proposition, which I have excepted. Please consider my application with you void. I thank you as sincerely for the intrest you have shown in me, I consider it an unusual privilage to have been allowed to apply for the assistantship you have." Accordingly, in a few months this man will presumably be teaching in the University of ——.

T. D. A. COCKERELL

MAY 27

THE PURPURIN METHOD OF LOCALIZING CALCIUM

DR. MYRA M. SAMPSON[1] is in error in attributing to me the introduction of the purpurin method of localizing calcium in animal and vegetable cells.

This method was first advanced by Grandis and Mainani in 1900 (*Arch. Ital. de Biol. 34,* 73) and a paper of theirs in the same Archives (1902, *38,* 143) gives the results of their use of the method in studying the distribution and deposition of calcium in epiphysial cartilage during bone formation.

In 1903, and later, I put this method to the test and found that while it is serviceable in localizing calcium in certain structures, *e.g.,* epiphysial cartilage, in which its salts may abound, it does not give decisive results in tissues or cellular elements in which it undoubtedly occurs, but much less abundantly, because the reagent is not sensitive to calcium when the latter is in greater dilution than 1 in 800, and it reacts the more slowly the more this degree of dilution is approached.

It is possible, however, that a mode of using the reagent, which will increase its sensitivity to calcium, may be found. A sensitive microchemical reagent for calcium in tissues and cells is a great desideratum and I would express the hope that Dr. Sampson will endeavor to find such a method and succeed in doing so.

A. B. MACALLUM

MCGILL UNIVERSITY,
MONTREAL, CANADA

SCIENTIFIC BOOKS

The Chemistry of Wheat Flour. By DR. C. H. BAILEY, New York: The Chemical Catalog Company, Inc., 1925.

BREAD is our fundamental diet. The more we can learn about it the better will our judgment be respecting its use. A study of the milling processes now in vogue is extremely important for the chemist and more so for the biologist. This work is a rich treasure of knowledge in regard to the milling processes by means of which wheat is converted into flour. The author had a particularly good opportunity of collecting the information in this book because of his location in the midst of the greatest milling region in the world and because of his own studies in the milling industry.

In his introduction he calls attention to the general plan of the work. The properties of flour are to be considered in their relation, first, to the raw state from which they are manufactured, namely, wheat; second, to the process of milling and third, to its adaptability to the principal use to which flour is put for baking.

A short sketch of the history of baking is found in Chapter I. This is particularly interesting now because we learn from it when the present system of milling was introduced into this country. In 1870 the purifier was introduced into the mills in Minneapolis. In combination with the new system of grinding, that is, using steel breakers instead of millstones with the purifying apparatus, it made the mills of Minneapolis famous. Following the new system of milling, according to the author, the next major development was the introduction of chemical bleaching of the finished flour, a practice which came into effect in the first decade of the present century.

The author departs very materially from his fundamental principles in introducing the discussion of the bleaching of finished flour. This practice has nothing whatever to do with milling but has to do with the products of milling and the health of the consumer. It is not, therefore, a part of the fundamental principles on which the book is said to be written.

This view is also held by Samuel T. Ballard, a prominent miller of Louisville, a witness for the United States at the famous bleached flour trial, as shown from the following extract from his testimony:

> I consider that bleaching is no part of the milling process. Milling consists in making pure flour and separating all impurities from it. After the flour is made I do not consider treating it with chemicals any part of the milling art. Natural aging improves the quality of flour. Bleached flour deteriorates from the day it is made.

The general accomplishments, up to the present time, are stated by the author in the following language:

> In both of these particulars remarkable success has attended his efforts until to-day the modern flour mill is one of the most completely automatic establishments of

[1] SCIENCE, October 30, 1925, p. 400.

the food industries, and the whiteness of the flour which can be produced from the pigmented wheats with dark colored, vitreous kernels is remarkable.

I shall return to this point further on.

