sprayed in the air. It may also prevent inhaled cross-infecting organisms from establishing themselves in the nose.

An obvious reason for failure is lack of contact between the sulphathiazole and organisms, and there are at least three different ways in which contact may be prevented:

1. Failure to administer the snuff successfully to the very young, particularly if the nasal passages are partly blocked as a result of catarrh, crusting, etc.

2. Heavy crusting in the nose, preventing contact between snuff and organism even after effective inhalation of snuff. The necessity for this thorough contact was stressed by Col. Colebrook when dealing with the dressing of war wounds with sulphonamide powders; he pointed out the need for a thorough wound toilet and a prompt application of powder before the surface of the wound has time to dry and become coated with fibrin. In the nose the same problem presents itself, and it might be beneficial, at least in resistant cases, to perform some kind of nasal toilet immediately before giving the snuff.

3. Presence of *C. diphtheriae* in the nasal sinuses; the snuff would be unlikely to penetrate so far regularly or in quantities sufficient to clear them.

In cases of failure of treatment there still remains the possibility of sulphathiazole-resistant strains of *C. diphtheriae*. However, a study of the rest of the nasal flora is of value here, because, unless this is reduced quantitatively and the *C. diphtheriae* continues to flourish, there are probably some of the above factors at work.

This investigation represents a trial of sulphathiazole under field conditions, and is an attempt to glean information from routine specimens rather than from a carefully planned scheme. The snuff was originally given to subjects who were known to be heavy and long-standing nasal carriers of *Staph. pyogenes*, to find out the effect of this organism. Only incidentally were the effects on *C. diphtheriae*, *Str. pyogenes*, and other organisms noted; these effects appeared pronounced enough to warrant publication. Subsequently diphtheria infection in the district declined, and it was not possible to investigate the problem satisfactorily by a comparison of treated and controlled groups of cases; accordingly the graphic representation of results before and after treatment has been adopted. Considerable difficulty has been experienced as the result of separation of the laboratory and the wards; it is particularly desirable in an investigation of this type to co-ordinate the clinical and laboratory findings. It should be emphasized that the use of an effective snuff in the treatment of diphtheria carriers and convalescents should not be the signal for relaxation of measures designed to prevent the spread of ward infection.

I am indebted to Dr. W. J. Cox, medical officer of health for Watford, for his co-operation and for the facilities extended to me; to Prof. W. W. C. Topley for a supply of snuff; and to Prof. A. A. Miles for his advice and encouragement.

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Dr. Henry F. Vaughan, health commissioner of Detroit, has been appointed professor of public health at the University of Michigan, where he will also take part in planning for a new building and organization of a school of public health. The Kellogg Foundation and the Rockefeller Foundation have undertaken to co-operate in the project, each agreeing to pay £100,000 for the establishment of the school. Not more than half of the total sum will be available for site, building, and equipment; the remainder will be spread over a ten-year period for the initial expenses of the school.

THE NUTRITIVE VALUE OF BREAD FORTIFIED WHITE FLOUR AND NATIONAL WHEATMEAL COMPARED

BY

MARGARET D. WRIGHT, B.A., M.B., B.S.

Despite the importance of estimating the relative nutritive values of the two alternative wartime flours—national wheatmeal of 85% extraction and white flour of 75% extraction fortified with vitamin B₁—experimental work on the subject is not yet extensive. Wholemeal bread, with its higher content of the vitamin B₂ complex, of vitamin E, and of iron, would appear from a nutritive point of view to have definite advantages.

Dr. Chick's Experiment with White and Wholemeal Bread

Dr. Harriette Chick (1940), describing an experiment in which the two flours were compared by the growth response of young rats, concluded that the advantage lies with wholemeal flour. She summarizes her findings as follows: "The nutritive value of a straight-run white flour [73% extraction] tested on young growing rats has been found inferior to that of wholemeal flour [82% extraction], even when the defects of the former in protein, minerals, and vitamin B₁ have been corrected. The inferiority must be attributed to lack of B₂ vitamins."

