agreeing with the normal white equation, agree with it when the comparison white is diminished in intensity.

The facts in this article, whilst in complete accord with those previously given ("The Physiology of Vision," G. Bell and Sons, 1920), are inconsistent with any theory of three fundamental sensations of which the other colour sensations are compounded.

Defects of light perception are quite distinct from defective colour discrimination. All degrees of colour discrimination may be classified as dichromic, trichromic, tetrachromic, pentachromic, hexachromic, and heptachromic. This classification is fact and not theory. For instance, the dichromic have two colour sensations, red and violet, with a neutral division in the spectrum. There are innumerable varieties of dichromic vision, as there may be shortening of either end of the spectrum or defects in the luminosity curve. When the luminosity curve is the same as the normal there is no evidence to show that the perception of white is not the same as the normal.

I must express my indebtedness to Capt. Fulton and Mr. Isaacs, of the Board of Trade, for their help in making these observations.

Regional Geology.

OUR knowledge of the geology of England is enriched by Dr. J. E. Marr's conception (*The Naturalist*, February, 1921) of Yorkshire as an earth-block surrounded by down-folded strata, but with its own Carboniferous series little disturbed, owing to the rigidity of a pre-Cambrian mass beneath. The block, which became tilted somewhat to the east, has had an important effect on the drainage, and even on the progress of ice-sheets, in northern England.

A useful summary and map of the geology of Jersey, by G. H. Plymen, appear in the Proceedings of the Geologists' Association, vol. xxxii., p. 151 (1921), a journal that has maintained its characteristic features despite the difficult conditions following on the war. The Geological Survey should find a ready sale, even at the price of 10*s.*, for its "Short Account of the Geology of the Isle of Wight," by H. J. Osborne White (1921), which contains a coloured geological map on the scale of one quarter of an inch to one mile. The second edition of the memoir that it succeeds is now exhausted, and we must look back on that handsome cloth-bound volume, issued at 8*s.* 6*d.*, with the customary regret. But Mr. White's treatise is not a mere abridgment of the older one, since he brings to the work his wide knowledge of the south-east of England, and of the literature of the intervening thirty years. He adds original drawings, showing the development of the surface and the relations of the rocks to well known scenic features, and geologists who are fortunate enough to possess the memoir by Reid and Strahan must now add its successor to their libraries before they start once more for the island. Here, again, the question is raised as to whether memoirs by public surveys should be supposed to cover their own "cost of production," or whether their dissemination should, as in Canada and the United States, be regarded as a part of public education.

Dr. Arthur Winkler, as Ordnance-officer of the 7th Gebirgsbrigadecommando, was stationed at Santa Lucia, near Tolmino, in 1916, and found time to extend F. Kossmat's researches on the central Isonzo valley. He remarks, in the true spirit of science, that the war had inflicted wounds on the mountain-sides, and that many new exposures required registration. His observations, continued in 1918, are now recorded in a paper in the *Jahrbuch der geologischen 'Staatsanstalt*, vol. lxx., pp. 11–124 (1920), illustrated by numerous sections showing the Alpine folding of the strata, from the Triassic limestones to flysch of Eocene age. Glacial beds, dumped down into the valley, play an important part in the dusty groove, and walls of pebbly calcicrete are undermined by the green swirls of the Isonzo. Above them tower the crags of contorted limestone, marked by brown scars where slabs of rock have fallen away. Dr. Winkler's work brings back happier memories than those recently associated with the Bainsizza Plateau and Caporetto.

The Geological Survey of India issues a handsomely illustrated memoir, by C. S. Middlemiss, on Idar State, which lies on the tropic in the north-east of the Bombay Presidency. Evidences of solar weathering are given in the fine views of granite surfaces. The main interest of the district lies in the junction of the Delhi quartzite with the underlying series of Aravalli schists and gneisses. Quartzite blocks again and again appear to be stoped off into the Aravalli rocks; but the latter cannot in all cases be regarded as igneous invaders. The author suggests that the igneous masses which penetrate the Aravalli series softened the metamorphosed sediments until they behaved as a semi-solid or plastic mass. The floor of Finland seems to offer much support to his conclusions.

