matters arising

Nonradioactive silver

SIR,—Lindner *et al.*[1] described the detection of small amounts of radioactive silver isotopes (^{108m}Ag and ^{110m}Ag) in silver bars from an eastern European source. They suggested that the activity may have originated from any one of several causes: nuclear mining, that is, the breaking up of rock before the removal of the ore, using nuclear explosions; neutron irradiation of the ore after it was mined; the introduction of silver isotopes into the melted silver during processing; or irradiation of the silver bars.

Another possibility has been suggested by Boyle[2]. An intimate contact of silver, uranium and light elements such as boron, might produce, through (α, n) reactions, enough neutrons to give measurable events of ^{108m}Ag ^{110m}Ag. This phenomenon could occur in uranium deposits of the vein type, which are found in eastern Europe.

We have checked this speculation by counting specimens of silver ore collected from the Echo Bay Mine (near Port Radium), Great Bear Lake, Canada[3]. Ore samples from this vein-type uranium deposit included two pieces of massive native silver mined from uraninite-rich areas of the 302 Stope, and a third sample from an occurrence of pitchblende, 206A W Drift in the mine, containing veinlets of native silver. The first two samples were counted directly but in the latter case the silver was separated from the ore by dissolution in nitric acid. The silver was therefore in intimate contact with the pitchblende until a few hours before it was counted.

For counting, a 70 cm^3 Ge(Li) γ-ray detector and multichannel analyser were used. The sensitivity was 10 nCi, the same as that of the NaI(T1) detector used by the Dutch workers. Since we did not possess an anticoincidence array, we were compelled to count for several days in order to achieve this. In all three cases there was no measurable ^{108m}Ag or ^{110m}Ag in the samples. On the basis of the Dutch work, we would have expected to have detected as much as 3 μCi.

We conclude that, at least for our samples, uranium does not produce significant activity in the silver associated with it. In view of the calculated low neutron flux[2], this is not surprising. Our conclusion can probably be applied to similar ore bodies.

R. W. Boyle (personal communication) cannot find any reported nuclear detonations which correlate with the time of origin of the activity as calculated by the Dutch workers. We agree with their current view (personal communication) that the most likely source of the reported activity is the addition of silver tracer to the silver during some stage of the refining process.

Yours faithfully,

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Great Glen Fault

SIR,—Detailed mapping of the regional metamorphic pattern of the central and northern Highlands has led to the conclusion that a post-metamorphic sinistral shift of 160 km must have occurred along the Great Glen Fault[1]. A reappraisal of the considered data suggests, however, that the proposed shift probably represents a minimum estimate; a displacement of 200 km would, for example, fit the data equally well but even this figure cannot be taken as a reasonable upper limit of possible strike-slip movement.

The most likely northward continuation of the Great Glen Fault is through the Walls Boundary Fault in Shetland[2]. This provides a slight curvature in the fault line which seems to have an important geophysical bearing on the displacement problem. Thus, it can be shown[3,4] that a certain discordance in Devonian palaeomagnetism across the Great Glen Fault can be fully explained by incorporating a late or post-Devonian sinistral shift of at least about 200 km. At present, palaeomagnetic results cannot be used to set an upper limit of the actual movement but a displacement of at least 250 km is possible. What is really important at this stage, however, is to stress that a geophysical and a geological method have both led to practically identical palaeogeographic reconstruction of Scotland, which involve a transcurrent movement, at least twice as large as previously suspected along the Great Glen Fault. Consideration of the lower age limit of this movement (provided by palaeomagnetic results) seems to indicate that the Strontian and Foyers granites (K/Ar ages of around 400 Myr, ref. 5) never formed part of the same intrusive complex.

Yours faithfully,

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DR WINCHESTER replies: Storetvedt's comments are very welcome. The suggested displacement of 160 km was chosen as the optimum fit of the metamorphic patterns in the opposing blocks. A precise metamorphic zonal correlation across the fault is not possible because on opposite sides of the fault, Moinian rocks are concealed beneath Devonian sediments east of Inverness, and beneath Tertiary volcanics in Mull. The zonal pattern may therefore be extrapolated across these areas to fit a post-metamorphic displacement of between 140 and 200 km along the Great Glen Fault, before it becomes impossible to match without requiring an unjustified warping of the metamorphic pattern adjacent to the fault. A displacement of 250 km is therefore not supported by the metamorphic evidence. It is significant, however, that the maximum displacement allowed by the metamorphic pattern, and the minimum shift indicated by Storetvedt's palaeomagnetic work should agree so well.

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McCollough colour after effect

SIR,—McCollough[1] demonstrated a striking, long lasting colour after effect. Observers adapted (2–4 min) to a vertical grating of black and orange stripes alternating with a horizontal grating of black and blue stripes. Thereafter a pattern made up of a black and white vertical grating and an adjacent horizontal grating appeared tinted with colours complementary to the adapting colours. The

vertical grating appeared blue-green and the horizontal grating appeared orange.

Piggins and Leppmann[2] repeated the McCollough-type experiment with the adapting pattern stabilised on the retina by the conventional contact lens method. They were unable to build up the after effect with a stabilised image. They concluded that the eye must scan the adapting pattern to generate the after effect, and explanations of the after effect must include 'image motion mechanisms'.