In Chapter II a fine discussion of wheat in its relation to flour composition is found. The various kinds of wheat for the production of various kinds of flour are set out and the experimental work for determining which of these kinds of flour are best adapted to particular purposes is given in sufficient detail to throw a flood of light upon this whole question.

In connection with these studies the supreme importance of a proper protein content for the baking of bread is duly stressed. The experiments which have been conducted for producing flour of great strength, that is, capable of holding moisture, by the amount and character of its gluten are given in great detail.

Chapter III is given to the development of the wheat plant and kernel along these lines.

In Chapter IV the influence of environment on the composition of wheat is discussed. It is well known that wheats of rapid growth, that are sown in the spring, develop a much greater content of gluten than wheat sown in the fall. This has shown the way to a distinct class of wheat products with a high content of gluten which is one of the most important constituents from the point of view of panification. Cool summers with high rainfall and a relatively long growth period result in the production of wheat with a high percentage of starch and a low percentage of protein. Climatic conditions are responsible for all the great variations in the composition of wheat, and of these quick growth and dry weather at the time of ripening are the greatest factors in the production of high protein harvest products.

Chapter V is given to the character of impurities and the methods of cleaning commercial wheat.

Chapter VI discusses the storage and handling of wheat. These are most important factors to the farmer himself as it will lead him to follow those methods of storage and handling of wheat which give the greatest rewards for his labor.

Chapter VII deals with the composition of the various products of roller milling. It is by far, in my opinion, the most interesting chapter in the book. The author recognizes the early activities of the Bureau of Chemistry in the study of the chemistry of roller milling. He does not, however, stress the fact that the first complete study of the chemistry of the roller milling process ever made in this country was conducted in the Bureau of Chemistry by Clifford Richardson, my first assistant therein. The results obtained by Richardson are still classic and have been confirmed by all subsequent investigators along that line. It has long been a subject of discussion why it is that in the modern milling of flour a large increase of moisture is effected without apparently exciting the attention of any of the executors of the pure food laws, either of nation or of state. It seems rather strange that if you add two or three per cent. of water to oats or to corn to be fed to cattle or horses, the food laws find this to be an adulteration and many convictions for this practice have been secured. On the other hand, in the "conditioning" of wheat, as it is called, for grinding in a modern mill it is always submitted first to the operation of moisture and from two to four per cent. of water, according to circumstances, is incorporated. It is true some of this added moisture may escape during the processes of milling because of the exposure of the wheat to the air, but the flour produced by the modern methods of milling always contains a considerable increase of moisture over the wheat from which it has been formed. This is really an adulteration, although the amount of increased weight is not very great. If there be two per cent. additional moisture in a barrel of flour weighing approximately two hundred pounds, there are four pounds of added water sold to the purchaser. This is a very considerable increase in the weight of flour without any additional nutrient compensation. The only limit of the amount of added water seems to be the suitability for grinding. The purpose of the added water is to make the bran more tough so that, as it is run through successive rollers and flattened out, it keeps its form while it permits all attached starch particles to be removed. Thus, there is a very complete separation of the bran and, to a certain extent, the moisture also facilitates the separation of the germ, both of which components of wheat it is the object of the modern miller to remove as perfectly as possible.

The methods of conditioning, the amounts of moisture added and the results of thus preparing the wheat and kernel for the purpose of making the maximum amount of white flour are duly set forth and explained in a very illuminating way by the author. In spite of the conditioning, however, some particles of bran are comminuted and the number of bran particles in the flour in its successive steps from grain to pure flour increases.

In table 83 on page 146 the number of particles of bran in the first break was 113, while the number at the fifth break was 368. This does not mean that there was any more bran in the flour. There was probably a great deal less, but it means that the particles that are in the flour have been more finely

comminuted. In the first middlings the number of bran particles was found to be 21, while in the eighth middlings they had reached 264. The object of the modern-day miller is to get all bran particles out of the flour as particularly as possible, and also all particles of the germ. To this end the refinement of milling has been chiefly directed for the last few years. The result is that the flour of the country is gradually approaching the condition in which the bran and germ remnants are reduced to the greatest possible minimum. This means a more thorough extraction from white flour of the vital elements of the wheat. While the flour is improved in color it is distinctly deteriorated in nutritional value.

