fast as the original flow (100 per cent.). In five cats the flow became as fast (or even faster) as immediately after opening the abdomen; and in one of these five the flow was as fast as the original. The blood pressure rose slightly on section of the nerve in eleven cats. The remaining three were those in which there was little or no increase in flow.

The fact that in these experiments the blood flow after section of the sciatic nerve in shock is usually far below normal, and never above normal, certainly does not support the assumption, now current, that vaso-constriction is greater in shock than in normal conditions of the animal.

6 (1381)

Experimental studies of plant pigments.

By BENJAMIN HARROW and WILLIAM J. GIES.

[*From the Biochemical Laboratory of Columbia University, at the College of Physicians and Surgeons, New York.*]

This communication was confined to a report on studies of (*a*) *flavones*, a group of yellow pigments, characterized by the production, in their solutions, of intense yellowish-brown color on the addition of ammonia, and of (*b*) *anthocyanins*, a group of red, violet, or blue pigments, which, in solution, change to bluish-green on the addition of alkali, and pink on the addition of acid.

These pigments were obtained from tulips: flavone, from "*La Reine*"; anthocyanin, from "*Crimson King.*" Both varieties of flowers were collected at the N. Y. Botanical Garden through the courtesy of Dr. A. B. Stout.

The chemical relationship of flavones and anthocyanins.—Wheldale and others believe that flavone is convertible into anthocyanin by *oxidation.* The Armstrongs regard this conversion as due to processes of oxidation *and* reduction. Combes and Willstätter consider that *reduction alone* effects the change. The results of our own experiments accord with the view of the latter investigators. We find that active ("nascent") hydrogen reduces flavone to anthocyanin. The latter can be further reduced

to a leuco-base, which in turn, by exposure to air or, more rapidly, by addition of an oxidizing agent, is reconverted into anthocyanin, thus possibly explaining the facts observed by the Armstrongs:

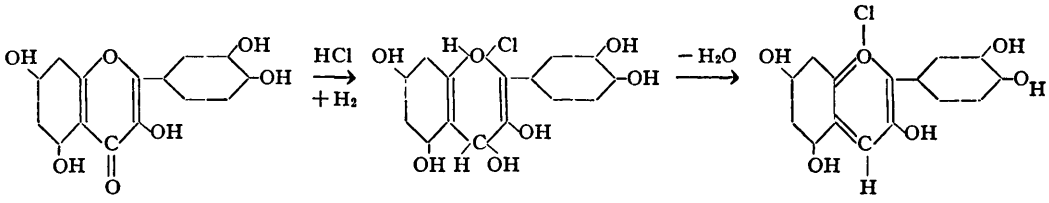
$$\text{Flavone} \xrightarrow{+H} \text{Anthocyanin} \underset{+O}{\overset{+H}{\rightleftarrows}} \text{Leuco-base}$$

We have also succeeded in oxidizing anthocyanin to flavone. This was done most effectively by first isolating anthocyanin in a fairly pure condition, by Willstätter's method. The only oxidizing agent we have been able to use with success thus far is hydrogen peroxide. Oxidase from potato, as well as oxidase from *Crimson King* tulip, could not be used as a substitute for hydrogen peroxide.

Flavone thus obtained from anthocyanin can be reduced back again to anthocyanin:

$$\text{Anthocyanin} \underset{+O}{\overset{+H}{\rightleftarrows}} \text{Flavone}$$

The chemical relationship between flavones and anthocyanins may be expressed thus (Willstätter):



Quercetin (a flavone) — Cyanidin (an anthocyanin)

Anthocyanin as an indicator.—Anthocyanin (tulip, *Crimson King*), when extracted with absolute alcohol made anhydrous with copper sulfate, yields a *red* extract, whereas if extraction is made with absolute alcohol rendered anhydrous with calcium oxid, a *green* solution is obtained. The red extract can be changed to green by the addition of calcium oxide, or soluble *alkali*, whereas, vice-versa, the green extract can be changed to red by the addition of anhydrous copper sulfate or soluble *acid*.

The extreme delicacy of this reaction naturally suggested the possible use of anthocyanin as an indicator. Anthocyanin, prepared according to Willstätter's method and dissolved in absolute alcohol, was compared with phenolthalein, by the Henderson and Palmer indicator-method for the determination of the concentration of hydrogen ions, with the results tabulated below:

Tubes	P_H	Phenolthalein	Anthocyanin
1	9.27	Red + +	Yellowish green + +
2	8.70	Red +	Yellowish green +
3	8.00	Colorless	Colorless
4	7.48	"	Pink +
5	7.38	"	Pink + +
6	6.90	"	Pink + + +
7	6.70	"	Intensity of pink coloration increases in the direction of 11, with increase in acidity
8	6.30	"	
9	6.00	"	
10	5.70	"	
11	5.30	"	

From these data it is obvious that, in point of delicacy, under the conditions specified, anthrocyanin is, in general, the equal of phenolthalein. Furthermore, anthocyanin is superior to the latter in the fact that a change from alkali to acid is indicated by a sharp change from green to red, and not, as for phenolthalein, from red to no color at all.

The relationship of these observations to those by Gies,[1] on "alkaverdin," will be indicated in a later communication.

7 (1382)

The probable cause for the failure of some sodium tungstate to give a suitable reagent for the determination of uric acid.

By GRETE EGERER and FRANCES FORD (by invitation).

[*From the Chemical Laboratory, Department of Medicine, Medical School, University of Minnesota, Minneapolis, Minn.*]

In one of his articles, Folin mentions that some preparations of sodium tungstate on the market do not yield a satisfactory

[1] Gies, Chemical studies of the pitcher plant, *Sarracenia purpurea; Journal of the New York Botanical Garden*, 1903, iv, p. 37.