The experimental work which led to these conclusions may be described very briefly as a comparison of the effects on the growth of nine young rats of two diets, one based on straight-run white flour of 73% extraction (not 75% as at present in use), the other based on "wholemeal" flour of 82% extraction (not the 85% wheatmeal now being advocated). In view of its slightly higher protein content compared with white flour (13% against 12.1%), the wholemeal flour was fed at the lower level of 82% against 88% for the white flour, the balance being restored so far as carbohydrate is concerned by the addition of 6% of pure maize starch to the wholemeal diet. The two diets were alike in all other respects, except that to each rat on the white-flour diet there was given daily by pipette 10 microgrammes of pure vitamin B₁, this being regarded as an optimal amount.

Examination of the numerical results given for the average weekly gains in weight shows that the rats on the wholemeal-flour diet grew much faster than those on the white-flour diet, and at first sight these figures are impressive. On closer investigation, however, it is seen that during the first week the food intake of the rats on the white-flour diet was much lower than that of rats on the "wholemeal" diet. While this may have been due to nothing more than differences in palatability—since the animals' appetites were presumably normal on their B₁ intake—it nevertheless follows that the carefully computed theoretical equality of protein intake was not attained in practice: the rats on the white-flour diet received 6.25 grammes of protein in the first week, whereas the rats on the wholemeal-flour diet received 9.09 grammes of protein (of a slightly higher biological value). The figures for the second week were 6.8 grammes for rats on the white-flour diet and 10.3 grammes for those on the "wholemeal" diet. It should be observed that this differential intake of protein for the first and second weeks can have been due to nothing more than inacceptability of the white-bread diet to the rat palate. The effect of such a wide difference in protein intake, in a growth-rate experiment designed to be crucial as to the relative value of the diets in other respects, is fundamental.

Certain other possibly less important points appear to arise. Having regard to the food intake of the animals concerned, 82% of "wholemeal" flour—assuming a value of 1 I.U. per gramme—should provide approximately twice as much vitamin B₁ daily as was received by the rats on the white-flour diet. As already stated, 10 microgrammes (3½ I.U.) has been regarded as optimal for these animals, but in such a comparison as is

now being made it should not pass unnoticed that the other group of rats was receiving approximately 6 I.U. of vitamin B₁ daily.

It should be noted that although Dr. Chick attributed her findings to an inferiority of the B₂ vitamins in the white-flour diet, this diet was much inferior to the other in vitamin E also. Published findings on the subject are scanty, and Olcott and Mattill (1937) record the same rate of growth in young rats on an E-deficient as on an E-adequate diet. Yet it is known that adult rats reach a lower maximum weight on diets deficient in vitamin E; the comparison between the two flours in respect of the B₂ vitamins would have been closer if the requirements for vitamin E of rats on the white-flour diet had been satisfied. It has also been shown that vitamin E is not without influence on the fate of vitamin A in the body (Davies and Moore, 1941).

In view of the small number of animals employed (nine in all) we should have liked to examine the significance of the differences between the growths of the rats on the two diets; it has not proved possible to do this, since figures for individual rats are not given. The four points so far enumerated are:

1. The quantitative shortage of protein and of all other ingredients of the white-flour diet during the first and second weeks of the experiment.
2. The imbalance of the diets in respect of vitamin B₁.
3. Their imbalance in respect of vitamin E.
4. The fact that it has not been possible to assess statistically the significance or otherwise of the findings.

Of these points, the only one which would probably be generally regarded as of sufficient weight to throw doubt on Dr. Chick's conclusions is the first, although it is unfortunate from the point of view of the findings of the experiment that the other, minor, objections both operate in favour of the "wholemeal" diet and against the white. The cause of the differences in protein intake in the first and second weeks was clearly the contrast between the two diets in palatability to the rat.