Dr. W. F. Hume, untiring in his surveys of barren lands, has issued, with his colleagues, a preliminary report on Abu Durba (Western Sinai). This bulletin, dated 1921, is No. 1 of a series on petroleum research. The oil that is traceable at Abu Durba seems to have been absorbed from shales into the Nubian sandstone, and may originate (p. 11) in organic matter washed down with the shale-particles into the Cretaceous sea.

A. L. Du Toit (Union of S. Africa, Geol. Surv., Explanation of Cape Sheet 28, 1920) traces in Pondoland the great monoclinal flexure that, as Penck showed, is responsible for the edge of the plateau-lands of south-eastern Africa. The down-folding has determined the coast-line, and ceased about the close of Cretaceous times. The inland region, however, continued to rise, since Upper Cretaceous beds, near East London, occur 1100 ft. above the sea. The shelves over which the rivers reach the sea represent successive stages of the uplift. One is inclined to ask once more: When was the great peneplain of the plateau-surface formed? How has it escaped dissection inward from its Eocene edge? Has it been perpetuated by wind-action in a region where rains are only seasonal and droughts are more prevalent than rains?

The first pamphlet of the Geological Department of Uganda (Entebbe, 1920) is written by E. J. Wayland, and is intended to direct the attention of residents to the interest of geological features. The prevalence of laterite is discussed; but we should hesitate to say that the iron was "from the first" in the state of hydrous oxide. Glauconite, mentioned in connection with clays, is a silicate and not a phosphate. Are not the cubic pseudomorphs in the argillites (p. 11) more likely to have been originally pyrite than rock-salt? The author introduces (p. 36) a useful geographical term, *arena*, for undulating areas more or less completely surrounded by hill-ranges. These areas are shown to result from the denudation of domes of strata, and rivers run through the surrounding walls. The Woolhope inlier may thus be called an arena, and numerous examples occur in the

Old Red Sandstone and Silurian country of Southern Ireland.

From Australasia we receive comprehensive descriptions of the "Palæozoic Geology of Victoria," by E. O. Teale (Proc. Roy. Soc. Victoria, vol. xxxii., p. 67), with a map of the Mount Wellington area; also of the "Geology of Western Australia," by A. Gibb Maitland, extracted from the Mining Handbook published in 1919 by the Geological Survey. The latter memoir has excellent sketch-maps and illustrations throughout the text, and includes a large coloured geological map of the State, dated 1920, corresponding with that described in NATURE, vol. cv., p. 498. This summary should be serviceable in very many libraries in the homeland, and should be made available in all Australian schools.

In Bulletin 21, at the moderate price of 5*s.*, the New Zealand Geological Survey continues its illustrated descriptions of the Dominion. The Osborne and Whatatutu subdivisions, which are here dealt with by J. Henderson and M. Ongley, lie on the east side of North Island, and include peaks rising to 4000 ft. on the main divide. Oil is found in the district, probably oozing from the Te Arai (Lower Miocene) and Cretaceous strata. As usual in these bulletins, the authors pay full attention to the origin of surface-features, and one of their pleasing landscapes shows us, incidentally, the gathering of thousands of sheep under the raised rock-platform of Waihau Beach.

New Zealand now extends its responsibilities to Pacific isles; and J. Allan Thomson describes (*N.Z. Journal of Science and Technology*, vol. iv., p. 49, 1921) the geology of Western Samoa. The lava-tunnels appear to have been used as dwellings, and terraces for sleeping-accommodation have been built up in them—a feature that will pleasantly remind playgoers of the opening scene of Kelly's "Bird of Paradise."

