seeds kept under interior diffuse daylight is an initial irradiation of from five to ten minutes. Longer periods of irradiation appear to have no additional stimulative effect. Two or three periods of daily irradiation of from five to ten minutes each induce the maximal growth in seedlings kept under interior daylight. Therefore we may believe that such quantities of irradiation are able to counteract the untoward conditions relative to germination and growth induced by daylight.

(8) These experiments, in toto, lend support to the hypothesis that ultraviolet radiation in the so-called biologic or "near"-ultraviolet region aids in the germination and growth of a cell or normal functioning of an organism which is kept under an unphysiologic environment.

(9) These experiments also support the hypothesis that biologic or "near"-ultraviolet radiation stimulates the endogenous growth of the cells and of the organism as a whole, while the greater wavelengths influence the exogenous metabolic processes.

CHARLES SHEARD
GEORGE M. HIGGINS

SECTION OF PHYSICS AND
DIVISION OF EXPERIMENTAL MEDICINE
MAYO CLINIC AND THE MAYO FOUNDATION,
ROCHESTER, MINNESOTA

THE EFFECT OF SODIUM BICARBONATE ON THE TITRATION OF IODINE WITH THIOSULFATE

THE well-known reaction between iodine and sodium thiosulfate has been studied under different hydrogen-ion concentrations by a number of investigators.[1,2,3,4] In the course of a recent investigation, it became desirable to titrate iodine in the presence of iodate in an initially acid solution, and it was considered possible to accomplish this result by adding an excess of sodium bicarbonate and titrating with thiosulfate.

Since the results were found to vary with the amount of bicarbonate added, the following experiments were carried out: Twenty-five ccm of standard iodine solution were titrated under the following conditions: (1) In different concentrations of hydrochloric acid; (2) in initially neutral solution; (3) in initially neutral solution to which various known amounts of sodium bicarbonate were added; (4) in a solution initially 0.08 normal in hydrochloric acid to which sodium bicarbonate was added in known excess of that required just to neutralize the initial acidity.

[1] Bray, *Z. physik. Chem.*, 54, 471–2 (1906).
[2] Kolthoff, *Zeit. anal. Chem.*, 60, 343 (1921).
[3] Abel, *Z. anorg. Chem.*, 74, 393 (1912).
[4] V. Auger, Compt. Rend. 154, 1806–7 (1911); and others.

The table shows the results obtained. The volumetric ratio found in acid solution, namely, 1.236, has been taken as standard[5,6] for the calculation of percentage error.

THE TITRATION OF IODINE BY THIOSULFATE UNDER DIFFERENT CONDITIONS

Initial concen. HCl	$NaHCO_3$ excess grams	Volume of thiosulfate in ccm	Ratio ccm thio/ ccm iodine	Percentage error Schupp	Kolthoff
2.0 N.		30.90	1.236	0.00	
0.03		30.90	1.236	0.0	
		30.84	1.234	0.2	0.0
	0.1	30.52	1.221	1.2	
	0.25	29.96	1.198	3.1	
	0.5	29.67	1.186	4.0	4.2
	1.0	28.64	1.146	7.3	4.6
	2.0	28.21	1.128	8.7	9.6
	3.0	27.92	1.117	9.7	16.0
	5.0	27.16	1.098	11.2	
0.08	3.0	30.82	1.233	0.2	
0.08	6.0	30.23	1.210	2.1	

In each titration, 25 ccm of approximately 0.1 N. iodine solution in 0.12 N. potassium iodide were used. Initial volume, 25–35 ccm. Each titration was made almost immediately after adding the bicarbonate.

The results, which compare favorably with those of Kolthoff[2] given in the last column of the table, and with the work of Bray,[1] are low if the iodine solution is initially neutral and sodium bicarbonate added. This is doubtless due to the formation of sodium hypoiodite and iodide from the hydrolysis of the bicarbonate, and to the oxidation of the thiosulfate to sulfate instead of to tetrathionate by the hypoiodite thus formed. If the solution is initially acid, the results agree closely with the accepted ratio, even when a small amount of bicarbonate is present. If the solution is more than normal in bicarbonate at the time of titration, even though saturated with carbon dioxide, less than the theoretical amount of thiosulfate is required. The results also indicate that the titration of iodine with thiosulfate can be made with approximately the same accuracy in an initially acid solution not over normal in bicarbonate as in a neutral solution of iodine. However, if the iodine solution is made more concentrated in bicarbonate, even if also saturated with carbon dioxide, the results are always low.

The direct titration of iodine in the presence of an acidified iodate solution is probably not accurate, since the iodate-iodide reaction takes place to some extent in the presence of carbonic acid.

O. E. SCHUPP, JR.

DEPARTMENT OF CHEMISTRY,
UNIVERSITY OF ARIZONA

[5] Vosburgh, *J. A. C. S.*, 44, 2120 (1922).
[6] Bray and Miller, *J. A. C. S.*, 46, 2204 (1924).