The fundamental nature of this objection is perhaps best appreciated by considering the situation which would arise were it possible to carry out feeding experiments on a sufficiently large number of human subjects. It is generally agreed that white bread is more widely acceptable, and in an *ad lib.* test on growing children the advantage might therefore for this reason well appear to be with white bread. It is clear that such an experiment would not be regarded as conclusive in respect of the relative nutritive values of the two breads. For such a comparison equality of intake is essential. For this and the other reasons already cited it was decided to undertake further work on the relative values of the two main flours suggested for general use under more nearly equal conditions.

First Experiment, comparing Fortified White Flour and National Wheatmeal

Thus, although the work planned was, like Dr. Chick's, a comparative study of the nutritive values of a high-extraction flour and a white flour whose deficiencies of vitamin B₁, protein, and mineral salts were made good, the bases of the diets differed. The materials used in this test were white flour of 75% extraction fortified with 0.2 gramme of aneurin per 280-lb. sack, and national wheatmeal of 85% extraction. Both were purchased direct from one of the largest plant bakeries in North-West London.

	% Ash	% Protein
White flour, 75% extraction	0.53	N ₂ 2.27 × 5.7
Wheatmeal, 85% extraction	0.86	N ₂ 2.39 × 5.7

All previous tests on flours appear to have been carried out with the flour either untreated or cooked by steaming, as was done in Dr. Chick's work; but, since flour is always eaten after cooking and the vast bulk is consumed baked into bread, it seemed that the results obtained would be more directly applicable to human nutrition if the experi-

mental diets were also baked into loaves before feeding. It was necessary to add a small quantity of baker's yeast containing the other vitamins of the B complex. This was not regarded as a disadvantage, since yeast is so widely used in bread-making—contributing, in the quantities generally employed, an addition of vitamins insignificant in human nutrition. The diets were as follows:

- 400 grammes of flour (fortified white of 75% extraction or national wheatmeal).
- 27 grammes of G.L. ashless extracted casein.
- 18 grammes of arachis oil.
- 9 grammes of McCollum's salt mixture.
- 12 grammes of yeast.

The iron in the salt mixture compensated for the deficiency of this mineral in white bread. The yeast used throughout the test was identical and the baking conditions were kept constant.

Young black-and-white rats of our own inbred laboratory strain weighing 36 to 54 grammes were used. They were divided into groups, each group composed of rats as similar as possible, with the sexes and litter-mates proportionately distributed. Two groups were given the diets described, and in addition each rat received daily a drop of cod-liver oil in which α -tocopherol had been mixed at the rate of 170 mg. in 6 oz. of oil. The rats were caged separately. The test lasted for thirty-three days, beginning when the rats were 4 weeks old.

The vitamin B₁ content of white flour of 75% extraction is about 42 units per 100 grammes. The addition of 0.2 gramme aneurin per sack would add approximately 52 units per 100 grammes, thus making a total of 90 to 95 units. The wheatmeal contained 109 units per 100 grammes. Allowing for the water added to mix the diets—more was used for the wheatmeal than for the white-flour loaves—and for some loss in baking, the vitamin B₁ contents found were in accordance with expectations. Thiochrome assays of the two foods showed very comparable vitamin B₁ contents, tests on the baked loaves giving values between 57 and 61 units per 100 grammes.

The wheatmeal loaves had approximately 3% higher moisture content than the white loaves, and allowance was made for this in weighing the slices for the animals. It would have been desirable to add a flavouring agent to both diets to equalize their palatability and thus increase the total intake of food; but since no means of doing this was known it was decided to restrict the intake where necessary, so that all rats consumed approximately equal amounts of food. This was accomplished in practice by always feeding the rats as soon as those eating at the slowest rate had finished or practically finished their previous feed. The animals on the wheatmeal diet always consumed their share before those of the other group.

