DISCUSSION

A PHOTOCHEMICAL ASPECT OF NITRATE ASSIMILATION IN PLANTS[1]

THE prominence of nitrate as a form of soil nitrogen absorbed by plants confers fundamental significance upon the mechanism of reduction and assimilation in respect to this nutrient. It has been a matter of general recognition that this function is dependent upon participation of sugars or other compounds derived through photosynthesis, and that it bears a complementary relation to respiratory activity of the tissues. With a collaborator the authors have reported[2] a relatively direct effect of shorter visible light rays and longer ultra-violet radiation in promoting the absorption of nitrate by young plants of wheat (*Triticum sativum*) and tomato (*Lycopersicum esculentum*). Attention has since been given to the mechanism by which this light stimulus is made effective. The procedures followed were based upon the assumption that appreciable differences in the nature and content of reducing compounds might arise under exposure to short wave radiation. Inasmuch as the technique of producing the plants and the analytical methods employed are to be described in a later paper, only a summary statement is presented here.

It was found that blue to violet light increases the percentage of protein in the young wheat plant, while causing a decrease of pentosan. These changes are attended by a limited decrease of cellulosic compounds (crude fiber) and limited replacement of the nitrate by the nitrite form of nitrogen. More marked changes in these directions occurred under the influence of solar ultra-violet radiation, and in addition there was an increased percentage of lipides (ether extract) in the dry matter. The general picture of tissue conditions at this point is one of nitrate assimilation at the expense of carbohydrate reserves, with alcoholic constituents among the lipides somewhat favored by the shorter radiations.

Further investigation indicated that the content of a factor or factors responding to the conventional oxidimetric determination of glutathione, but insoluble in 50 per cent. alcohol, was consistently increased in both leaf and stem of wheat and tomato and the leaf of the soy-bean (*Glycine hispida,* stems not tested) by both the shorter visible and long ultra-violet radiations. This response was accompanied by increase in the percentage of uronic acids, as determined in the acidic extract of hemicellulose.

These results are in accord with results previously reported from this laboratory[3] for various species reared under vita glass, to the extent that the latter contained increased percentages of nitrogenous compounds and lipides as compared with controls receiving less solar ultra-violet under common glass. While it is hardly to be supposed that the isolated observations above recorded are likely to account in full for increased nitrate assimilating capacity, and hence also for increased absorption of this nutrient, they appear to correlate with facts and concepts presented by other investigators. Ward[4] has shown that cystine, in distinction from several other amino acids tested by him, absorbs shorter visible rays of light as well as longer ultra-violet. A possible path for the production of the sulphydryl from the di-thio grouping by photoreduction is thus suggested. From the work of Szent-Gyorgyi[5] it appears that hexuronic acids are to be included in the reducing system of at least some plant species, and that at neutral reaction these are reduced by glutathione. There is thus present in plants irradiated by light of the wave-length range characteristic of sunlight, on liberal nitrate supply, a system capable of replacing oxygen in the latter nutrient. It seems well to emphasize the rôle of nitrate itself in maintenance of this system in view of the loss of nitrate absorbing power observed with the preparatory use of nitrate-free nutrient solution, as reported in our earlier work (1934). The suggestion emerges that the functioning of the system here considered, in association with other oxidizing-reducing systems, may account for the general depletion of hemicellulosic constituents observed under the influence of blue to middle ultra-violet light.

In accordance with reported experience and in agreement with properties of individual factors involved, this sort of system should lead to variability in nitrate assimilation with changes in such factors as pH of the nutrient medium, age of the plant and species tested. The rôle of hemicellulosic constituents here indicated is of particular interest in relation to the observation of Stahl and Shive[6] that nitrate absorption is most active in late vegetative activity of oats (*Avena sativa*) and buckwheat (*Polygonum fago-*

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2 *Plant Physiol.*, 7: 551, 1932; 9: 127, 1934.

3 *Jour. Agric. Res.*, 43: 133, 1931; SCIENCE, 75: 223, 1932.

4 *Biochem. Jour.*, 17: 898, 1923.

5 *Biochem. Jour.*, 22: 1399, 1929; *Jour. Biol. Chem.*, 90: 385, 1931.

6 *Soil Sci.*, 35: 375, 469, 1933.

pyrum), or coincident with extensive elaboration of hemicellulose.