Among American publications, we may note, for comparison with the Triassic beds of Cheshire, the cemented sand-dunes of Eocene age in north-eastern Montana (A. J. Collier, U.S. Geol. Surv., Prof. Paper 120–B, plate iv.), and the cross-bedded De Chelly sandstones (Permian?) of Arizona (H. E. Gregory, *ibid.*, Prof. Paper 93, p. 31, etc.). The latter paper, which is on the "Geology of the Navajo Country," contains notable illustrations of erosion in an arid land. E. G. Fenton (Sci. Proc. Royal Dublin Soc., vol. xvi., No. 19, 1921, 4*s.* 6*d.*), in his "Studies in the Physiography and Glacial Geology of Southern Patagonia," brings us to an unusual field. He has specially examined, through years of residence, the results of glacial outwash and of river-erosion between the Andes and the Atlantic coast. He interestingly attributes the hollows known as *bajos* to the action of water falling over an ice-front during a pause in the general retreat of the pampas glaciers. Though he traces several epochs of retreat and of renewed glaciation, during some of which lavas flowed down into valleys cut by rivers streaming from the ice, Dr. Fenton finds no evidence of any genial interglacial epoch in Patagonia.

G. A. J. C.

Artificial Farmyard Manure.

AN article in the current issue (August) of the *Journal of the Ministry of Agriculture* under the above title somewhat modestly announces what must be regarded as one of the most notable advances in agricultural science made by our oldest agricultural research laboratory, the Rothamsted Experimental Station. For many years the composition and fertilising value of farmyard manure have occupied the attention of investigators. The chemical problems involved at first sight appear simple. When cattle are fed with food rich in nitrogen there is a corresponding enrichment of their excrement. "Cake-fed" dung has long been given a high value by the farmer, and on a purely chemical basis its merit was recognised by the man of science. Hence such publications as "Hall and Voelcker's Tables," which give the "residual" values of various foodstuffs—that is to say, the value of the fertilising constituents (mainly nitrogen) in various substances present in the dung of animals to which they have been fed. But the perplexing fact emerged that dung with this higher theoretic value did not give crop increases corresponding to its assumed chemical content. Nevertheless, so strong has been the effect of the publication of these theoretic values that they are given quasi-statutory effect. Entering tenants have generally to pay compensation "for improvements" based upon the quantity and quality of the foods consumed on the farm during the years preceding their entry.

In the paper alluded to Messrs. Hutchinson and Richards indicate the solution of the conundrum. Put shortly, they have established that the whole of nitrogen in the urine of animals will not be present in the manure as applied to the crops unless a certain ratio subsists between the nitrogen voided by the animals and the carbonaceous matter of the litter by which the urine is absorbed. It seems to follow that "compensation for improvements" should not be awarded on the basis of the food supplied to the stock until the valuer is assured that the feeding was accompanied by an adequate supply of litter, the adequacy being determined by the amount of nitrogen voided by the animals.

Messrs. Hutchinson and Richards show that the factors involved are, in the main, biological, not chemical. The "making" of farmyard manure is essentially the rotting or fermentation of straw. The former writer has published a paper (*Journal of Agricultural Science*, 1919, p. 143) which establishes that straw is fermented by a new aerobic organism, *Spirochaeta cytophaga*, and that this organism requires (in addition to air) a supply of nitrogen, preferably in the form of an ammonia compound (such as, in effect, urea is). It is shown that the amount of nitrogen required for the fermentation of 100 lb. of straw is 0·72 lb. Further, if the nitrogen is in excess of this amount, it tends to pass into the atmosphere as ammonia, with the result that, with a free supply of air, the end product is dung containing about 2 per cent. of nitrogen, *whatever* the original content of the excrement may have been. Under the conditions, however, which obtain in the ordinary farmyard, where some portions of the heap may receive more excrementitious matter than others, the ammonia set free where the nitrogen : cellulose proportion is greater than 0·72 : 100 may be picked up by those portions where the ratio is less, and used to build up their nitrogen content until the whole heap reaches the characteristic and uniform 2 per cent. content of nitrogen.

Using these results, it has been found possible to make an artificial product, closely resembling farmyard manure in appearance as well as in properties, by