MINISTRY OF THE INTERIOR, EGYPT.

PRISONS DEPARTMENT.

INTERIM

REPORT

OF THE

PRISON DIETS COMMITTEE.

CAIRO.
GOVERNMENT PRESS.
1917.

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ERRATA.

PAGE 25, second table (October 1915), the line of figures opposite " Milk " should be read as referring to " Bread " in the next line.

PAGE 37, line 9, *for* " to equal " *read* " to be equal."

PAGE 51, last line of third table, column " Calories," *for* 2,558·2 *read* 2,458·2.

NOTE.

PAGE 40, line 28, "British Army active service" refers to "Army Report" (c.d. 1782), Lieut.-Colonel Melville's Commission, p. 40, para. 18.

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PRISON DIETS COMMITTEE.

INTERIM REPORT.

CIRCUMSTANCES LEADING TO THE APPOINTMENT OF THE COMMITTEE.

1. Attention was called to the question of the prison dietary in the early part of 1914, when it was observed that the cost of feeding 14,000 prisoners was nearly L.E. 70,000, or slightly under L.E. 5 per head, compared with less than L.E. 2 per head in India.* The question arose whether the high cost of the Egyptian diet could be justified, especially when the chief factor in the cost was found to be the inclusion of meat in the diet on a liberal scale, nearly ten ounces (about seven ounces of meat and three ounces of bone) being purchased four times a week for each convict on hard labour. This largely exceeds in frequency and amount the meat habitually consumed by the class from which the bulk of the prisoners is drawn, and is said to be one of the causes which detract from the deterrent effect of prison life in this country. In his Report for 1913 the Judicial Adviser, referring to the prevalence of crime, remarks: "Imprisonment, since it carries no social stigma, is no real deterrent. The work is no harder than the *fellâh* is accustomed to perform in the fields, the food and accommodation infinitely better."

While no one would propose to add underfeeding to the punishment of well-behaved prisoners, it is clearly indefensible to add to prison fare anything which is a luxury to the majority of the population. The law-abiding section of the community should not be taxed to provide for the lawless luxuries which they cannot afford for themselves.

In these circumstances an investigation was *prima facie* required, and it was decided to appoint a Committee.

COMPOSITION OF THE COMMITTEE.

2. The Committee was constituted on March 1, 1914, the members being:—

Mr. H. Higgs, *President.*
Mr. R. E. Monteith-Smith.
Dr. R. G. Kirton, P.M.O., Prisons Department.
Mohammed Qotry Bey, Sub-Inspector General, Prisons Department.
Mr. A. Lucas, Director of the Analytical Laboratory.

Dr. W. H. Wilson, Prof. Physiology at the School of Medicine, Qasr el Aini, and Mr. J. I. Craig, Controller of the Statistical Department, were subsequently added to the Committee.

REASONS CALLING FOR AN INTERIM REPORT.

3. It was hoped that the Sub-Committee would have been able to agree upon an alternative diet which would have been at once economical and sufficient. On its failure to arrive at a unanimous conclusion it was thought desirable to test by experiment alternative diets. Considerable time must elapse before the results of this experiment, which will form the subject of a final report, are available. In the meantime, we have decided to present this Interim Report, which places on record the scientific and other data collected in the course of our work, in the hope that they will be found of value to other Departments, *e.g.* the Ministry of Education, the Department of Public Health, the Lunacy Department, and, possibly, the Army, which have food problems to consider.

* The latest figures available for India referred to 1910.

HISTORY OF THE EXISTING DIETS.

4. Attention was first drawn to the insufficiency of the then existing diets in 1895. It was decided in 1902 to appoint a Commission to study the question, but owing to the outbreak of cholera which took place in that year, the Commission dissolved without reporting.

At the close of the year, however, new diets, which are still in force, were drawn up by Dr. Kirton, and were introduced in 1905.

These are four in number, excluding hospital and other special diets :—

(*a*) A Bread Ration, served to Markaz prisoners and to contravention prisoners in Cairo for a period not exceeding one week.

The attention of the Committee has been called to the fact that prisoners in Markazes may be kept on this diet for periods as long as three months. For so long a period this ration is physiologically inadequate.

(*b*) Diet No. I, for non-labour prisoners.

