Technical Papers

Apparent Visible Violet Radiation in the Recent Large Sunspot Group

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The appearance of well-defined colors in sunspots, while not unknown, is rare enough to be noteworthy. As far back as 1826 Capocci reported violet tints associated with umbrae; Secchi, at Rome, using a Merz polarizer, saw a rosy tinge to umbrae; while the celebrated Herr Schwabe of Dessau saw occasional umbrae which were reddish-brown. Miss Brown, of Harvard, noted occasionally red-tinted umbrae. Young saw *all* umbrae as deep purple rather than black (*1*), but was disposed to regard this color as false and caused by the secondary spectrum of achromatics. However, it is clear that the *occasional* nature of the phenomenon rather disposes of the argument in favor of color by contrast, overcorrected objectives, etc. Moreover, such colors often have been seen in spots immediately adjacent to others which showed no color at all.

The normal color scheme of a sunspot is black and gray, the umbra being black and the penumbra, gray to yellowish-gray. Although Young fancied all umbrae to be very dark purple, to most eyes they appear as simply black by contrast with the photosphere. Penumbrae normally vary from very light to dark gray, although the apparent colors of both umbrae and penumbrae will be modified by the color of the helioscope screen.

A recent example of color was afforded by the Great Group of spots which appeared in the sun's northern hemisphere from 29 January to 12 February, and which has now returned to view. These spots, visible to the naked eye, and among the largest ever recorded, caused considerable radio disturbance and induced a brilliant aurora which was plainly seen at the latitude of Baltimore.

The writer first saw these spots on 29 January, when they were just coming around the following limb. By 1 February they were far enough on the disc to be seen well. At that time it was discovered that the so-called Great Group really consisted of three distinct groups: two relatively small groups, followed by an enormous penumbral field which enveloped a number of umbrae. The two principal umbrae of this group were unmistakably of a very dark violet hue, although no other umbrae within the same penumbral field, nor the umbrae of the two groups preceding, showed any color whatever. The penumbra of the largest group was normally gray. The penumbral filaments were distorted and confused, and a brilliant flocculus-like mass was observed, superimposed above the penumbra in its approximate center.

On 2 February the entire penumbra of this group had taken on a red-violet tint, the principal umbrae remaining very dark violet. On the same date the penumbra was found to be much rifted and ragged, and shot through in spots by brilliant eruptions manifested as bright spots within the penumbra.

On 3 February the penumbra had become greatly enlarged in area and had also changed color, now appearing as brown-violet. The two principal umbrae remained dark violet, all other umbrae within the penumbral field appearing normally black. Brilliant spots, rifts, and lanes in the penumbra were frequent, and a brilliant, detached flocculus was seen suspended above the largest umbra. A similar flocculus was observed over the leading umbra of the group immediately preceding the penumbral field group, but no color whatever was seen in the former.

On the following day *all* of the umbrae within the penumbral field group had assumed dark-violet tones, the umbrae in the two smaller groups preceding remaining normally black. The penumbra of the largest group remained brown-violet and continued to exhibit confused filamentation and brilliant eruptions. A detached flocculus was observed over another umbra within the field. It was clear that very violent activity was in progress here, apparently in concert with emission of radiation in the violet and of the spectrum, with invisible but implied emission in the ultraviolet. On the night of 7 February, this group having just passed the meridian, a brilliant aurora was seen in Baltimore even above the city lights.

On 8 February, when this group was nearing the preceding limb, the color of the penumbra had faded out to a pale violet, the principal umbrae appearing dark violet. Again, no color was seen in the adjacent groups. On 4 March when this group was again in position for good observation, the penumbra was seen to be *varicolored*—a sort of orange-brown on the west, fading into neutral gray on the east. The three principal umbrae then visible were deep violet and appeared to be surrounded by a red haze. No color was seen in any other spots on the disc.

The writer would like to emphasize that at no time was color *anticipated*. Moreover, the only previous occasion on which well-marked color had been seen

was in 1928, when the writer was using the 8-inch Clark refractor of the Maryland Academy of Sciences.

