ties resting on it, has recently spent £36,000 in helping science to determine an arc of the meridian, we shall not grudge time, nor trouble, nor expense to protect the white and native populations of the territories within our jurisdiction from the horrors of the sleeping sickness. I have myself within the last few days had an interview with Dr. Todd, than whom there is no higher authority, and he has pointed out the nature of the precautionary steps to be taken to discover and isolate cases and prevent any extension of the area which the disease afflicted. For my part, I venture to think that, with intelligent care, the railway may help and not hinder the devoted medical men engaged in fighting the sleeping sickness, sometimes, as in the case of Dr. Tulloch, at the risk of their own lives.

Before bringing this paper to a close, let me remind you that, while our progress to the north has been fairly rapid and reflects credit on the financiers, engineers, and contractors, it is not the only progress that has been made. I have already quoted Mr. Rhodes's strikingly picturesque dream of "Kitchener coming down from Khartum." Lord Kitchener has long since left Egypt, and served his country well in another part of Africa, but his spirit still haunts the land of the Pharaohs—the strong will still seems to dominate the Soudan. There, too, the railway progress has been considerable. From Cairo or Alexandria southward to Assuan, a distance of 590 miles, the line is constructed, and another 560 miles between Wady Halfa and Khartum, while a further extension of 410 miles to Usambara is, I believe, projected. In the aggregate, the line from the north, completed or contemplated, is thus about 1,600 miles, and from the south rather more than 2,000 miles. Add to this the long Tanganyika waterway and you will see that the great enterprise is already far advanced. I do not believe that the courage and tenacity of our race are failing us, and some of those here present to-night may live to see the land of the Pyramids and the Sphinx linked up with that cape of storms now called the Cape of Good Hope, round which that intrepid Portuguese sailor, Vasco da Gama, drove his crazy barque a little over 400 years ago. I have finished. I trust I have not wearied you. It has been my aim to avoid the dry bones of tabular statistics, but to give you, in very general terms, an outline of the origination and partial completion of a line destined, in my opinion and, I trust, in yours, to regenerate a continent, to bring peace and prosperity to Africa, and an expansion of trade to the country whose citizens we are and whose faithful servants we are proud to be.

THE VALUATION OF BREAD.*

BREAD FROM SIFTED FLOUR OR BREAD FROM THE ENTIRE GRAIN?

By DR. A. KUELLENBERG.

THE number of different kinds of bread existing in commerce is very large. The diversity is less due to the raw material—as mostly wheat and rye are used—than to the preparation of the cereal as well as to the baking process. There are various, strongly contrasting views upon this subject. Some demand a more thorough perfection of the old mill process, others want to use coarsely ground grain only, with or without a larger or smaller percentage of bran; others again grind the grain to a dough after it has been allowed to germinate; and many have constructed complicated machinery in order to pare the grain before grinding. This latter process is not only supposed to yield a larger amount of flour, but it is also claimed to improve the quality of the bread considerably, especially so in the case of rye bread. Then there is bread prepared with the admixture of gluten or other nitrogenous substances in order to increase the food value of the bread; some of these are of importance for the nutrition of invalids, others are proposed for the purpose of supplying the most nutritious food at the lowest cost, as, for instance, in the provision of soldiers.

There are innumerable types of bread, making the valuation of the same not always an easy task; we must not only take into account adulteration of all kinds, but also the method of preparation and the purpose for which the bread is intended.

Bread must be prepared from pure flour with the use of good yeast or sour dough. The crumb should be neither sour (use of too much sour dough) nor soggy (use of flour from germinated grain or defective kneading of dough). It should be rather elastic and porous and should not contain any ungelatinized flour clots. Bad odor, especially due to mold growth, should always be condemned.

The chemical analysis of a bread embraces mainly the determinations of moisture, degree of acidity, carbohydrates, proteids, and crude fiber. This should naturally be supplemented by microscopical examination. The amount of moisture should not exceed 45 to 50 per cent; bread with a higher percentage of moisture must be considered defective. The percentage of ash or mineral matter should be not higher than 2.5 per cent after subtraction of the salt; higher amounts indicate foreign additions such as barytes (barium sulfate), copper, zinc, or aluminium salts; these are sometimes added to flours which have lost their property of forming a good adhesive dough in order to increase their kneading capacity. The acidity should be neutralized by 3 to 5 cubic centimeters of normal caustic soda for each 100 grammes of bread; Lehmann† considers 7 to 10 cubic centimeters normal alkali as a maximum limit of acidity. The determinations of car-

bohydrates and proteids present a fair picture of the approximate, relative food value of the bread.