Our experiments show that the after effect requires no retinal image motion. Four observers adapted to a high contrast sine-wave grating of two cycles per degree flashed on an oscilloscope field that was 12° in diameter. The observer carefully fixated a tiny light in the centre of the field and then pressed a button which presented a stationary grating for one 9 ms sweep. The luminance of the P4 white phosphor, as measured with a 1P22 phototube, fell to $1/e$ of the peak value in 1 ms. The field was dark between flashes. The grating was presented in a different, random position on each flash and could be vertical or horizontal. When vertical, it was viewed through a Wratten 30 magenta filter (or a Wratten 11 yellow-green filter) and when horizontal, through the yellow-green filter (or magenta filter). The mean luminance of the gratings through the filter was about 4 cd m^{-2}. The observer presented himself with a grating about every second for a total of 2,000 times. Every 50 flashes, the grating changed orientation and colour. After effects were built up to counter any initial colour bias that the observer reported while viewing black and white test gratings before adaptation.

All observers saw weak McCollough after effects of pink and green on a test pattern consisting of adjacent vertical and horizontal square-wave gratings of two cycles per degree. The pattern was viewed in fluorescent room light. The colours were more pronounced when the mean luminance was reduced considerably—from 100 to 0.1 cd m^{-2}.

Retinal image motion during adaptation cannot be completely ruled out in this experiment. It has been shown,[3] however, that movements greater than 1 min of arc are very unlikely during attempted fixation of a target which is exposed for less than 20 ms, and the retinal image is virtually stationary for exposures less than 10 ms. The second experiment eliminates even these tiny retinal image movements.

High contrast vertical and horizontal square-wave gratings of two cycles per degree were placed on a diffusing screen to form two fields 9° in diameter. These patterns were illuminated from the rear by Grass photo-stimulators rated at about 10^6 candles. Measurements showed that the flash lasted less than 60 μs. The lights did not appear bright, and the after image they produced lasted 1 or 2 s. Four observers viewed the vertical grating through the magenta filter and the horizontal grating through the yellow-green filter. To spread the adaptation evenly over the retina, four tiny lighted fixation points were placed on each grating, separated by phase angles of 90° with respect to the fundamental period of each grating. The observer triggered the flash about every 2 s while fixating one of these lights. Each fixation light was fixated equally often. Total adaptation was 200 flashes, with alternation between the vertical and horizontal grating every 20 flashes.

All observers reported seeing the McCollough effect, which was very evident. The colours were still seen 30 min after adaptation. This experiment shows that no retinal image motion is required to build up the McCollough effect. Our method of stabilising the image has the advantage over the contact lens method in that the image does not fade over time, and is thus a potent stimulus.

Retinal image motion is thus not required for the McCollough effect. Flashed gratings and gratings stabilised by the contact lens method might well cause movement mechanisms to fire and thus adapt. But the optimal stimulus for these mechanisms is a pattern moving in a specific direction. Thus, these experiments tell us nothing about movement mechanisms. It is possible, however, to generate McCollough effects selective to the direction of motion[4,5].

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Mouse granulocyte precursors and multiple sclerosis

Sir,—Brown and Gajdusek[1] have recently reported failure to reproduce the suppression of peripheral blood granulocytes which was described[2] in mice following inoculation of material from patients with multiple sclerosis (MS).

We have also studied the effect on groups of ten weaning C57BL and CBA mice of intraperitoneal inoculation of 0.2 ml serum or brain extract (prepared as in ref. 2) from patients with MS. In agreement with Brown and Gajdusek, we found no differences in peripheral blood granulocyte levels up to 35 d after inoculation between mice inoculated with MS material, normal human serum, normal human brain or saline.

We used the agar culture technique for granulocyte-macrophage colonies[3] to enumerate granulocyte-macrophage precursor cells (colony-forming cells, CFC) in the marrow and spleen of inoculated mice, and in addition measured serum levels of the myelopoietic colony-stimulating (CS) factor[4]. Table 1 shows that 34 d after inoculation of MS brain extract into groups of 5 weanling C57BL mice there was no depression of granulopoietic potential compared with similar mice given normal brain extract or the medium used to prepare the extracts.

Table 1 Colony-forming cells after inoculation of normal and MS brain.

Material inoculated	CFC per femur ($\times 10^{-3}$)	CFC per 10^6 spleen leukocytes	Serum CS activity
Medium	42 ± 17	25 ± 15	10 ± 7
Normal brain	45 ± 10	19 ± 8	8 ± 5
MS brain	61 ± 6	16 ± 7	15 ± 7

In this experiment the mice inoculated with MS brain actually showed a statistically significant increase in CFC per femur (but not in spleen which is usually a more sensitive indicator of changes in CFC populations[5]) compared with the mice given normal brain ($0.01 > P > 0.005$). No consistent differences in any of these parameters were found, however, between MS serum-inoculated mice and controls when tested in both C57BL and CBA strains.

We thank Dr J. H. D. Millar for sera from his MS patients, Dr Margaret Haire for specimens of normal and MS brain and the Medical Research Council for financial support.

Yours faithfully,

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