The helioscope used in the observations of present date was one which has the effect of reddening the photosphere but is otherwise neutral. It consists of a thin glass slide, smoked to the proper density and mounted in an adapter which screws directly onto the eyepiece. The writer has found this type of screen very satisfactory, since it intercepts the heat perfectly and gives a beautifully defined, natural-colored image of the sun in which the photosphere appears as light orange. Umbrae normally appear black and penumbrae gray against the orange background. The telescope used is a 3-inch one giving splendid definition with very fine color correction. The objective was ground for the writer some years ago by the American Optical Company and stands up perfectly with respect to color on even such bright objects as Jupiter when seen against a dark sky. It is felt, therefore, that the observations cited above were observations of fact and not mere illusions.

Reference

1. YOUNG, C. A. *The sun.* New York: Appleton, 1881. Footnote, p. 117.

The Activity of Synthetic Folic Acid in Purified Rations for the Chick[1]

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Previous studies have shown that vitamin B_{10} and B_{11} preparations (*3*), impure folic acid (from University of Texas) (*4*), crystalline isolated third *L. casei* factor (*4, 6*), and pure isolated vitamin B_c (*5*) have activity for growth, feathering, and hemoglobin formation in growing chicks. These earlier studies were necessarily limited by the lack of pure material or sufficient quantities of the compound. Since synthetic folic acid,[2] which has been reported active for growth and hematopoiesis (*1*), has now become available, it is important to study the activity of this compound under our experimental conditions.

Experimental method. Day-old White Leghorn cockerels from a commercial hatchery were maintained in electrically heated cages (32–37°) with raised screen bottoms for three or four days on a basal ration with the following percentage composition: dextrin, 61; casein, 18; gelatin, 10; l-cystine, 0.3; salts V (*2*), 6; soybean oil, 5; α-tocopherol, 0.3 mg.; 2-methyl-1,4-naphthaquinone, 0.05 mg.; thiamin · HCl, 0.3 mg.; riboflavin, 0.6 mg.; Ca pantothenate, 2 mg.; choline, Cl, 150 mg.; nicotinic acid, 5 mg.; pyridoxine · HCl, 0.4 mg.; biotin, 0.02 mg.; and i-inositol, 100 mg. In addition 1,700 U.S.P. units of vitamin A and 170 A.O.A.C. units of vitamin D_3 were administered by dropper. Chicks within a 10-gram weight range were then divided uniformly into groups of six, and supplements were added to the diet as follows: synthetic folic acid at levels of 10–300γ/100 grams of ration, isolated vitamin B_c, and preparations of vitamins B_{10} and B_{11} containing different amounts of "folic acid"[3] which were fed for comparison.

The three experiments were terminated when the chicks were four weeks old. The methods used for determining hemoglobin and measuring feather development were the same as those used previously (*3*). The hematocrit determinations were made following the procedure of O'Dell, *et al.* (*9*).

Results. The addition of 25γ of synthetic folic acid to our basal ration prevents the reduced growth, poor feathering condition, and low hemoglobin and hematocrit values which are consistently obtained when this ration is fed to chicks. Twenty-five micrograms of isolated crystalline vitamin B_c gave a similar effect, although the growth was slightly less than in chicks fed similar levels of synthetic folic acid. When vitamin C or whole liver powder was fed with folic acid, the chicks grew somewhat better than when fed folic acid alone (compare Groups 10 and 11 with 4). The addition to the diet of 50γ of of α-pyracin (2-methyl-3-hydroxy-4-hydroxymethyl-5-carboxypyridine) alone or with 10 or 50γ of synthetic folic acid produced slightly better growth but no improvement in feathering or hemoglobin. When 500γ of α-pyracin were fed with the basal ration alone, no response in growth, hemoglobin, or feathering was noted (Group 14).

Neither *p*-aminobenzoic acid nor a vitamin B_{10} and B_{11} concentrate gave a significant supplementary effect in the presence of an adequate amount of synthetic folic acid. Further comparison of the addition of vitamin B_{10} and B_{11} preparations without added folic acid (Groups 19 and 21) shows clearly the lack of

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[2] Synthetic folic acid was originally called *L. casei* factor.

[3] "Folic acid" (in quotes) is used throughout the paper to designate the microbiological activity of a material when compared to synthetic folic acid on a weight basis (7).