SCIENTIFIC APPARATUS AND LABORATORY METHODS

HINT FOR BETTER GEOLOGICAL PHOTOGRAPHS

FOR years the writer has been dissatisfied with the mediocre results of his numerous attempts to photograph sand dunes, clay banks and other light-colored features in which contrast was deficient. Recently, following a hint from Dr. John E. Wolff, of Pasadena, he tried the use of a dark violet ray-filter. The results were splendid. Details such as fine ripple-marks on sand dunes stood out sharp and clear. In photographs of gravel banks each small pebble was distinct. In general almost every near-by object was beautifully rendered, and this was especially true of the light-colored ones.

The utility of this ray-filter in photographing landscapes seems to be limited to the immediate foreground. Up to distances of about 100 feet it gives excellent results; at 1,000 feet it is of doubtful value; and at the distance of a mile there is serious loss of detail and contrast, as compared with ordinary photographs taken without a ray-filter.

Geologists who need photographs of road cuts, gravel banks, quarries, rock outcrops, and other features of that nature, as well as desert surfaces, sea beaches, and all sorts of sedimentary deposits, will probably find this simple device useful, as it will enable them to obtain photographs that will make excellent half-tone illustrations and will possess unusual clearness of detail. Since the length of exposure must ordinarily be multiplied by ten when the violet ray-filter is used, the latter will not ordinarily be practical for simple hand cameras without tripods, especially as it is generally necessary to use a small diaphragm aperture in order to secure depth of focus in the foreground.

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A SIPHON MOIST CHAMBER

I HAVE just read an article by Florence A. McCormick in the January 30 number of SCIENCE, entitled "A Siphon Moist Chamber for Microscopic Mounts." A question has arisen in my mind concerning one statement that is made in this article: "A mount can be made in a nutritive solution and with this method the concentration will not be changed." Since there is a constant evaporation from the edges of the coverglass and the solution is being added to from the wick, it seems to me that the concentration under the coverglass will be increasing because of the loss of moisture from around the edge which in turn is replaced by a nutrient solution. This difficulty, however, could be overcome by using a nutrient solution in the first place and then replacing the water lost by evaporation by distilled water through the wick. I realize that there may be a tendency for some of the nutrient solution to pass back into the wick and thus dilute the concentration slightly, but it seems doubtful under the conditions as to whether this would be of any consequence and certainly would not be as great a factor as the concentration of the solution would be where a nutrient solution is used to replace the water lost by evaporation.

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SPECIAL ARTICLES

A DIRECT QUANTITATIVE RELATIONSHIP BETWEEN VITAMIN A IN CORN AND THE NUMBER OF GENES FOR YELLOW PIGMENTATION

IT has been known for some years that yellow corn is richer in vitamin A than white corn.[1] A similar association between vitamin A and carotinoid pigments has been discovered in many other materials; also there are numerous cases in which this association does not occur. Since the carotinoid pigments in the endosperm of corn are known to be inherited in definite Mendelian ratios, and since the technique for estimating the amount of vitamin A has been perfected to a degree of reasonable reliability, the writers have felt that estimations of vitamin A in seeds resulting from different doses of the gene for yellow pigment would throw additional light on the association of the carotinoid pigments with the nutritional factor and might also have some bearing on the behavior of the gene. Accordingly, work on this problem was undertaken in 1928. Steenbock and Boutwell[1] had already shown that, on ears segregating for white and yellow endosperm, the deep yellow seeds were higher in vitamin A than a mixture of the pale yellow and white seeds. After our work was started, a paper by Hauge and Trost[2] reported that the white seeds on segregating ears of a cross between yellow and white are no more effective in promoting growth than seeds of the white-seeded parent. Both these investigations indicate strongly an association of yellow pigment with vitamin A in inheritance but neither shows the quantitative relation of the nutritional factor to different doses of the gene involved. In fact, Hauge and Trost found the light yellow seeds, which were a mixture of two genotypes, to be apparently as effective in promoting growth as the deep yellow seeds.

The endosperm of corn, as of most of the angio-

[1] H. Steenbock and P. W. Boutwell, *J. Biol. Chem.*, 41: 81.