For the recognition of adulteration with flour from weeds or inferior cereals the microscopical examination is the only decisive factor. The addition of rye to wheat flour may thus be readily ascertained by the distinctive structure of the layer of cross cells. If possible, the microscopical examination should be made of the flour from which the bread has been prepared, as sometimes the structure of many elements and especially the characteristic form of the starch grains may be considerably changed by the baking process.

It is true that on the strength of such chemical and microscopical examinations many conclusions may be drawn regarding the valuation of a bread; nevertheless there still exists a wide gap of criteria for its perfect valuation. All these figures do not give us definite information to what extent those in the bread existing nutritive elements may be made available for absorption in the body. Sometimes the chemical data may even give rise to erroneous conclusions regarding the food value. This is especially true of the protein figures. The bran and the so-called gluten or aleuron layer is richer in nitrogen than the meal body; consequently the bran bread shows a higher percentage of nitrogen than the white bread. Notwithstanding this fact, however, the white bread must be considered as the more nutritious of the two. This has been recognized since the digestion experiments with different kinds of bread. Exhaustive and determinative tests were first made in this direction by Voit, Rubner, Lehmann, and in recent times by Plagge and Lebbin.

Such nutritive experiments are generally conducted in the following manner: The experimental person is nourished for several days exclusively with the bread to be tested; the bread is accurately weighed and the percentage of moisture, dry substance, protein, carbohydrates and fat is exactly determined.

This permits a calculation how much of the different nutritive substances has been absorbed by the individual during the entire period of the experiment. The faeces are weighed and examined in the same manner. They contain the non-absorbed, nutritive elements which are, of course, without value for the nutrition, having passed the body unchanged. As the total amount of the various nutritive elements is known from the analysis of the bread, the loss in percentage may be calculated from the faeces. The line of demarcation in the faeces from the bread and those from the previously or afterward administered food is ascertained in the following manner: Before the experiment and after conclusion of the same, some food is given to the individual that will produce faeces totally different from those of the bread. In most cases milk is employed for this purpose or sometimes also cranberries, huckleberries, or blueberries, the peel of which will pass the stomach undigested and may thus be recognized in the faeces. If diarrhoea does not occur it is possible to always distinguish sharply between the different faeces.

The following table contains a number of results from such digestion experiments. The first four were made by Voit, the other four by Plagge and Lebbin. The figures represent the percentage loss of the various nutritive elements:

Kind of Bread.	Dry Substance.	Proteids.	Ash.	Carbohydrates.
1. Horsford-Liebig bread.	11.5	32.4	38.1	
(Whole grain)				
2. Munich rye bread.	10.1	22.2	30.5	
3. Munich wheat bread.	5.6	19.9	30.2	
4. Oldenburg Pumpernickel.	19.3	42.3	96.6	
(Whole grain)				
5. German army bread.	13.2	43.35		8.32
(Rye with 15 per cent bran)				
6. Bread from fine rye-flour with 25 per cent bran.	9.49	33.75		5.61
7. Westphalian Pumpernickel.	15.66	52.04	82.58	
(Entire grain)				
8. Bread from finely pulverized pure bran.	42.71	53.55	73.38	

As may be seen from these figures there exists a remarkable difference concerning the availability of the nutritive elements from the various kinds of bread.

The largest amount of nutriment is derived from the white; that is a bread from good, bran-free wheat flour; these results have been corroborated by repeated experiments. Less available nutrition seems to be contained in a bread from good rye flour, and a bread with a larger percentage of bran is still inferior in its nutritive value. Of particular interest are the experiments made by Plagge and Lebbin with the bread prepared entirely from bran flour. Adherents of bran breads have often claimed that the low nutritive value of these breads is entirely to be attributed to the insufficient comminution of the bran. In order to prove this assertion, bread was prepared from pure bran flour that had been pulverized as finely as possible; this was then fed to the experimental individual. The tabulated figures give sufficient evidence that the nutritive availability of this bread is extremely low. Even if in a natural mixture of bran and white flour the finely pulverized bran would perhaps be made more available for nutrition, this experiment shows conclusively that the nutritive value of bran flour is very low. Moreover, the fine comminution of the bran presents considerable technical difficulties; it seems therefore very doubtful whether this process will ever be adopted as a rational method of bread-making.