Chapter IX is the only questionable chapter in the book. It treats of the color of flour and flour bleaching. The various methods of bleaching flour are described in detail, and also the number and character of the bleaching reagents. There may be some difference of opinion in regard to the origin and practice of the bleaching process. The millers claim that the bleaching process has arisen by reason of the demand of the consumer for a whiter flour. This may have some merit if by the consumer is meant the retail dealer. I doubt, however, if any household consumer ever demanded from the millers a whiter flour. The housewife, as a rule, never sees the flour that she buys. It is always in a sack or package of some kind and very rarely is it sold in bulk. If it is, she does not gage its value by its color. She never sees it until it reaches her home. There is no doubt of the fact that the brokers and buyers of flour are willing to pay a higher price for a whiter flour. The patent flour, so-called, as first mentioned, filled this bill, but it was not possible to get all the flour into the patent classification. There was always a remainder amounting to some five to fifteen per cent. which refused to become sufficiently white to be sold as patent flour. By the bleaching of the whiter portions of this residue it could be mixed in with the patent flour and sold at the patent price. This fact was clearly brought out in the courts of justice and in the arguments made before the Bureau of Chemistry for the justification of the bleaching process.

I have no time here to discuss the mechanical methods by means of which the bleaching takes place. I can only enumerate the principal bleaching reagents. One of the most common and effective of these reagents is nitrogen peroxide or a mixture of nitrogen and nitrous oxides. This is generated by a chemical reaction or by a flaming arc passing through the atmosphere and causing a combination of nitrogen and oxygen of the atmosphere.

Other reagents are ozone, sulphur dioxide, chlorine and certain compounds of chlorine, such as nitrosyl chloride, nitrogen trichloride and certain organic peroxides, notably benzoyl peroxide, nitrous oxide as sodium nitrite, a somewhat evanescent compound, liquid chlorine, nitrogen trichloride, benzoyl peroxide, peraldehydes, ozonides, perozonides and peroxozonides.

Among these reagents which have been extensively used there are many that are dangerous by reason of their tendency to explode. Benzoyl peroxide belongs to this class and this is a reagent which has been extensively used in the commercial bleaching of flour. In the market it is known under the trade name of Novadelox B, which is a mixture of benzoyl peroxide (25 parts), and calcium phosphate (75 parts.) The author says that the last-named substance is used in the mixture to reduce its inflammability and its liability of spontaneous combustion. There are other reagents along this line. The author gives a very fair summary of the opinions of experts, particularly those engaged in the bleached flour trial in regard to the effects of bleaching upon the character of the dough and the bread made therefrom. After citing the testimony on both sides he sums up the matter in the following paragraph:

> The weakness of the contention that bleaching constitutes a hazard in the nutrition of man because bleached flour is less digestible than unbleached, lies in part in the fact that flour is not eaten in the raw state, and experiments with raw flour are hardly valid as evidence. In such experiments as have been reported in which a baked product or bread was used, the resulting data justify the conclusion that the effect of bleaching on digestibility is too slight to merit consideration.

I consider the above conclusion unfortunate. The evidence of injury to the digestibility came from sources beyond criticism and should not be dismissed in such a summary way by the author. This paragraph has had this effect upon me and probably will have the same effect upon other unprejudiced readers, namely, that the author, in view of the almost universal practice of bleaching, is inclined to condone it and consider it as a legitimate part of milling. The fact that bleaching can only be accomplished by the intake of powerful reagents and that these reagents must of necessity remain, to a certain extent, in the baked product does not justify his conclusion, but rather indicates a considerable bias towards the side of the bleachers. If any evidence could be adduced in regard to any beneficial effects from the process of bleaching, it has not been cited by the author.