The weight gains throughout the period of tests were as follows:

TABLE I.—Weight Gains

Diet containing Fortified White Flour		Diet containing Wheatmeal Flour	
49 gm.	Mean of 10 = 63.9 gm. σ = 9.67 s = 3.058	48 gm.	Mean of 15 = 60.53 gm. σ = 7.03 s = 1.817
56 "		51 "	
58 "		52 "	
58 "		56 "	
62 "		58 "	
64 "		58 "	
67 "		59 "	
69 "		61 "	
73 "		62 "	
83 "		64 "	
		65 "	
		65 "	
		67 "	
		68 "	
		74 "	

$$t = 1.01; P = 0.33.$$

TABLE II

	Total Food Fed Throughout the Test (Av. per Rat)	Dry Weight of the Food Given (Av. per Rat)	Dry Weight of the Food Wasted (Av. per Rat)	Food Residue Uneaten at End of Test (Av. per Rat)	Actual Intake of Food
Fortified white-bread diet	388 gm.	229.3 gm.	19.3 gm.	6.4 gm.	203.6 gm.
Wheatmeal-bread diet	406 gm.	226.9 gm.	14.3 gm.	1.6 gm.	211.0 gm.

This corresponds to an average weight increase of 1 gramme from a consumption of 3.19 grammes of the white-bread diet and from 3.48 grammes of the wheatmeal diet.

A study of the figures given in Table I shows that there is no significant difference between the gains in weight made by the two groups of animals. The average growth rate is about seven-tenths of the normal for rats of this strain on an unrestricted intake of their adequate stock diet, which is what would be expected having regard to the restriction of food intake in the present test.

Second Experiment: Application to Human Diets

When the experiment just described was being planned it was thought that if its results should show a definite difference between the nutritive values of the two flours it might still be held that this would lose its significance when considering the application to human diets, since man consumes a range of foods not commonly used in laboratory experiments. Concurrently with the first experiment, a second was therefore planned to see how rats would thrive on the same two flours when these were baked into bread and used as a percentage of an ordinary human mixed diet. It was not possible to obtain figures of the wartime consumption of the standard foods, but a formula was chosen based upon the estimated consumption in 1934 (Sir John Orr, 1937) modified, in conformity with present-day rationing arrangements, by reducing the amounts of meat, fish, and eggs, and including greater quantities of potatoes, vegetables, and bread. The diets were as follows:

Bread (fortified white of 75% extraction or wheatmeal of 85% extraction) ..	35.5%	Margarine	3.0%
Boiled potato	30.0%	Cheese	0.7%
Cooked meat	6.0%	Cooked vegetables ..	14.0%
Fresh milk	3.0%	Jam	1.2%
Cooked fish	3.0%	Eggs	1.2%
		Sugar	2.4%

The bread was crumbed and the other foods were minced. Three batches of food were prepared during the four-weeks test and, except when required for weighing, were kept refrigerated. The meat used was beef on two occasions and mutton on the third. The vegetables were cooked cabbage and other greens; 1 oz. of raw lettuce was included in each batch. The fish was canned herring on the first occasion, canned salmon on the second, and fresh cooked herring for the third batch. The ingredients were mixed by prolonged hand-kneading, and this was continued for half an hour after the diet looked and felt uniformly mixed. Even so, the analysis suggests that the constituents were not distributed perfectly evenly throughout the whole.

The analyses of the diets were as follows:

	White (75% extraction)	Wheatmeal (85% extraction)
Protein	8.81	8.15
Oil	6.09	5.09
Ash	0.63	0.67
H ₂ O	54.30	55.10
Ca	0.19	0.10
P	0.07	0.20

The rats were given these diets for four weeks, beginning when they were 4 weeks old. They were caged singly and

weighed weekly, being fed weighed quantities of food as soon as all the rats had completely or almost completely finished the last batch.

The weight gains were as follows:

Mixed Diet, with White Bread	Mixed Diet, with Wheatmeal Bread
65 gm.	58 gm.
58 "	59 "
59 "	66 "
59 "	68 "
61 "	68 "
62 "	71 "
65 "	71 "
72 "	72 "
73 "	73 "
75 "	76 "
81 "	84 "

$$t = 1.23; P = 0.23.$$

Each rat received 603 grammes of food during the four-weeks test. The total food wastage (dry weight) of the two groups was very similar—165 grammes for the white-diet group and 151 grammes for the wheatmeal-diet group. There was no residue to deduct at the end.