(*c*) Diet No. II, for ordinary-labour prisoners.

(*d*) Diet No. III, for hard-labour convicts.

The present composition and cost of these diets, according to the contracts which expired in June 1914, is as follows :—

	No. I.	No. II.	No. III.
	Dirhems.	Dirhems.	Dirhems.
Bread	250	300	300
Oil	6	8	8
Meat	0	10	38
Lentils	24	24	18
Beans	24	24	24
Rice	15	10	18
Onions	4	4	4
Vegetables and fruit ...	32	32	32
Salt	4	4	4
Duqqa...	1	1	1
Cost ... ... L.E.	3·766	4·884	6·459

Prior to 1900 the health of the prisoners was very unsatisfactory, and outbreaks of infectious disease were frequent.

After 1905 the death-rate considerably abated, and Dr. Kirton is of opinion that when due allowance has been made for all other factors the improved diet was the main cause of the drop in mortality. The other members of the Committee are unable to dissociate the operation of the different new and important hygienic factors which came into play about 1905, but they see no reason to fear that such an alteration in the diets as they propose will lead to a recrudescence of disease.

GUIDING PRINCIPLES OF THE COMMITTEE'S PROCEEDINGS.

5. The Committee was struck at the outset with the anomaly of feeding prisoners to so large an extent on meat, which to Egyptians of the class to which prisoners in general belong is a luxury.

The cost of meat is high—more than one-third of the total cost of Diet No. III.

The dietary now in use is based on the analogy of European and American practice. The analogy is a bad one. The Egyptian diet should be based on Egyptian habits with due regard to climatic differences.

We have adopted as our guiding principle that the fare of prisoners, while sufficient to satisfy all physiological requirements, should be (*a*) consonant with the food habits of the general population, and (*b*) economical.

Preliminary enquiries, collected from various sources, satisfied us that there is no ground in habit for giving meat four times a week.

SCIENTIFIC ASPECTS OF THE CASE.

6. We were next led to consider the physiological requirements of the case, *i.e.* what nourishment is essential to maintain the health of prisoners doing different classes of work.

In constructing a diet five considerations must be borne in mind: (i) energy value, *i.e.* the number of calories (heat units) provided by the food to replace the energy expended in doing work; (ii) protein content, *i.e.* the extent to which it provides tissue-building material; (iii) bulk; (iv) digestibility; and (v) cost.

It may be stated generally that the difficulty is to provide sufficient protein at a reasonable cost. If that is done, the food will usually contain sufficient fats and carbohydrates (energy-producing substances). In this connection the total bulk and composition of the diet offered is important, as the wastage through non-absorption becomes disproportionately great when the amount of food consumed is excessive or the elements are ill-assorted.

The degree to which the proteins contained in the food are absorbed into the system, and the biological value of the protein taken up, vary with the source of the protein, *i.e.* the kind of food from which it is derived.

As stated above, the solution of the problem, what the most satisfactory diet is, depends upon the value of the protein which the body absorbs from it, and this is unfortunately the question upon which physiologists are most at variance. Further, the majority of the experiments in this connection have been made on Europeans of different food habits and of greater average weight than the inhabitants of this country and under different climatic conditions. The correction which should be made in adopting their figures is open to discussion.

The Committee having carefully studied the reports drawn up by Major McKay, of the Indian Medical Service, who was instructed to consider the possibility of introducing modifications into the existing Indian gaol dietaries, requested Dr. Wilson to draw up a note on the physiological value of the existing Egyptian diets.

The composition and physiological value of these is set out in Appendix IV, page 19, which shows that Diets Nos. II and III have a value of 2,846 calories and 2,911 calories respectively, with 82 grammes and 95·6 grammes of available protein, and contains suggestions for improving the diets while reducing their cost.

Attention is also invited to the tables in Appendix V, page 24, showing comparative prices and food values.

The question being a contentious one, further expert consideration was felt to be desirable.

A Sub-Committee consisting of Dr. Wilson, Dr. Kirton, and Mr. Lucas was therefore requested to report on the following points:—

(*a*) The sufficiency of the existing diets.

(*b*) Could any economy be made on any of them by the use of other food materials?

(*c*) Are the existing food materials suitable, and are they prepared in the most suitable manner?