In the eyes of the law, a food product is judged on its own constitution and not what may be done

with it subsequently. This is also the opinion of the Supreme Court of the United States in its decision on the bleached flour case. The court makes the following illuminating statements:

It is not required that the article of food containing added poisonous or other added deleterious ingredients must affect the public health, and it is not incumbent upon the Government, in order to make out a case, to establish that fact. The act has placed upon the Government the burden of establishing, in order to secure a verdict of condemnation under this statute, that the added poisonous or deleterious substances must be such as may render such article injurious to health. The word "may" is here used in its ordinary and usual signification, there being nothing to show the intention of Congress to affix to it any other meaning. "It is," says Webster, "an auxiliary verb, qualifying the meaning of another verb by expressing ability, . . . contingency or liability, or possibility or probability." In thus describing the offense Congress doubtless took into consideration that flour may be used in many ways—in bread, cake, gravy, broth, etc. It may be consumed, when prepared as a food, by the strong and the weak, the old and the young, the well and the sick; and it is intended that if any flour, because of any added poisonous or other deleterious ingredients, may possibly injure the health of any of these, it shall come within the ban of the statute.

Also, the jury after hearing all the evidence in the case of injury to the flour by the Alsop bleaching process brought in a verdict for the government on all the counts in the libel. These counts included injury to the flour for making bread and for being colored in such a way as to conceal inferiority and thus permit the sale of the flour at a higher price.

The only point in the verdict of the Supreme Court reversing the conclusion of the lower court was on the failure of the judge in the lower court to instruct the jury properly in regard to injury to health. The Supreme Court did not enter into any discussion of the merits of the case whatever. It would be proper to state that when the case was remanded to the original court for a new trial, the United States attorney agreed to withdraw that part of the libel charging injury to health, whereupon the claimants acceded to all the other parts of the libel and the decree of the court condemned the 625 sacks of bleached flour, in the following terms:

Now, therefore, it is ordered that the said amended libel be taken pro confesso; and the said cause coming on to be heard ex parte, and the court being fully advised, doth find all of the allegations of said amended libel herein are true.

It is, therefore, ordered, adjudged and decreed that the said six hundred and twenty-five (625) sacks of flour, more or less, as aforesaid, be and the same are hereby condemned and forfeited to the United States, and the marshal of this court is hereby ordered and directed to proceed to confiscate and utterly destroy all of said property, and to report to this court how he executed this order and decree.

It is further ordered, adjudged and decreed that the taxed costs of the libelant herein, and the taxed costs of the claimant, be paid by the claimant, Lexington Mill and Elevator Company, said claimant in open court consenting thereto.

The above condemnation, it seems to me, is more nearly in harmony with the facts of the case than the author's conclusion as to the practical harmlessness of bleaching above referred to. In spite of the fact that this decision, from which, of course, no appeal could be taken, as it was a consent decree, settled once and for all the legal status of bleached flour and opened a clear way for the complete suppression of bleaching except when the flour was consumed within the state in which it was bleached. As most bleached flours transgress state lines, if this decree had been properly enforced the bleaching of flour would have entirely ceased within a short time.

Unfortunately, the authorities having in hand the administration of the law failed to improve this opportunity of forever destroying this reprehensible process. On the contrary, they issued a statement which was considered an invitation by the flour bleachers to go to the limit in extending this practice. The fact that there were many important problems which had been settled by the court seemed to have escaped their notice and they published a statement as follows:

No action will be taken at the present time on the ground that the bleaching introduces into the flour a substance which may be injurious to health provided, as a result of bleaching there is not introduced such a quantity of the bleaching agent as to render the flour injurious as indicated in the decision of the Supreme Court.

This was understood by the flour bleachers to mean that no action of any kind would be taken against bleached flour on the other grounds which had been established by the court as the reason for condemning bleached flour as both adulterated and misbranded. In point of fact, no action of any kind ever has been taken by the properly constituted authorities to hold in check or to stop the bleaching of flour, and it has become well-nigh universal. Even the millers who were bitterly opposed to bleaching have been forced to practice it in order that they could sell in the markets of the country a larger percentage of their output as patent flour. The most remarkable statement, however, of the food enforcing authorities is the following:

Whether bleaching in any given shipment reduces the quality and strength of the flour or conceals damage or inferiority must be decided on the basis of facts in each particular case.

