immediately in water and decomposed by sulfur hydrogen. The solution of glutathione thus obtained was freed from sulfur hydrogen by aeration; the substance was oxidized and further purified by a crystalized glutathione-copper compound.[1]

If small amounts of glutathione are needed, it is sufficient to mix 100 gms of yeast with 30 cc of water and to add 150 cc of 95 per cent. alcohol, containing about 0.2 cc of H_2SO_4. After one hour the precipitate is centrifugalized off, and the supernatant liquid, filtered if necessary, is mixed with 6 cc of 1.5 per cent. solution of copper sulfate in 45 per cent. alcohol. The precipitated substance is centrifugalized off. The mechanism of the reaction involved in the precipitation lies here in the reduction of cupric to cuprous ions, which form an insoluble compound with the reduced glutathione.

The yield of glutathione in the above method is not quantitative and depends upon the correct proportion of the reagents (H_2SO_4 and $CuSO_4$), which should not be used in a too small or too large quantity.

ANTONI KOZLOWSKI

UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE

1 *Biochem. Ztschr.*, 242: 249, 1931.

SPECIAL ARTICLES

METHYLENE BLUE AND GASSED PLANTS

THE recent publications of Brooks[1] on the effectiveness of methylene blue in antidoting hydrocyanic acid and carbon monoxide poisoning in animals raised the question of how this dye would influence gassed plants. Illuminating gas leaks in greenhouses and in the soil in the vicinity of shade trees present a wide range of problems of practical as well as theoretical interest. Commercial illuminating gases contain carbon monoxide and frequently hydrocyanic acid as well as many other constituents which are singly or collectively toxic to plants.

In this study methylene blue was supplied to tomato plants exposed to illuminating gas or to ethylene. The characteristic behavior of the leaf petioles of tomato plants when exposed to these, as well as other gases, to move downward and when placed in fresh air to move upward was the response and recovery feature followed. The roots of pot-grown tomato plants were washed free of soil and placed in a nutrient solution before being subjected to relatively low concentrations of illuminating gas or ethylene in a closed chamber. After twenty-four hours' exposure to either of these gases the nutrient solutions were renewed. One half of the plants received methylene blue at concentrations from 1:100,000 to 1:1,000,000 of the nutrient solution. The remaining plants did not receive this dye. Both lots were then placed in a well-ventilated greenhouse. The movements of the petioles were followed by measuring the angles formed by the third and fourth leaf petioles and the stem above them before the gassing, immediately after and at two and four days following removal from the gas chamber to note the recovery.

The detailed results of the experiments conducted during the summer of 1933 will be published elsewhere. The following abbreviated table, however, gives the trend of the results.

These and the complete results of this investigation are interpreted as indicating that methylene blue sup-

1 M. M. Brooks, *Am. Jour. Physiol.*, 102: 145, 1932; *Proc. Soc. Exp. Biol. and Med.*, xxix: 1228, 1932; *Am. Jour. Physiol.*, 104: 139, 1933; *Proc. Exp. Biol. and Med.*, xxx: 493, 1933.

Expt. no.	Plants exposed to:	Conc. of methylene blue	Recovery* of petioles in: Two days	Four days
1	Illuminating gas	none	19.4 per cent.	——
	1: 100	1: 100,000	36.5 " "	——
3	Ethylene	none	66.8 " "	75.7 per cent.
	1: 10,000	1: 1,000,000	72.7 " "	78.5 " "
5	Illuminating gas	none	80.0 " "	75.4 " "
	trace	1: 500,000	65.4 " "	87.1 " "
6	Ethylene	none	50.0 " "	71.1 " "
	1: 1,000	1: 500,000	55.5 " "	89.9 " "

* Recovery is given as the percentage of the average upward movement of the petioles after the gassing on the average downward movement in response to the gassing.

plied to the roots is effective in aiding the recovery of tomato plants that have been exposed to illuminating gas and to ethylene.

