described in (1) below. Complete identification of all of the rootstocks was not attained by using dimethoxypropane alone; so the extractions were subjected to reactions with salts of heavy metals. Of the thirty-six salts tried, anhydrous aluminium chloride, when used with dimethoxypropane, was the best. See (2) below.

(1) Freshly dug roots, ⅜ in. diam. and larger, are washed free of dirt and wiped dry. The bark is cut through to the cambium and into pieces ¼ in. square and smaller. 10 gm. of the fresh bark are placed in a bottle. 15 ml. of 2,2-dimethoxypropane 98 per cent (Dow Chemical Co.) are added, and the mixture is allowed to stand for 30 min. at room temperature. Then single drops of the extraction are placed with a medicine dropper on a sheet of Whatman No. 1 filter paper. It will be noticed in Fig. 1 that the two left-hand vertical columns of spots represent the 30-min. extractions of the eight varieties of rootstocks. The two right-hand columns of spots were made by following the procedure described in the next paragraph.

(2) Arrange a series of clean, dry, 10 mm. × 75 mm. test-tubes, one tube for each rootstock. In each tube place 0·1 gm. of anhydrous aluminium chloride. This should be done ahead of time so that, immediately following step (1), 1·5 ml. of each of the 30-min. extractions may be added separately to 0·1 gm. of the aluminium chloride. Shake the tubes and allow them to stand for 30 min. At the end of that time single drops of the supernatant fluid in each test-tube are placed on the filter paper in the two right-hand columns. The spots should be allowed to dry thoroughly before comparisons are made between the known and unknown varieties.

The spots tend to deteriorate in a day or two. Precautions should be taken to prevent the spots on one sheet from spoiling those on other sheets which may be piled on top or below by inserting each sheet between a folded piece of wax-paper.

Unused roots may be kept for 2 or 3 days in plastic bags in a refrigerator at 4° C. or less. One batch of roots was kept in a food freezer at 0° C. for 34 months. The fluorescent spots of all of the varieties were within the usual range of colours except for the sweet rootstocks.

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Perceptual Stability of a Stroboscopically Lit Visual Field containing Self-Luminous Objects

It is a familiar observation that when the retinal image is displaced as a result of an externally forced rotation of the eyeball (for example, by light sideways pressure with the finger), the visual world appears to move; whereas when the same rotation is produced voluntarily the visual world remains stable. This stability is often attributed to some (as yet unknown) process by which the effects of retinal change are thought to be accurately compensated or cancelled out during voluntary movement.

In the course of experiments designed to explore a different hypothesis[1], a rather striking phenomenon has been observed. If a room containing self-luminous objects (such as the cathodes of thermionic valves) is lit stroboscopically, it is found that at rates of flash down to some 15 per sec. the effects of pressing the eyeball intermittently (say, twice per sec.) and very lightly, are similar to those in ordinary light. At rates of some 5 or 6 per sec., however, a remarkable disparity is observed between the apparent motion of the self-luminous objects and that of the rest of the room. The glowing cathode of a valve, for example, appears to move whereas its envelope remains at rest, although surprisingly enough their relative positions can be clearly seen to be unaltered. A similar violent perceptual disturbance occurs with an artificial nystagmus, induced, for example, by first rotating the observer rapidly about a vertical axis with his eyes closed. The effect seems insensitive to level of illumination over the range used (0·3–3 Joules per flash), and has been described in similar terms by all of some fifty observers to date. To by-pass speculations invoking distortion of the eyeball, it may be said that the same disturbance occurs when the retinal image is displaced by moving a prism or mirror before the eye.

The apparent movement of the self-luminous objects would seem to be interpretable as the normal result of involuntary displacement of their retinal image, since that image is thrown continuously upon the retina. What is at first sight surprising (especially on any theory of 'compensation') is the relative stability of the stroboscopically lit room. It seems clear that a discontinuous displacement of the retinal image is not so powerful a stimulus for the perception of world-movement as when continuous motion produces the same displacement. If the eyeball is lightly pressed and held in its new position, the stroboscopically lit field is seen to move sluggishly to 'catch up' with the self-luminous objects, requiring several flashes to do so. The interesting conclusion suggested is that the magnitude of perceived movement is a function of the amount of information (in the technical sense) supplied by the retinal image, rather than of the magnitude of its displacement.

Two related observations seem to support this tentative conclusion. First, even in normal light the motion perceived during involuntary rotation of the eyeball seems to most observers to be greater in the central than in the peripheral parts of the field. This again suggests that the greater density of foveal information is transformed into a greater magnitude of perceived motion. Secondly, when a retinal image of radial lines (such as my 'ray' figure[2]) is involuntarily displaced, the normal apparent movement of the centre is accompanied by a fanwise movement of the rays lying nearest to the line of motion. The pattern appears to open out, as if on a distended rubber sheet, on the side away from which the centre moves, and to contract on the opposite side. The effect is suppressed if a line is drawn across the pattern at right angles to the rays concerned. The suggested inference is again that the magnitude of motion perceived is greater in those directions in which more information is generated by the retinal displacement.

