

invariably associated with two or more of these abnormal physical signs.

It may be considered therefore that the ideal pulse for a flying officer has a small range between systolic and diastolic pressures (20-30), with a rest-rate increased at most 20-25 by exercise and returning to the rest-rate in 10-15 seconds.

From the respiratory point of view the subject must be possessed of good vital capacity, good expiratory force. The accessory "respiratory pump" is of particular importance in the airman owing to the fact that his position is frequently somewhat cramped in the machine. Good diaphragmatic action and good tone of the abdominal muscles are essential to ensure adequate venous return to the heart and prevent any tendency to splanchnic pooling. The adequacy of the vital capacity can be calculated from the Dreyer formulæ.<sup>6</sup> It is of interest to note that this falls away with the onset of fatigue, and that this falling-off is associated with a diminution of the supplemental air. In consequence there is an increase in the "residual air," the effect being that a man is very much in the position of a machine running on a "wrong mixture." Such a man becomes a "panter" instead of a deep breather at high altitudes. For the assessment of respiratory efficiency the following tests are employed: (1) the vital capacity; (2) the power to hold the breath after full expiration and inspiration; (3) the height to which a column of mercury can be blown (with the cheeks held); and (4) the time at which a column of mercury can be sustained at 40 mm. Hg, the pulse being counted meanwhile.<sup>7</sup>

Experience has shown that although designed primarily as tests for respiratory efficiency these tests (particularly Test No. 4) have also great value in aiding the formation of an opinion as to the stability of the nervous system and the efficiency of the circulatory system. They are also of service in aiding the making of an assessment of the mentality of a subject.

Tests to be Taken as a Whole.

It should be remembered that these tests were devised to serve as adjuncts to the general clinical examination. It has been found that some purely temporary cause may be the reason of failure in some of the tests, and for this reason attention should be directed to the subject's performance as a whole rather than to failure in any one particular test. It is also of the greatest importance that the tests be carried out exactly as specified in the directions, and that it be carefully observed whether the subject is really trying to do his best. Results obtained from an individual who is not trying are of little value beyond showing that at the moment he is not "keen," and therefore, to that extent, not thoroughly efficient.

Various considerations led the writer to the conclusion that the first breakdown in the bodily systems is frequently associated with the respiratory mechanism which, becoming defective in working, reacts owing to inefficient respiratory ventilation upon the cardiovascular and nervous systems, thereby bringing out secondary signs of cardiovascular and nervous debility. In support of this view it should be stated that early on it was observed that pilots stated to be suffering from stress suffered from breathlessness and manifested inability to blow hard or expire deeply. Investigations were therefore made into the condition of the respiratory mechanism of successful and unsuccessful pilots. The first test devised was that of holding the breath. Preliminary figures obtained from successful pilots showed that on an average these officers could hold their breath under the conditions of the test for 69 seconds, whereas many officers who were attending medical boards owing to their inability to fly high could hold the breath, generally speaking, but 20 to 40 seconds, the performance being attended usually with a considerable degree of discomfort.

Table VII. gives the figures obtained in various groups of officers.

TABLE VII.

Subjects.	Number examined.	Breath held in secs.*	Vital capacity in c.cm.	Supplemental air in c.cm.	Expiratory force in mm. Hg.	Sustaining 40 mm. Hg.
Fit instructors...	22	67 46†	4062 3300	1620 1000	112 80	32 43
Home defence pilots...	24	72	3940	1496	119	50
British candidates	23	69	3823	1590	106	52
U.S. candidates...	7	66	3814	1386	116.4	53.5
Delivery and test pilots ...	10	57	3620	1050	108	40
Pilots returned for rest ...	17	57	3897	1423	95	40
Pilots training for scouts ...	15	62	3820	1433	96	49
Pilots taken off flying through stress ...	27	49	3480	1134	74	25
Hospital cases ...	55	54	3560	—	87	35.5

\* Average (with the exception noted). † Minimum.  
‡ One or two suffering from stress included in the table.

