received the visitors in the Machinery Hall, and gave an account of the collective pig-iron exhibit and the other objects of interest in the iron and steel section. The French mining section, in which the scientific aspects of working are well shown, was much appreciated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—On Monday, June 8, Mr. William Bateson, F.R.S., was elected to the chair of biology, which has been established for five years largely owing to the generosity of an anonymous benefactor. Mr. Bateson, who was born in 1861, is a son of the late Rev. W. H. Bateson, D.D., Master of St. John's College, and has been a fellow at the same foundation since 1885. He was educated at Rugby School, and held the Balfour studentship from 1887 to 1890; for many years he has been one of the leading workers in England on heredity and variation, and has published several important treatises on these subjects. In 1904 he received the Darwin medal of the Royal Society.

Mr. A. R. Hinks has been re-appointed chief assistant of the observatory for a period of five years from June 24, and Mr. W. E. Hartley has been re-appointed an assistant of the observatory for a period of five years from July 13.

Prof. Thomson gives notice that the new building of the Cavendish Laboratory will be opened by the Chancellor on Tuesday, June 16, at 4 p.m. In consequence of the limited accommodation, admission will be by ticket only.

In the forty-second annual report the museums and lecture-rooms syndicate records a gift of 500*l.*, made by Mr. Frank Smart, for the purchase of additional furniture and fittings in the museum of botany. The library in the department of physiology has been materially increased by many books formerly in the possession of Sir Michael Foster; the library of the medical school has also received many additions, including a large number of pamphlets and books presented by Sir T. Clifford Allbutt, K.C.B. The Woodwardian professor records several important additions to the museum, especially a fine series of slates, marbles, and rocks of economic value, which have been presented by Mrs. J. F. Walker, of York. The syndics' accounts for the year show a balance in favour of the maintenance fund of 330*l.* 4*s.* 4*d.*

The prize of 50*l.* out of the Gordon-Wigan fund for a research in chemistry has been awarded to Mr. L. A. Levy for his research entitled "Investigations on the Fluorescence of Platinocyanides."

Notice is given that a prize of 50*l.* out of the Gordon-Wigan fund will be awarded at the end of the Easter term, 1909, for a research in chemistry, of sufficient merit,