The foregoing observations afford some encouraging confirmation of the hypothesis I have put forward[1]—this having, for once, had the good fortune to be advanced ahead of them on theoretical grounds. Briefly, the argument is that if perception is the adaptive 'keeping up to date' of an organism's state of organization for activity in its world[3], then what requires informational justification is not the maintenance of stability but the perception of change. The internal state of organization, which implicitly represents the perceived world, should remain unaltered unless sufficient information (in the technical sense) arrives to justify a change, by indicating that the current state of organization is significantly mismatched to the state of affairs sampled by the receptor system[4].

Thus the retinal changes resulting from voluntary movement evoke no perception of world-motion, because they are not an awkward consequence to be compensated, but part of the goal to be achieved. If these changes are prevented from occurring, for example by stabilizing the retinal image, the absence of retinal change evokes an impression of movement.

From this point of view, all the anomalies reported above make some sense as evidence that: (*a*) perceptive activity is relatively detached from that of the receptor system; (*b*) in sampling the receptor field, the perceptive system is relatively insensitive to the position of the image, and demands a combination of evidence exceeding some 'threshold of significance' before it responds by the perception of a change; (*c*) the strength of the impression of change depends on the total amount of information validating a change in the state of organization—in other words, it depends on the informational weight attached to discrepant samples from the receptor system; (*d*) the change perceived, however surprising to the observer, is always the most parsimonious which will match the discrepant information; perception would appear to be organized on the conservative principle of a null-hypothesis.

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Sub-aerial Volcanicity in Snowdonia

Extensive recent work in south-central Lleyn (F. J. F.), Beddgelert (N. R.) and the pass of Llanberis (F. J. F. and N. R.), supplemented by observations from the pass of Aberglaslyn (R. V. B.) warrants a new interpretation of Snowdonian volcanics of mid-Ordovician age.

It appears now that the acid volcanics of Snowdonia exhibit many phenomena found in areas where recent volcanicity has been in progress (for example, New Zealand, Alaska). Four main features of Snowdonian volcanics are worthy of emphasis. (1) The bulk of the volcanics consist of ignimbrites or welded tuffs. A wide variety of these rocks are found ranging from fine dusty varieties (National Grid No. $SH_{(2)}576_{(3)}509$) to coarse welded agglomerates ($SH_{(2)}632_{(3)}563$). The general absence of bedding and the widespread presence of flattened vesicles in these rocks is suggestive of sub-aerial rather than submarine deposition of the glowing avalanches. Frequent vertical explosive shoots and tuff pipes traversing the ignimbrites are now recognized (for example, $SH_{(2)}593_{(3)}525$). The tuff pipes are probably produced by fumarolic action similar to that recorded from the Valley of Ten Thousands Smokes, Alaska.

(2) In many cases extrusion of basic lavas preceded the deposition of welded tuffs. Well-preserved top surfaces of ropy lava have been found suggesting that the top of the flow was sub-aerial. Since these lavas are often blocky or even pillowy at their lower boundary, where they are often mixed with muddy sediments, a transition from sub-marine to sub-aerial conditions must have taken place during their extrusion. The basic lavas have been mapped by H. Williams[1] as deformed dolerites.

(3) The acid deposits often contain rocks previously called 'the nodular rhyolites'. There are several varieties of 'nodular rhyolites', each originating in a different way. For example, some of the so-called 'nodular rhyolites' near Beddgelert are spherical bodies of medium grain welded tuff in a matrix of a fine grain welded tuff.

(4) Near Pont y Gromlech in the pass of Llanberis a volcanic centre has been recently identified. West of Pont y Gromlech a vent of agglomerate ($SH_{(2)}623_{(3)}565$) traverses the grits and slates of the Gwastadnant Group terminating in the Lower Rhyolite Tuff. Hereabouts, the main volcanic sequence is underlain by deposits consisting of large boulders of grit, slate and volcanic material in muddy or silicified matrix. These deposits seem to represent mud-flows (lahars), which preceded the main Snowdonian ignimbrites.

The presence of welded tuffs in Snowdonia was first recorded by Oliver[2], who identified as such a thin section from Capel Curig. Our work suggests that the bulk of Snowdonian acid volcanics are welded tuffs with subsidiary basic lavas. If so, then the thickness of such deposits has no direct bearing on the proximity to the volcanic centres, since the modern welded tuffs are known to thicken in the pre-existing topographic hollows (for example, see Enlows[3]). That the main Snowdonian ignimbrites were deposited on an irregular surface possessing such hollows has been now proved by detailed mapping of the well-exposed lower boundary of the Lower Rhyolite Tuff near the Pen-y-pass Hotel, Pass of Llanberis.

In so far as their mode of extrusion is concerned, accumulating evidence suggests that the Snowdonian volcanics were derived from numerous small sub-aerial explosive vents, such as have been recognized in the Pass of Llanberis and in Lleyn. These vents are associated with intrusive rhyolites but, contrary to Matley's[4] opinion, not with granophyre or microgranite intrusions.

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