From the above figures it is seen that for the expiratory force test 80 mm. Hg should be taken as a minimum. For the test of sustaining 40 mm. Hg with the breath held 40 seconds should be regarded as the minimum time. It was found that these tests in combination were of use in indicating the powers of endurance of the subject for high or prolonged flying and also of value in assessing the degree of shock sustained by a pilot in so-called "minor" crashes. It is of interest that by it during the stage of investigation a number of subjects found unfit at the Aviation Candidates Board were also found unfit on this test.

It is believed that the above results show that in the selection of the flying officer by the medical officer much may be done by submitting him to an overhaul as regards normal performance in much the same way as an aeroplane is examined as to its efficiency by a technical officer. Evidence is also brought forward to show what attributes are especially to be sought in the selection of a successful flying officer.

SOME REMARKS ON  
FOOD VALUES IN TUBERCULOSIS.

BY H. DE CARLE WOODCOCK, M.D., D.P.H.,  
F.R.C.P. EDIN.,

PRESIDENT OF THE TUBERCULOSIS SOCIETY (1919-20);

AND

ARTHUR G. RUSTON, D.Sc. LEEDS, B.A., B.Sc. LOND.,  
LECTURER IN FARM ECONOMICS, THE UNIVERSITY, LEEDS.

THIS is to some extent an empirical paper. It is well known that the philosophy of diet has grown up almost in a night; apart from this it is in the memory of the writers of this paper that during the last 20 years there have been various phases in the teaching of the treatment of tuberculosis by diet. About 1900 the Strasbourg geese method was generally accepted. Even then Clifford Allbutt with his usual clarity of mind sounded a note of warning. At the International Tuberculosis Congress—the Congress at which Koch enunciated at Queen's Hall his later opinion on bovine tubercle—Allbutt was advising that whilst a tuberculous patient with fever should not be treated as a fever patient, still more, he should not be stuffed to repletion by masses of food which he was incapable of transforming into energy. His advice was that the patient on first coming under the notice of a sanatorium physician should be fed on a spare diet, which should be increased as the physician gauged the assimilative powers of the patient. Later it became plain to all that a mountain of fat might conceal a mole-hill of muscle, and that fat stored up at the sanatorium rapidly melted away in the workshop, leaving the

<sup>6</sup> THE LANCET, August 9th, 1919.  
<sup>7</sup> For details see Air Ministry Publication C.A.1; also THE LANCET, Feb. 8th, 1919.

patient in a state of physical exhaustion and mental depression at his apparently rapid relapse.

Walther told one of us that the principles which guided him in the dieting of his patients were: first, to remember that they had lost weight and the loss must be replaced; second, that the loss was still going on and extra food was obviously required day by day to replace this loss; third, that the everyday wear and tear normal to the human machine must be met by an amount of food also normal for a healthy person of similar bulk to the patient in question. He knew nothing of vitamins nor of the action of calcium or potassium salts, but he knew and spoke of the sandwich, the bread, the butter, and the meat as the main therapeutic agent in the war against tubercle.

*Production and Maintenance Rations.*

Two terms are of special importance in considering the diet of a tuberculous patient; these terms are production ration and maintenance ration. It is desirable to think of these terms, and indeed in these terms when we consider, say, the growth of a young child, the well-being of a pregnant mother, the needs of the mother and the child when the child is at the breast, and also the welfare of a patient suffering from tubercle. In each case there must be given a maintenance ration to neutralise ordinary waste and produce ordinary energy and an excess or production ration which will supply material for growth or meet the needs of special waste. In the production of cow's milk these principles have been recognised after much scientific research, and stabilised diets have resulted. There is a definite ratio between the weight of the animal and the digestible protein and digestible starch equivalent that she requires. For every 1000 lb. of animal, live weight, 0.75 lb. of protein and 6.25 of digestible starch equivalent are required per day. For the production of milk add 0.65 digestible protein and 2.50 starch equivalent for each gallon of milk given by the animal. If this production ration is not supplied the animal either draws on its own reserves, gets out of condition, and loses weight, or the milk yield quickly drops.

In the case of the tuberculous patient a counterbalancing increase of diet is required unless he is to lose ground. The average requirement of a normal working man may be taken as 3400 calories per day. The voluntary ration advised by the Food Controller during the war only provided for about 2100 calories per head per day.