Discussion

McCarrison's well-known work demonstrated that young rats thrive very badly on a mixed diet containing unfortified white bread, mixed with the other staple foods characteristic of those used by the poorest people in this country. The animals showed all the signs of vitamin-B deficiency, and some were ultimately killed and eaten by their fellows.

In the present test, using fortified white bread, no doubt of higher extraction than was used by McCarrison, the results were entirely different. The animals grew and showed every sign of health. Comparison of the growth increments of the two experimental groups shows that between the ages of 4 and 8 weeks rat growth appears to be equally well supported by wheatmeal of 85% extraction or by white flour of 75% extraction fortified with vitamin B₁ when these are mixed with the staple foods into the diets previously described.

Fifty ounces of the mixed diet made up with white bread supplies 2,600 calories, 0.46 gramme calcium, and 79.3 grammes of protein, of which 32.3 grammes is of animal origin. It would thus resemble the diets of Orr's Groups I and II (Orr, 1937) (the lowest-paid groups of the population).

	Calories	Total Protein	Animal Protein	Calcium
Group I (Orr)	2,317	71.6 gm.	50.7 gm.	0.37 gm.
Present experimental mixed diet (50 oz.)	2,600	79.3 gm.	32.3 gm.	0.46 gm.*
Group II (Orr)	2,768	98.8 gm.	80.9 gm.	0.52 gm.

* By calculation.

This particular diet, it should be noted, contains more bread (17.75 oz.) than the average pre-war intake throughout the country (12 oz. daily per head). The riboflavin supplied by these foods in the 2,600-calorie diet would amount to 0.93 mg. (figures from Fixsen and Roscoe, 1940; also some, unpublished, from Dr. Magnus Pyke). Slightly over 16% of this is given by the admittedly large amount of bread. If this were all in the form of wheatmeal the riboflavin it supplies would rise to 23%. The potatoes and vegetables between them supply over 43% of the total riboflavin. The large amounts of bread, potatoes, and vegetables in this diet, and its low animal protein content as compared with those quoted above from Orr's book, are believed to reproduce in the main the changes in our diet during the last two years.

Although we have used considerably more animals than did Dr. Chick and aimed at a stricter control of the other dietary factors that may affect growth, our finding that

wheatmeal bread from flour of 85% extraction and white bread from flour of 75% extraction—fortified in the manner described—do not differ markedly in nutritive value contrasts with Dr. Chick's statement that wholemeal flour of 82% extraction is superior to white flour of 73% extraction corrected for its deficiency of protein, minerals, and vitamin B₁.

A more refined statistical analysis than it is possible to give here somewhat weakens the apparent superiority of the white-flour diet in the first experiment and somewhat strengthens that of the wheatmeal diet in the second, but in both cases the difference between the two diets remains non-significant.

I should like to express my thanks to Dr. D. W. Kent-Jones and to Dr. Magnus Pyke for checking the thiochrome values of the diets used and for their advice and criticism; and to Mr. E. C. Fieller of Boots Ltd., Nottingham, for his statistical analyses of the data.

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A TREATMENT FOR CHRONIC PSORIASIS

BY

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The dermatologist, perhaps more than any of his medical colleagues, views with reserve sweeping claims on behalf of new treatments. The great variation in individual skin sensitivity impresses upon him the truth of the old adage, "One man's meat is another man's poison." Bearing this in mind, I can state that I have been amazed at the uniformity of response of chronic psoriasis to a line of treatment I have recently evolved. The two methods which I have partially combined are those of Madden (1940) and Goeckerman and O'Leary (1932). I will run through these briefly.