These were the very facts that were decided by the court. This particular phrase, of course, was understood by the bleachers as a general statement which indicated that the whole evidence in regard to concealing damage or inferiority or in reducing the quality and strength of the flour would have to be gone over again, as the authorities simply ignored that these matters were already settled once and all in the decree of the court.

The curse of the corpse-white flour will, of course, die out in time. The people of our country are learning little by little that the whiteness in the flour is inversely proportional to its nutritive value. It has been established by the experiments of the Public Health Service that white flour fed to fowls induced a speedy occurrence of polyneuritis or beriberi which quickly proved fatal. On the other hand, the fowls of same quality and age fed upon the whole grain wheat, or wheat flour made of whole grain, at the end of ninety days, when all the white flour fed fowls were dead, showed no sign of even an approach of beriberi or polyneuritis.

Facts of this kind which have now been established by all investigators will gradually permeate into the conscience of our people and lead to such a demand for wholesome flour that the process of bleaching, if never again attacked by the authorities of the government, will lapse of its own innate prejudicial character. Our bread supply will then be restored to normal, and thus the cheapest source of food for our people be preserved in its natural degree of wholesomeness. It is, of course, a matter of regret that a work of such high character and value as the one in question should so far lose sight of the fundamental principles of nutrition as to convey an impression to the reader that the bleaching of flour is a wholly innocuous and apparently praiseworthy proceeding.

H. W. WILEY

WASHINGTON, D. C.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID METHOD FOR DEMONSTRATING THE EFFECTS OF PLANTS ON A CULTURE SOLUTION

TEACHERS or students of plant physiology may find the method here described useful in demonstrating very easily and graphically within a few hours the changes in concentration of various ions in a solution produced by the growth of plants in the solution. The chief difference between this and the usual methods of growing plants in culture solution consists in the much larger ratio of plants to volume of solution used in this method. With this procedure, it is easily possible to demonstrate to a class of students that plants absorb different ions at very different rates and thereby cause very considerable changes in composition of the culture solution.

The technique is as follows, actual figures from a certain experiment being given. A number of trials with similar procedure at different times have given similar results.

To five grams (about two hundred seeds) of club wheat kernels in a test tube were added 5 cc of water. After two hours the grain was spread on wet filter paper and covered with two sheets of the same paper. The whole was thoroughly wet, placed in a pan and covered with another pan to keep the seed moist. After two days, the roots were about 1 cm long. The sprouted grain was then spread on a piece of mosquito net tied over the mouth of a glass jar 8 cm in diameter and covered with wet filter paper. The jar was kept filled with tap water up to the net. Two days later, the roots had gone down into the water and the young shoots were about 1 cm high. The wet filter paper cover was then removed, leaving the plants exposed to the air. Six days later, the young shoots were 7 to 12 cm high, with roots about the same length. Five days later, the plants were 10 to 15 cm high, growing vigorously. During all the time the plants were kept in a south window at a temperature of 60 to 75° F.

At this time, when the plants were fifteen days old from the time seed was soaked, the net was removed from the top of the jar, the roots of the plants washed in distilled water, and the whole mass of plants was then placed upright in a beaker 6 cm in diameter. Thus the roots were compressed into a small space. Now absorption experiments were begun. On successive days the plants were supplied with dilute solutions of single salts, the volume of solution being just sufficient to keep the roots immersed. If necessary, more water was added in order to maintain sufficient liquid to cover the roots. At the end of the period of absorption, the remaining solution was made up to the original volume with distilled water and tests made for ions remaining. Portions of the original solutions were tested in the same way at the same time. The tests were only very roughly quantitative. The results obtained are set down in the following table. The numbers given represent milligrams of the ions present before and after the absorption period. In some cases, a considerable