*War Ration for Tuberculous Patients.*

Under these adverse circumstances the Food Controller, prompted by medical advice, recognised that the ration for the tuberculous patient should be considerably above that of the average individual. At the same time the Local Government Board published a diet scale allowing 3750 calories per head per day to all male sanatorium (tuberculous) patients over 10 years of age. It is true that this was the fixed maximum allowance but it was a significant admission. For the medical and nursing staff a less generous diet was suggested, though this diet was again above that of the average individual and was equal to 2490 calories.

Since January, 1917, careful records have been kept of the weight of food consumed each week at Gateforth Sanatorium, and the number of calories per head per day correlated with the weekly alteration in the weight of the patients. Throughout the whole period these figures have kept almost constant. The calories per head per day occasionally fell during the summer months as low as 3300, and in the winter once rose as high as 3800; but the daily average throughout the three and a half years of the investigation was 3556. This figure is well within the Local Government Board maximum, but certainly in excess of the normal food-supply of persons engaged in sedentary or light muscular work. This supply answered physiological demands. We had as patients very few women and no children. The men were engaged during three hours of the day in light gardening. The food was scarcely ever really restricted, though some items were necessarily limited in quantity, their place being taken by other substances.

There was thus considerable thought given to the question of diet, and personal likes and dislikes were never ignored. On this diet, to a great extent one of personal—that is, instinctive—choice, the patients did extremely well, their calamity being greatly modified. There was an almost universal gain in the individual body weights. So far our dietetic diagnosis was successful.

*Comparisons of National and Sanatorium Diets.*

Let us take another point of view. From the official figures published by the Food (War) Committee of the Royal Society as a command paper (Ed. 8421) at the request of the President of the Board of Trade, it is seen that during the five years 1909–13 inclusive cereals provided 34 per cent. of the total energy value of the nation's food; potatoes and other vegetables, 20 per cent.; sugar, 13 per cent.; meat, 18 per cent.; and dairy produce, 15 per cent. Now at Gateforth cereals, sugar, potatoes, and other vegetables provided a much lower percentage of the total work-producing power, and the meat and dairy produce a much higher percentage.

	Percentage of work-producing power contributed by various classes of food.			
	United Kingdom 1909-1913.	Gateforth 1917-1920.	Rationing scheme for	
			Consumptive patients.	Resident sanatorium staff.
	Per cent.	Per cent.	Per cent.	Per cent.
Cereals... ..	34	30	30	35
Sugar* ... ..	13	9	7	9
Potatoes ... ..	10	4	5	8
Fruit and vegetables	10	3	4	3
Meat† ... ..	18	24	22	18
Dairy produce‡ ...	15	30	32	27

\* Includes treacle and jam.  
† Includes beef, mutton, pork, bacon, eggs, poultry, game.  
‡ Includes milk, cream, butter, cheese, margarine.

The great difference between the Gateforth diet and the diet outside evidently lies in the fact that the former is richer in protein and fat than the latter.

*Necessity of Increased Protein Content.*

It comes to this, that if the patient is wasting there must be a high percentage of nitrogenous food in his diet. Again, as T. B. Wood and F. G. Hopkins<sup>1</sup> have pointed out, protein, apart from its flesh-forming power, directly stimulates the metabolism of all foods, and therefore of non-nitrogenous varieties. Carbohydrates have not this power. Protein has a lower fuel value than starch or fat. The figures are, taking starch as 1: protein, 0.94; fat in oil seeds, 2.4; fat in cereals, 2.1. Increased protein content must be provided. A man doing heavy work under stress or exposed to cold requires a comparatively large amount of protein in his diet. The same rule applies to a man suffering from a wasting disease.

Of 1944 observations in the case of urban industrial families, the protein content per head per day amounted to 98 g., or 3.5 oz. Munition workers (18,000 observations in 1917) consumed 115.7 g., or 4.1 oz., per head per day. The maximum weekly ration sanctioned by the Local Government Board for patients over 10 years of age and suffering from tuberculosis, would supply 144 g., or 5.1 oz., of protein per head per day. The ration allowed to the resident staff was less rich; it supplied 92 g., or 3.3 oz., per head per day. The Gateforth diet (three and a half years' investigation) allowed 133 g., or 4.7 oz., of protein per head per day.