Madden's treatment resulted from a most comprehensive investigation of some 259 cases of psoriasis. He divided these into small groups and treated each group by a different method, utilizing the following: vitamin B₁, vitamin B₂, vitamin B whole complex, brewers' yeast, vitamin C, oestrogenic substances, sulphanilamide, bismuth salicylate in oil, anterior pituitary extract, adrenal cortex extract, low-fat diet with vitamin B₁, low-fat diet and liver extract, low-fat diet with vitamin B₁ and anterior pituitary extract, and low-fat diet with vitamin B₁, anterior pituitary extract, and adrenal cortex extract. He came to the conclusion that the best results were obtained with a low-fat diet plus 1,000 international units of vitamin B₁ daily by mouth, combined with an exfoliating ointment. Madden, however, says he realizes that not all cases will respond to this treatment. Goeckerman and O'Leary's line of treatment was as follows: the patient is anointed with a 2% ointment of crude coal tar before retiring at night. In the morning the ointment is removed with olive oil, leaving a thin film on the affected areas, and the body is then exposed to gradually increasing doses of ultra-violet light. In the interval between treatments a bland ointment, such as boric acid salve or petrolatum, should be applied.

Method of Treatment

My method has been as follows. The patient is told to rub 2% crude coal-tar ointment in soft paraffin into all

lesions each night. In the morning, with the ointment still on, the patient goes to the ultra-violet radiation department, where the ointment is removed by means of olive oil, a thin film of which is left on; then the ultra-violet irradiation is carried out. This treatment is given every day. At the same time the patient takes 1,000 units of vitamin B₁ by mouth daily. In some cases the ointment is so removed by movement in bed at night that it has to be reapplied in the morning before going to the radiation department. In other cases in which there are particularly thickened lesions I add 20 to 30 grains of salicylic acid to the tar ointment and advise the patient to scrub off the scales with a stiff brush or by the use of pumice stone. The ointment is reapplied after this exfoliating treatment, and then the radiation treatment is carried out as above. In certain cases I have used, in addition to the above measures, 300,000 units of vitamin D daily, but I have found that patients who have not had this have done just as well as those who have.

A word of warning must be given: care should be exercised in the treatment of children by this method, as the danger of lighting up a tuberculous focus is always present when general light baths are taken by young people.

Commentary

I have treated some 53 cases in this way. Admittedly the number is not large, but I have watched the condition gradually disappear in every case. Furthermore, the patients tell me from their own experience that they have never been so clear in the whole of their psoriatic life, and, incidentally, have never felt so well before. I am convinced there is a future for this method. The only drawback I can see is difficulty of daily attendance for radiation treatment. As, however, more and more large factories, etc., have increased facilities for their workers, including ultra-violet irradiation, something may yet evolve to overcome the loss of time at work. It is necessary to insist on *daily* ultra-violet irradiation, as the treatment will not produce the same results if it is given only once or twice a week. This I have proved.

A good many of the patients who received treatment and responded to it have had psoriasis for over 40 years, 30 years, 20 years, 16 years, and lesser periods. They had been constant in their attendance for treatment, and the measures which they had resisted included exfoliating salicylic and tar ointments, cignolin, etc., high-vitamin dietary, protein-shock therapy (T.A.B. vaccine, aolan, peptone, and whole blood), ultra-violet radiation, autogenous vaccines, oestrogenic substances, tar baths, x-ray therapy, and, in one instance, a course of gold therapy (using solganal B oleosum).

I cannot dogmatize on the prognosis of these cases, but from past experience it has been learnt that once a case of psoriasis has been *completely* cleared that case may remain clear for some considerable time. Should there be a recurrence the patient is warned to attend for treatment immediately, and the prospect is that the condition can be brought under control rapidly while it is still of small extent.

I know that psoriasis can clear for a time without treatment and with almost any treatment, but when it starts to clear in every resistant case dealt with as above I think the treatment must take the credit. Now that I have stated that so far no snags have been encountered I expect they will begin to arrive, but it is the *universal* response to the line of treatment which has caused me to write this short paper.

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