and 328 deg. F. with water containing 2 per cent of hydrogen dioxide and ½ per cent of sulphuric acid. The percentages of alcohol compare as follows with those obtained with sulphuric acid alone:

	Without Hydrogen Dioxide.	With Hydrogen Dioxide.
Wood	6.0	9.9
Sulphite cellulose	12.8	14.6
Straw	9.6	10.3

Hence it appears that hydrogen dioxide increases the yield of alcohol, especially from wood.

In another series of experiments the hydrogen dioxide was replaced by an equivalent quantity of potassium bichromate, the injurious action of the chromium compounds on the yeast being prevented by precipitation with lime before fermentation. The addition of the bichromate greatly diminishes the yield of alcohol in all cases, as appears from the following table:

	Without Bichromate.	With Bichromate.
Wood	6.0	3.2
Sulphite cellulose	12.8	2.3
Straw	9.6	3.2

In another series an equivalent amount of potassium persulphate was substituted for the bichromate, with similar results:

	Without Persulphate.	With Persulphate.
Wood	6.0	4.2
Sulphite cellulose	12.8	7.3
Straw	9.6	2.6

Roth and Gentzen in the application for their patent covering the employment of ozone in the saccharification of sawdust assert that ozone not only promotes fermentation but also converts lignin into sugar. They also assert that the substances associated with cellulose in wood are very similar to carbohydrates, but although the sulphite liquor of cellulose factories employing the sulphite process contains a great deal of lignin Lindsey could obtain from it only small quantities of levulinic acid, the production of which, according to Wehner, is a certain proof of the presence of carbohydrates. I treated sawdust with increasing quantities of ozone and then digested it with 3 per cent sulphuric acid (the strength recommended in the patent). The alcohol obtained decreased steadily from 6.6 per cent to 1/3 per cent, the decrease being nearly proportional to the quantity of ozone employed. Similar results were obtained with sulphite cellulose.

SUMMARY.

For wood my results agree with those of Simonsen and give a yield of absolute alcohol equal to 6 per cent of the weight of dry wood. Sulphite cellulose contains about twice as much pure cellulose as dry wood contains, and yields about twice as much alcohol. This proves that the sugar which is converted into alcohol is derived from cellulose and not at all from lignin. The addition of sulphurous acid, recommended by Classen, diminishes the yield of alcohol in all cases.

The yield of alcohol is increased by hydrogen dioxide but diminished by stronger oxidizing agents. These results suggest that hydrogen dioxide converts the cellulose into hydrocellulose, which I found to yield a very high percentage of alcohol, but that the stronger agents oxidize the cellulose to a higher stage, producing non-saccharifiable compounds.

The employment of ozone recommended by Roth and Gentzen diminishes the yield of alcohol in proportion to the quantity of ozone used.

The actual yield of alcohol from wood, 6 per cent, is less than one-quarter of the theoretical yield, for wood is nearly half cellulose, and cellulose, theoretically, should yield 56.91 per cent of alcohol. This great disparity suggests the hypothesis that a portion of the complex cellulose molecule $(C_6H_{10}O_5)_x$ is split off and converted into sugar.—Condensed from Zeitschrift fuer Angewandte Chemie.

FLOWER PIGMENTS.

THE SCIENCE OF A BLOSSOM'S HUE.

BY C. M. BROOMALL.

To look upon the wonderful and varied hues of the flowers that surround us and not feel a desire to know something of the pigments that produce their colors is well-nigh impossible. Unfortunately, however, it is a subject about which there is much yet to learn, as is evidenced by the comparatively scant literature relating thereto and the absence of a consensus of opinion regarding the chemical and physiological relations of the pigments.

A few easily performed tests with the pigments as extracted from many kinds of flowers, both cultivated and wild, will exhibit certain reactions common to all flowers of a given color, which reactions are very suggestive both from a physical as well as from a physiological standpoint.

Thus, if an alcoholic extract is made of the petals of a flower we find it to exhibit, at least in the great majority of the cases, the property of changing color as the reaction of the solution changes. In other words, the alcoholic solution makes what chemists call an "indicator," that is, a solution which turns one color when a drop of alkali is added and another color with a drop of acid. In the tests by the writer sodium hydroxide and nitric acid were found to be very satisfactory reagents, although care had to be exercised not to add an excess. Of course other alkalies and acids will answer as well.

A series of tests covering a considerable number of plants indicates the reactions given below as applicable to the variously colored flowers. The flowers, in accordance with the reactions, may be divided into four classes: (1) The red flowers; (2) the yellow flowers; (3) the purple flowers, and (4) the blue flowers. As regards the existence of a really blue flower, however, the writer is inclined to be somewhat skeptical. Testing the alcoholic solutions made from the petals of these four classes of flowers we find the following reactions: (1) Red flowers, green with alkali, red with acid; (2) yellow flowers, green with alkali, yellowish or colorless with acid; (3) purple flowers, green with alkali, purple with acid, and (4) blue flowers (so-called), green with alkali, colorless or very faintly bluish with acid.

These reactions the writer has found to occur in solutions made from many kinds of flowers, both wild and cultivated. With the exception of solutions from Class 4, the color changes are strong and delicate and capable of reversal back and forth a number of times. As regards Class 4, only two or three flowers were found which really seemed blue to the eye and which gave reaction 4 unmasked by the purple reaction.