[2] S. M. Hauge and J. F. Trost, *J. Biol. Chem.*, 80: 107.

sperms, is the product of a sexual fusion in which two maternal nuclei combine with one pollen nucleus. Consequently, it is triploid in its chromosomal constitution. This has been repeatedly demonstrated, both cytologically and genetically. The triploid nature of the endosperm makes it possible to produce four classes of seed differing in the proportion of dominant and recessive genes. In the case of the factor for yellow pigmentation, the cells of the endosperm may have 0, 1, 2 or 3 genes for yellow pigment with the corresponding factorial composition *y y y, y y Y, y Y Y* or *Y Y Y*. These four classes differ in color and may be described roughly as white, pale yellow, dilute yellow and deep yellow. If all types occur on the same ears it is often difficult to make an accurate classification, especially between the two intermediate classes. By making appropriate pollinations, however, they can be separated with a high degree of accuracy.

In 1928 pollinations were made to produce these four classes of seeds. Surcropper, a white-seeded variety, and Ferguson's Yellow Dent, a yellow-seeded variety, were pollinated by a mixture of pollen from both sorts. On the ears of the white-seeded variety two types of seeds were produced, white and pale yellow, having, respectively, 0 and 1 factors for yellow endosperm. On the ears of the yellow seeded variety two additional types, dilute yellow and deep yellow, were produced, having, respectively, 2 and 3 factors for yellow endosperm.

The vitamin assay of these four classes was made by feeding to albino rats according to the Sherman-Munsell unit method.[3] The results in 1928 showed a high degree of association between the number of genes for yellow pigment and the number of units of vitamin A per gram of material. The pollinations and vitamin estimates were repeated in 1929 with corn grown under different seasonal conditions. Again, almost complete association was shown. The average results for two years are shown in the following table:

No. of genes for yellow	Factorial composition of endosperm	Units of vitamin A per gram		
		1928	1929	Average
0	*y y y*	0.05	0.05	0.05
1	*y y Y*	2.50	2.00	2.25
2	*y Y Y*	5.00	5.00	5.00
3	*Y Y Y*	7.00	8.00	7.50

These results show, first, that a white-seeded variety of corn, which ordinarily has little or no vitamin A in the endosperm, is capable of forming this substance in its seeds if the gene for yellow pigmentation is introduced. The white and pale yellow seeds were produced by the same plants, the only difference between them being in the microscopic pollen nuclei which entered into the fusion to produce the endosperm.

The next point of interest is that there is a direct quantitative relationship between the number of genes for pigmentation in the cells of the endosperm and the amount of vitamin A in the seed. Each gene for yellow induces the formation of approximately 2.5 units of vitamin A per gram of seed. The obvious conclusion must be that the gene for yellow pigmentation is responsible for the formation of vitamin A, either directly, or indirectly, with the production of carotinoid pigments as an intermediate step.

Finally, these results may have some bearing on the chemical nature of this particular gene. So far as we are aware, this is the first case in which it has been possible to establish, with any degree of exactness, a direct quantitative relationship between different doses of the same gene and their chemical effect. Although even this tells us little of what the gene may be, it does, perhaps, furnish some indirect evidence of what the gene is not. It seems scarcely probable, for example, that this gene functions as an enzyme, since the total reaction resulting from enzyme activity is seldom closely related to the concentration of the enzyme, while each gene for yellow pigment seems to govern the formation of a definite quantity of vitamin A. It is true that the rate of a reaction in which an enzyme is involved varies with the concentration of the enzyme, but the proportion is usually not a direct one like that shown here.

The straight-line relationship between the number of genes for yellow pigmentation and amounts of vitamin A is more indicative of a direct chemical reaction between the gene and some other substance which is present in the cells of the endosperm of both white-seeded and yellow-seeded varieties of corn.

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A DIFFERENTIATION OF THE SO-CALLED ANTIPELLAGRIC FACTOR, VITAMIN G[1]

IN February of 1926 Goldberger and coworkers[2] and Smith and Hendrick[3] have demonstrated the dual nature of vitamin B. In May of the same year Goldberger and Lillie[4] submitted evidence that a deficiency of the stable factor in a diet fortified with an abun-

[3] H. C. Sherman and H. E. Munsell, *J. Am. Chem. Soc.*, 47: 1639.

[1] Research Paper No. 142, Journal Series, University of Arkansas.

[2] Goldberger, Wheeler, Lillie and Rogers, Pub. Health Rep., 1926, 41: 297–318.

[3] Smith and Hendrick, *ibid.*, 1926, 41: 201–207.

[4] Goldberger and Lillie, *ibid.*, 1926, 41: 1025–1030.