Is, however, the bran entirely without value for nutrition? This question must certainly be answered in the negative. Although the bran itself does not represent an ideal food, it can by no means be asserted

that bread from unbolted or unsifted flour has no claim for existence.

The digestion experiments with entire grain bread as well as with those containing a small percentage of bran are at a disadvantage in comparison to the white bread. We must consider that these experiments are more or less algebraic calculations which cannot express one factor playing an important rôle in all practical nutrition and one that cannot be determined by calculation, namely: agreeability of taste and palatableness.

It is by no means indifferent whether a bread possesses a more or less agreeable taste; it is rather a stimulus to a good digestion, if food is eaten with a certain degree of relish. Bread should not only contain the necessary nutrients, but it should also possess a certain amount of appetizing relish. In this respect there exists a remarkable difference between these two classes of bread. Generally breads from the entire grain possess a specific, wholesome, and substantial taste, that is very much relished by most people and many prefer it to the insipid, neutral taste of the white bread. Although this cannot be asserted of all breads of this type in commerce, there is no doubt that the better kinds of bran breads have a more appetizing and agreeable taste. It is not surprising, therefore, that this method of bread making has enjoyed such an extensive growth.

It appears also that this bread is of some significance from the hygienic standpoint, as many, suffering from the most persistent habitual constipation, have often been restored to normal health by a diet of bran bread. Dentists claim that the frequent chewing of coarse bran bread keeps the teeth in a healthy condition, as it supplies the sufficient measure of work so necessary for the maintenance of every living organism; this is only required to a small degree in the chewing of the soft, white bread containing no hard constituents except the crust.

Notwithstanding all these facts, however, the author does not believe that the preparation of bread from the entire grain will ever supplement the old system of bread making. This is not only due to the habit cultivated through centuries, but in a large measure attributable to the fact that the exclusive diet of such bread would not seem desirable from the hygienic standpoint generally. The eating of larger quantities of whole grain bread would in most people create an abnormal stimulation of the intestines, causing the food to be digested and absorbed too rapidly. This too energetic acceleration of the digestive operations would necessarily cause a considerable loss of nutritive elements as well as a decreased absorption of the entire food in general. From an economical standpoint it may further be said that it is entirely unratinal to employ the total amount of bran for the preparation of whole grain breads for human food. We know that the bran is utilized far better by the cattle, and nothing will be changed by the bold calculation of the adherents of whole grain bread who claim that, for instance, Germany could supply its total want of cereals from its own resources if it would adopt this method of bread making.

In view of all these facts, how may we be enabled to judge a bread properly? It seems especially requisite to ascertain in every case the purpose which the bread is supposed to serve. If it is a question of feeding large numbers of strong, mostly young people, as, for instance, in the provision of armies, a bread with less available nutrient elements may also be recommended as an exclusive bread diet. It may be justly assumed that such a bread, eaten together with other food and especially by strong, young people, is better utilized as may be supposed from the experiments made with bread exclusively, so that the above-mentioned disadvantages would not occur to any notable extent.

The valuation of bread becomes an entirely different problem if the bread is given as a diet for sick, old people or invalids. In this case, with the exception of individuals with chronic constipation, the bran-free, white bread should always have the first preference. The simultaneous use of entire grain bread is always recommendable as a great many people apparently enjoy the joint diet of both kinds of bread. It seems more wholesome for most people not to confine themselves to one kind of bread. The proportional quantities of the different types of bread depend entirely upon the individual taste to which just as much weight should be attached as to the digestion experiments. The former should also be quite as decisive in the valuation of bread containing specific nutritive additions. If such breads are disagreeable or unpalatable they would have failed their purpose from the start.

The taste is the natural regulator of all our diet, qualitatively as well as quantitatively. Any diet, may it be ever so rational from the scientific standpoint, will have entirely failed if it is permanently maintained with aversion.

BET SUGAR MANUFACTURE IN ITALY.

THE process employed, whereby an annual home consumption of over 100,000 tons is produced, is interestingly set forth in a recent issue of *The Engineer* (London), from which we abstract the following:

"The roots, transported to the factory, are weighed and discharged into great brick silos about 330 feet long, made in the form of a V, and being about 26 feet broad at the top and 20 feet at the base. Under the floor, made of movable wooden beams, runs a strong stream of warm water, which is turned on when it is necessary to empty the silos. The wooden beams are then drawn out one by one, the roots fall into the hot stream, and are carried by it into the

* Pure Products.

† Arch. f. Hygiene, 1893, 19, 363.