CARL G. DEUBER

OSBORN BOTANICAL LABORATORY
YALE UNIVERSITY

RESTING SPORANGIA OF CLADOCHYTRIUM

IN the course of experiments to determine the host range and pathogenicity of *Cladochytrium replicatum* Karling and its growth on artificial media during the past spring and summer, an abundance of resting sporangia were found in most of the host tissues examined. These sporangia are predominantly spherical in shape and vary from 9 to 21 µ in diameter, but oval, lemon-shaped and elongated ones are not uncommon. If the host cell is small and narrow they may frequently fill it and assume its characteristic shape. All resting sporangia so far observed have been markedly hyaline in color, with a fairly thick wall. A large globule usually occupies the center of the cell and is generally hyaline, also, but may sometimes be golden-orange or brown in color. In elongated sporangia two or more such globules may be present.

The outer wall appears to be predominantly smooth, but in a large number of sporangia fine, hyaline, straight filaments or spines radiate from the surface. As many as thirty such slender threads, varying from 4 to 9 µ, have been counted on a single sporangium. Oftentimes they are so fine and colorless as to be almost invisible, and it is not yet certain that they are of universal occurrence or belong to the sporangium at all. Frequently they appear like long filamentous bacteria clinging to the surface. If they are a part of the outer wall, they are obviously unlike the spines on the resting spores of the majority of chytrids.

So far only four cases of germination have been observed. A short sporangial neck is developed, the contents undergo cleavage and a considerable number of zoospores are formed. These pass out of the neck in rapid succession and lie quiescent at the mouth for a few moments before becoming actively motile. Germination and zoospores formation thus appear to be very similar to the same process in ordinary zoosporangia.

The resting sporangia of *Cl. replicatum* are markedly different from those of *Physoderma* and *Urophlyctis* in color, shape and method of germination, according to these observations. On this basis it is now possible to distinguish the genus *Cladochytrium* quite clearly from the other two. Heretofore there have been no sharp lines of distinction between the genera, and many mycologists have separated *Cladochytrium* from *Physoderma* and *Urophlyctis* on the basis of lack of resting spores. In the latter two genera, according to Schroeter, Magnus, Clinton, Bally, Tisdale, Bartlett and others, the resting sporangia are usually dark brown in color, flattened slightly on one side, and at the time of germination dehisce by throwing off a large disk or cap. In *Cladochytrium,* on the other hand, they are predominantly spherical and hyaline, and germinate by the formation of a well-defined exit tube or neck.

JOHN S. KARLING

DEPARTMENT OF BOTANY
COLUMBIA UNIVERSITY

THE PRESENCE OF PHOSPHORUS IN THE SUN

ON the basis of spectrographic evidence phosphorus may now with considerable assurance be added to the long list of elements present in the sun. The observations consist of measurements of recent infra-red solar spectrograms which, when compared with the laboratory data of Kiess,[1] show significant correspondence in position and intensity for five lines, all faint in the sun. The apparent absence from the solar spectrum of other phosphorus lines in this region is well explained by the fact that they would be expected to be still fainter and are thus beyond the power of our instruments. The only other known lines of phosphorus, besides these in the infra-red, lie in that part of the ultra-violet region that is rendered inaccessible for astronomical spectroscopy by the opacity of the earth's atmosphere. Full details of this work will be published elsewhere. The strongest lines are at $\lambda\lambda$9796, 10529 and 10581 and the corresponding solar intensities are −3, −1 and −1 respectively.

CHARLOTTE E. MOORE

PRINCETON UNIVERSITY OBSERVATORY

HAROLD D. BABCOCK

MOUNT WILSON OBSERVATORY,
CARNEGIE INSTITUTION OF WASHINGTON

C. C. KIESS

BUREAU OF STANDARDS,
WASHINGTON, D. C.

[1] *Bureau of Standards Journal of Research,* 8: 393 (R P 425), 1932; also unpublished material.

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