

methods reported in this paper any corn-grower will be able to select seed and to breed corn to increase or to decrease the percentage of any of its three principal chemical constituents.

All experiments reported in this paper have been carried on with the one variety of corn, namely, Burr's White. Of course it is not believed that Burr's White is the very best variety for improvement in corn in every one of the several important lines. Indeed, it seems highly probable that one variety of corn will be found best adapted to but one line of improvement. We have in progress chemical studies of other varieties of corn, and a considerable amount of data and information has been already acquired, but it is reserved, pending further investigations for future publication, the special object of this article being to give some of the data, thus far obtained, indicating the possibility and establishing the fact that the corn kernel may be improved in chemical composition.

It may be stated that improvement in the composition of other parts of the corn plant is under consideration by the Illinois Station. Plans are also made to investigate other questions relating to this general subject; such as the effect of changes in the chemical composition of corn upon its digestibility, vitality, yield, etc.

The results obtained in our investigations to improve the composition of corn have suggested the possibility of improving other grains by somewhat similar methods. It seems not improbable that the different grains, or kernels, produced in a single head of wheat, oats, or barley, may be found to be approximately uniform in composition.¹ If so, a method is thus afforded for selecting seed and breeding those cereals upon the basis of the chemical composition of the grain.

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NOTE.

The Determination of Chromium in Steel.—A method for the determination of chromium in steel, based upon its oxidation to chromic acid by potassium chlorate in nitric acid, and the titration of the chromic acid with ferrous sulphate and potassium

¹ Since this was written a chemical study of wheat has been begun in this laboratory, and in general the results thus far obtained support the suggestion which is offered above.

permanganate in the greatly diluted solution, has been described by McKenna.¹ I have found it accurate and rapid. Sargent and Faust² suggest sand held in place by a little glass-wool, and covered by a very thin layer of asbestos, for filtering the nitric acid solution, in order to remove the oxides of manganese. I have found paper a suitable filtering medium for the removal of these oxides. Another change in details which I am accustomed to employ, is the use of nitric acid and potassium chlorate in greatly reduced quantities.

Dissolve three grams of the sample in fifty cc. of concentrated hydrochloric acid, in a 400 cc. lipped beaker, covering with a (five inch) watch-glass. Boil down until little more than a moist cake is left. Add fifty cc. of concentrated nitric acid, and boil for a few minutes when the copious evolution of nitrous fumes will have largely ceased. Remove from the light, and when somewhat cooled, add four grams of potassium chlorate, and resume the boiling, continuing until the solution is reduced in volume to from twenty-five to thirty cc. Dilute to 300 cc. with cold water, and add fifteen cc. of ammonia of 0.90 sp. gr. Mix thoroughly by stirring and filter the solution (first cooled if necessary) through a ribbed double paper, washing with cold water. Dilute the filtrate and washings to about 450 cc., and titrate with standard solutions of ferrous ammonium sulphate, and potassium permanganate. The best, that is the most accurate and simplest, way of standardizing these solutions is by means of a standard solution of potassium bichromate.

I have made some hundreds of experiments upon the amounts of reagents needed for the successful execution of this estimation, the extent to which the concentration by boiling must be carried, and the amount allowable of free nitric acid in the solution, before filtration through paper.

When three grams of steel are used for an estimation, from one to two grams of potassium chlorate are taken in many cases, and sometimes one-half gram, is sufficient to oxidize the chromium, if perfect removal of hydrochloric acid by nitric was first effected. The last traces of hydrochloric acid are, however, more conveniently removed by potassium chlorate.

It is evident that a solution of chromic acid if brought into

¹ Proceedings of Engineers' Society of Western Pennsylvania, II, No. 6.

² This Journal, 21, 287.

contact with a paper filter, should be dilute and cold to avoid reduction. It is necessary also that not too much free nitric acid be present. The conditions for avoiding reduction by paper, are shown by the following results: They were obtained by titration of twenty cc. of potassium bichromate solution, which contained a quantity of chromium equal to 1.03 per cent. in three grams of steel. Each test was conducted as follows: the bichromate, nitric acid, and water were brought to the temperature desired, this being either nearly boiling, or cold to the touch, two washed papers placed in the beaker, and the whole stirred for five minutes, filtered through a ribbed paper, and the filtrate titrated after dilution to 450 cc.

Number of the experiment.	Nitric acid (1.42 sp. gr.) added before filtration. cc.	Temperature.	Volume filtered. cc.	Chromium expressed as a percentage for three grams of steel.	Remarks.
1....	0	1.03	No paper placed in this; no filtration.
2....	20	1.03	" " " " " " "
3....	5	cold	300	1.03	
4....	5	"	300	3.08	Sixty cc. of bichromate solution used.
5....	5	"	100	1.02	
6....	5	hot	100	0.95	
7....	10	cold	300	1.09	
8....	20	"	300	0.97	
9....	20	"	300	1.00	No paper placed in this; simply filtered.
10....	20	hot	300	0.96	" " " " " " "
11....	20	"	100	0.86	" " " " " " "

FOUR DETERMINATIONS OF CHROMIUM IN A CHROME STEEL.

Percentage of chromium.

0.80 Filtered through asbestos.

0.81 " " "

0.81 } Method described; filtering through paper.
0.81 }

RESULTS FROM ANALYZING SOLUTIONS OF KNOWN CONTENTS IN CHROMIUM.

These solutions were prepared as follows: three grams of steel containing no chromium were dissolved in hydrochloric acid, and a measured quantity of a standard solution of potas-

¹ Accuracy.

sium bichromate, reduced to chromic chloride by hydrochloric acid and alcohol, added.

These solutions were boiled down until little more than a moist cake was left, and the analysis in each case, further conducted exactly as described in the modified method, above given.

PERCENTAGE OF CHROMIUM.	
True.	Found.
1.55	1.54
1.55	1.52
1.03	1.04
1.03	1.04
3.09	3.11

Addendum—Gravimetric Determination of Manganese in Steel.

—The manganese precipitate collected upon a paper filter is a convenient starting-point for its gravimetric estimation. The solution of the precipitate in hydrochloric acid is to be treated in the customary way, the trace of iron being precipitated as basic acetate, and the manganese as manganous ammonium phosphate in the filtrate therefrom.

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NEW BOOKS.

THE DISCHARGE OF ELECTRICITY THROUGH GASES. BY J. J. THOMSON, Professor in the University of Cambridge. New York: Charles Scribner's Sons. 1898. 203 pp.

This work of Prof. Thomson's represents the material of lectures delivered by him in October, 1896, at the sesquicentennial celebration of Princeton University, but amplified with a record of later observations. As the subject is one of comparatively recent date, it is hardly to be expected that the ground should have been so uniformly covered as to enable the writer to give a thoroughly connected account of the peculiar phenomena, that he and others have observed, in the fashion of a text-book. On the other hand, the fact that the essays were to be delivered orally precluded a purely historical presentation of discoveries, with a detailed account of the author's own work upon the subject. In place of these, we have a very lucid and fair exposition of the most striking facts, and an impartial statement of the most noteworthy hypotheses involved. The book is therefore chiefly useful as a guide through the intricate mesh-work of hypotheses, which recent years have produced.