*Fats in Tuberculosis.*

Tuberculous patients require a rich fat diet. Fat is highly assimilable and almost entirely absorbed from the alimentary canal; it is more slowly digested and absorbed than are carbohydrates. The most intense absorption of fat occurs five hours after a meal; the starches have been absorbed in three and a half hours,

<sup>1</sup> Food Economy in War Time, p. 8.

and starchy foods thus give a sense of repletion directly after a meal and a regretful sense of emptiness five hours later; the fats have a greater staying power. It is an old and wise tradition that fat-eaters are more piously contented with existence than those who abhor fat. Again, if one wishes to give a person undergoing much strain from work or disease a more than generous amount of food he is given average diet, and fats and protein are added in more than average proportion; but if carbohydrate is piled on carbohydrate the result is flatulent fermentative dyspepsia and even physical exhaustion. Fats are tabloids of concentrated food, undiluted with water. They have more than double the calorific value of any alternative food. The question of bulk is of importance, as the alimentary capacity has its limits. E. H. Starling states<sup>2</sup> that fat should compose from 20 to 25 per cent. of the whole diet.

#### Summary.

(1) We find that tuberculous patients require more food than the average amount needed by the ordinary labourer outside. The minimum for Gateforth patients contains 3500 calories, the patients being almost invariably adults.

(2) The diet must be rich in protein and fat—protein, 4 to 4½ oz. per head per day; fat, 4 oz. per head per day. We consider that the fat should be largely animal fat, particularly in the form of milk and milk products. If margarine is used it should be as oleo-margarine and not made from vegetable fats.

(3) Eggs should be in the dietary, and when they are not supplied their place should be taken by an extra amount of meat given according to accurate calculation.

(4) Whole-meal bread, beans, peas, and lentils should always be used, together with a plentiful supply of fresh fruits and vegetables grown in the sanatorium grounds.

(5) Two pints of milk per day is the amount we suggest for each patient, and we draw attention to the following facts:—

In the final report on the production and distribution of milk (Cmd. 483) it is pointed out that 0.25 pints per head per day is the average amount of milk used in Great Britain, although this amount is increased by the use of condensed and other forms of preserved milk. This amount is inadequate, but from the daily milk allowance at Gateforth (namely, 2 pints per head) we get 25 per cent. of the calorific value of the total food supplied, 33 per cent. of the total protein, 36 per cent. of the total fat, and the following percentage of the total vitamins: 75 per cent. of the total food rich in fat soluble A; 63 per cent. of the total food rich in water soluble B; and 65 per cent. of the total food rich in antiscorbutic principles.

Can the importance of a plentiful, clean, rich, milk-supply, not only to the patient in the sanatorium but to the multitude outside its gates, be further emphasised? We have seldom needed to depart from a routine diet based upon the principles and rules of experience set down in the foregoing pages. Raw-meat feeding has not been carried out at Gateforth, although it is sometimes prescribed in the sister institution at Armley. Again, in the very few cases of hæmoptysis met with at Gateforth diet has been reduced to the traditional drastic minimum of hospital practice, the sufferers being transferred as soon as possible to a more suitable institution.

<sup>2</sup> Brit. Med. Jour., August 3rd, 1918, p. 105.

## SYMPTOMS RESEMBLING TABES DORSALIS

### ARISING AFTER ANTITYPHOID INOCULATION.

BY JUDSON S. BURY, M.D. LOND., F.R.C.P.,

VISITING PHYSICIAN TO THE NEUROLOGICAL HOSPITAL FOR PENSIONERS AT BRINNINGTON; CONSULTING PHYSICIAN TO THE MANCHESTER ROYAL INFIRMARY.