While these reactions of course may not be true for all flowers, yet in no case did they fail to appear in the writer's extended tests. Considering the large number of tests made they certainly seem generally enough true to warrant further inquiry. Let us see to what results we are led.

In the first place, we see that in all cases the color is green with alkali, while with acid the solution takes more or less the color of the mature flower as w[redacted]ee it. Bearing in mind, however, the f[redacted]not a simple color but a combination of red and blue, the reactions lead us to suspect that we are dealing with but three pigments, which, in the acid condition, are respectively red, yellow, and blue in color. But these are the three primary pigments from which, by various combinations, all colors may be produced. Hence, granting the existence of one or more of these three pigments in the flower petals, we see how it is possible to account for all the varied hues of the flowers around us. So much for the physical side of the subject.

But a still more interesting correlation results from a consideration of the physiological relations of the pigments. Thus, we know that all plants live, as it were, a dual existence. That is, in sunlight they breathe in carbon dioxide and exhale oxygen, while at night or during great activity they live like animals, using up the oxygen from the air and producing carbon dioxide. These processes are always going on more or less simultaneously. During the time of flowering we know that the animal side of the plant is very active, as a considerable production of heat, which can only result from oxidation, is then found to occur in the flowers. This means that the flowers at this time are the seat of active production of carbon dioxide. But since this compound is acid in reaction, it follows that the pigments in the flower petals will take on that color which corresponds to the acid reaction; that is, the flower will assume its ordinary color as met with, depending upon what pigments are present. In the earlier life of the flower, however, when it is simply living with the vegetable side of life predominant, there is not an acid reaction due to the presence of carbon dioxide and the petals are green, as we find them in young flowers. If the more or less greenish petals of an immature red flower, for example, be placed in water slightly acidified, they will assume the red color of the mature flower. This shows that the pigment is already present but that the reaction is not acid.

The theory of the physiology of the pigments, therefore, as far as it goes, may be briefly summarized as follows: In the petals of the young flower there exist certain of the three primary pigments in certain proportions. The reaction is alkaline, however, and no matter what pigments are present the color is green. But as the animal life of the flower becomes more pronounced and the bud matures, the carbon dioxide thus produced changes the reaction of the fluids of the petals to acid and the red, yellow, or blue color of the pigment or pigments develops and the flower gradually assumes its final hue.

As regards the chemistry of flower pigments but little seems to be known, and it is doubtful whether any of them have been isolated in the pure state. It is interesting to note, however, that despite their extreme susceptibility to change of reaction they are really quite stable. Thus, in some pansies (of the variety with both purple and yellow petals) which had lain between the leaves of an old book boxed up and packed away since about 1860, the respective purple and yellow pigment reactions were shown very nicely. And again, a solution from a purple pansy which had lain pressed away in an envelope in a book since "Easter Sunday, 1847," according to the label, changed back and forth between green and purple almost as markedly as a solution made from a fresh flower.

BUDAPEST NEWS-TELEPHONE.

In reply to a Missouri inquiry in regard to the Budapest news-telephone system, Consul-General Paul Nash writes as follows:

This system, which has been in successful operation in the capital of Hungary for several years past, is owned and managed by a private corporation, whereas the regular telephone system is owned by the government and administered by the ministry of posts and telegraphs. The annual subscription, $7.31, paid quarterly in advance, entitles the subscriber to two receivers and the full service of news, music, etc., the subscriber to pay the expenses of installation and removal, generally about $8.50. The service begins at 8.55 A. M., when a buzzing noise, loud enough to be heard across a large room and lasting for fifteen seconds, announces the correct time. At 9:30 the day's programme of important events is announced; that is to say, the ceremonies, lectures, plays, races, etc. At 10 and 11 o'clock stock quotations and general news items are given.

At noon comes a second announcement of the correct time, followed by parliamentary news and general items of interest. At 12:45 stock quotations from the local, Vienna, and Berlin exchanges and general news. At 2 o'clock more parliamentary and general news, and at 3 P. M. the closing prices of stocks, meteorological forecast, local personals and small items, and in winter the condition of the various skating places. At 4 P. M. court and miscellaneous news. From 4.30 to 6.30 military music from one of the great cafés or gardens. In the evening the subscriber may choose between the royal opera or one of the theaters, and later music by one of the *tzigane* orchestras.

This programme is sufficiently varied to satisfy the desires of all classes of subscribers, and in general the service seems to give the utmost satisfaction. Its advantages are so manifest that no comment appears necessary.

While the slide rule has only become universally used for calculating purposes during comparatively recent years, it is interesting to note from comment on the subject made in the Zeitschrift für Vermessungswesen that it was invented nearly 300 years ago. It is recorded that Gunter shortly after bringing out the trigonometric logarithm tables in 1620 placed logarithmic scales on wooden rules, and used a pair of dividers to add or subtract the logarithms. In 1627 these logarithmic scales were drawn by Wingate on two separate wooden rules, sliding against each other, and thus obviating the necessity of the dividers, and in 1657, or over 250 years ago, Partridge brought out the slide rule, which was more or less similar to the slide rule in its present form.