W. E. TOTTINGHAM
E. J. LEASE
UNIVERSITY OF WISCONSIN

OCCURRENCE OF UNIOVULAR TWINS IN MULTIPLE BIRTHS

ALTHOUGH there is no *a priori* basis for their nonexistence, the presence of uniovular twins in the multiple births of laboratory mammals is for obvious reasons usually difficult to detect. Wright,[1] describing an eight-factor cross in guinea pigs, reported two pairs which may have been identical twins, but since the number was no greater than that expected by chance their status remained uncertain.

In the back-cross generation of a mouse species cross, involving *Mus musculus,* with the recessive genes d, b and a, and *Mus bactrianus,* with the corresponding dominant allelomorphs D, B and A^w, eight color combinations are expected in equal numbers. With but slight deviations this has been realized.[2] In a litter of a given size the expected frequency of like-sexed pairs, due simply to chance, can be computed by the elementary rules of probability. For example, in a sub-litter (like-sexed litter mates) of two, the probability that both will be of the same color is $\frac{1}{8}$, while in a sub-litter of three the expectation for a pair is $\frac{1}{4}$, etc. Then by the appropriate multiplication and combination of probabilities, the approximate total number of pairs of like color in sub-litters of every size encountered can be obtained. In the summary given the relatively few instances of three litter mates of the same sex and color were disregarded, although the two examples of a pair and three and the single one of a pair and five were considered as two pairs and three pairs, respectively.

SUMMARY OF OBSERVATION ANE EXPECTATION. UNDEPLETED LITTERS ONLY

Mating	Size of sub-litters	No. sub-litters	No. mice	No. mice in like-colored pairs		Deviation
				Observed	Expected	
F_1 ♀ × dba ♂	2–9	174	626	206	165 ± 7.4	+41
dba ♀ × F_1 ♂	2–7	100	312	76	68 ± 4.9	+ 8

In the back-cross offspring of F_1 females there is a significant excess (5.5 P.E.) of litter mates of the same sex and color, while in the progeny of F_1 males the observed numbers are but little greater than the expected. Since the hybrid females are characterized by large litters and paucity of still births[3] it seems probable that this excess can be accounted for by uniovular twins which the unusual vigor of the mother has permitted to survive but which ordinarily would never have begun development or would have succumbed in prenatal competition. If this surplus consists of such twins, more like-colored pairs of the same sex than of different sex should be found. Such was the situation, for, compared with the 103 like-sexed in pairs in mice from F_1 females, there were only 79 pairs of unlike sex, while the comparable figures for back-cross animals from F_1 males were 38 and 40, respectively.

C. V. GREEN
JACKSON MEMORIAL LABORATORY
BAR HARBOR, MAINE

[1] Wright, *Genetics*, 13: 508–531, 1928.
[2] Green, *Am. Nat.*, 66: 87–91, 1932.
[3] Green, *Proc. Soc. Exp. Biol. and Med.*, 28: 55–57, 1930.

A BLUE MOON

THE writer observed a blue moon at Santa Barbara, California, on September 15, 1934, and a search for records of this phenomenon indicates that it is rare and worth recording. The stage of the moon was about the end of the first quarter. At 6:15 P. M., about eight minutes after sunset, the moon was plainly visible through a bank of thin rose-colored clouds, apparently cirro-cumulus. Around the cloud bank the brightly-illuminated western sky was a brilliant deep blue. Four witnesses were called by the writer and all agreed that the moon was blue. Two weeks later an attempt was made to remember the colors and to find their designations in Ridgway.[1] The results of this belated comparison are that the sky was spectrum blue; the cloud bank, begonia rose; the moon, sky blue.

Reference is made by Stimpson[2] to a blue moon seen on December 10, 1883, and to many observers who saw one in Ireland in 1927, during a total eclipse of the sun. He states also that "moons of unusual colors, such as green and blue, have been seen after certain violent volcanic explosions, and also occasionally through smoke-laden fogs."

Of related interest are references by Talman[3] to blue and green suns. Such suns were widely observed during the summer and autumn of 1831, in the northern hemisphere, and after the eruption of Krakatoa in 1883. No satisfactory explanation of the colors has been advanced.

PEREZ SIMMONS
FRESNO, CALIF.

[1] R. Ridgway, "Color Standards and Nomenclature," 1912.
[2] G. W. Stimpson, "Nuggets of Knowledge," 427 pp., 1929. See discussion of "How did *once in a blue moon* originate?"
[3] C. F. Talman, *Science Service Feature* (mimeograph), 1 p., April 17, 1930.