THERE is ample evidence that the low percentage of cases of enteric fever in the British army during the recent war was due to systematic inoculation with anti-typoid vaccine, and also that in the vast majority of cases such inoculation was quite harmless. Large doses of the vaccine are well tolerated by healthy persons, but this is not always the case in persons who have some morbid taint. The vaccine may light up a latent tuberculosis, may cause a rise of temperature, and a recrudescence of intestinal symptoms in persons who have suffered from enteritis, and may lead to the development of albuminuric retinitis in the subjects of Bright's disease.<sup>1</sup> Meyer has recorded a sudden death due to oedema of the glottis after inoculation in a case of status lymphaticus.<sup>2</sup> Very rarely symptoms of disease have been observed to develop in previously healthy persons soon after inoculation. The sequence, of course, may have been accidental, the observed illness being due not to the vaccine but to some other agent. A critical investigation of every case is essential, but even then it may be difficult or impossible to decide as to the cause of the illness. The absence of satisfactory proof, however, neither detracts from the interest of the association, nor lessens the necessity for putting it on record.

#### Sequelæ of Antityphoid Inoculations.

Before describing a case recently under observation, I will briefly allude to some communications by French physicians, in which cases of nervous sequelæ of anti-typoid inoculation are described. In nearly all the triple vaccine known as T.A.B. was used, and the symptoms appeared suddenly within a few hours of the vaccination. Two cases with signs of cortical thrombosis are reported by Roussy and Cornil<sup>3</sup>:—

1. A sensory disturbance of the left arm with ataxia developed on the day after a third injection of T.A.B.; the disturbance was of cortical type and corresponded to the description of cortical lesions given by H. Head and G. Holmes. There was slight tremor of the left hand and movements of the fingers resembling those of athetosis. The motor power was not impaired: slight muscular atrophy developed for a time.

2. The patient fell unconscious after a first injection of the same vaccine. He was found to have right hemiplegia, total aphasia, and signs of meningeal reaction. Six months later there was a typical residual hemiplegia with dysarthria.

In both cases the Wassermann reaction was negative. The authors think they were justified in regarding the inoculation as the cause of the cerebral lesion. Seven cases are recorded by Souques<sup>4</sup>:—

1. A man, aged 41, was found in a semi-comatose condition with right hemiplegia and aphasia a few hours after a second injection of an anti-paratyphoid A and B vaccine; he remained semi-conscious for about a week. Hemiplegia and dysarthria were present 18 months later. Syphilis and alcohol were excluded.

2. A man, aged 35, was suddenly seized with headache, pyrexia, and vomiting three hours after a fourth injection of anti-typoid vaccine. A year later there was right-sided paresis together with other symptoms which pointed, in the author's opinion, either to a unilateral cerebellar disturbance or to disseminated sclerosis.

3. A man, aged 33, almost immediately after a fourth injection of T.A.B., began to suffer from violent headache and other meningeal symptoms. Eight months later there were no objective signs of a cerebral lesion, but the patient complained of constant headache and was very irascible and indifferent to the conduct of his affairs; he also suffered from marked amnesia. The Wassermann reaction was negative.

4. A man, aged 38, previously healthy, had a genuine epileptic fit during the night following the day when he had a second injection of T.A.B. vaccine. Subsequently other fits occurred and always during the night.

5. A man, aged 19, a few hours after a second injection of T.A.B. vaccine, became feverish, vomited, and had a stiff neck. Four months later he suffered from constant headache. The Wassermann reaction was negative.

6. A man, aged 21, after a single injection of antityphoid vaccine, developed severe headache and vomiting; the vomiting continued for a month, the headache during the four months he was under observation.

7. A man, aged 41, after a third injection of the vaccine, noticed that the right side of his neck was getting larger; four months later his eyes were unduly prominent and his hands trembled. Graves's disease was diagnosed and marked signs of this disease were present

**A MEDICAL MAYOR.**—Mr. Arthur Charles Roper, honorary surgeon to the Royal Devon and Exeter Hospital and Exeter Eye Infirmary, has been nominated as Mayor of Exeter.

**SALARIES OF SCHOOL MEDICAL OFFICERS.**—At the last meeting of the Devon Education Committee it was decided that the salaries of school medical officers should in future be £500, increasing to £600 per annum by annual additions of £25. It was also determined that the salary of the present medical officers be raised to £500 a year, as from April 1st last, and that the travelling allowance be raised from £175 to £200 per annum.