(*d*) Should a determination of the nitrogen absorption under the existing diets be made?

The Sub-Committee was appointed on March 30, and on June 17 a memorandum drawn up by Dr. Wilson was presented to the Committee. This deals with the energy equivalent of different classes of prison labour, the energy value expressed in calories which should be contained in the diet, the minimum amount of available protein, and its sources, together with sundry observations on the preparation of the food, especially the bread, and a recommendation to employ the flour of the soya bean (Appendix VI, page 28).

Soya bean flour is not an article of food among the people, and although the suggestion may be considered with advantage at a later date, the Committee thought it desirable to confine its recommendations of a new dietary to ingredients already sanctioned by habit.

As a result of his investigations Dr. Wilson was prepared to recommend the adoption of modified diets without experiment. His memorandum (Appendix VI, page 28) did not, however, receive the full assent of the other members of the Sub-Committee, and it was decided in consequence that an experiment with modified diets should be carried out.

The Sub-Committee was agreed that the energy value of Diets Nos. II and III should be 2,750 and 3,200 calories respectively, with available protein of a biological value of not less than forty and forty-five grammes, on the basis of a labour output estimated at 60,000 kilogramme-metres for prisoners receiving Diet No. II, and 120,000 kilogramme-metres for those receiving Diet No. III.

The conditions of the experiment and the composition of the diets to be used were then decided upon. The experiment was to be carried out under strict medical supervision, for which Dr. Wilson was to be responsible.

7. Financial authority for the expenditure to be incurred was obtained.

8. The current season was deemed unsuitable for the experiment. Observations confined to the hot season would not be conclusive. The prison authorities were hard pressed by an outbreak of fever and by demands for assisting the military. It was therefore desired that the experiment might be postponed till September. The current contracts ran until March 31 following, but the experiment would be carried far enough to yield evidence in good time for the budget of 1916.

9. The data now collected appear to the Committee to be sufficiently valuable to be put on permanent record, and they recommend that they should be printed and distributed to Departments concerned.

10. Papers relating to the proposed experiment will be found in Appendix VII, page 58.

11. The Committee desires to express its sense of the deep obligation under which it lies to Dr. Wilson, whose work for the Committee has been of a particularly arduous nature. The special knowledge which he has put unstintedly at our disposal has been of the greatest value to us in our investigation.

Cairo, July 6, 1915.

Henry Higgs.
R. E. Monteith-Smith.
A. Lucas.
J. I. Craig.
W. H. Wilson.

E. Gascoigne Hogg,
Secretary.

NOTE BY DR. KIRTON.

I am not in full agreement with the Interim Report.

Paragraph 1 is misleading :—

(*a*) The comparative cost in Egypt and India of the various articles used in the diets, is not shown.

(*b*) One gets the idea that the bulk of the prison population receive seven ounces of meat, four times a week.

This it not so, only convict prisoners, doing the hardest labour, receive this at Tura and Abu Zaabal Prisons (Labour-Quarries).

Approximately this means about 2,000 prisoners (in 1914).

The rest of the prisoners (convicts and others) who are rationed receive No. 1 or No. 2 diet, or a bread ration (for amounts *see* page 2, Interim Report); of course this does not include those in Hospital.

(*c*) I do not consider meat a luxury.

In the years following the introduction of the present diets, the total number of admissions fell.

The attention of the Committee has been focussed on meat, but I consider that a mixed diet (*i.e.* derived from animal and vegetable sources) is desirable. I understand a considerable number of the poorer natives take meat once a week (on market day), not to mention such articles as milk, cheese, etc.

From administrative reasons it has been found difficult to give animal food of protein nature, other than in the form of meat.

In paragraph 4, I do not know what "different new and important hygienic factors came into play" about 1905. A number of factors came into play two or three years *earlier*, and it must be to these the Interim Report refers.

I do not agree with the first portion of paragraph 5, but my remarks above practically cover the part I am not in agreement with.

I am in substantial agreement with the rest of the Report and would especially emphasize my admiration for the vast amount of work Dr. Wilson has done.

(*Signed*) : R. G. Kirton.

Note.—Mohammed Bey Kotby agrees with this note.

APPENDICES.

APPENDIX I.

NOTE ON PRISON DIET.

The earliest report I have come across in connection with food of Egyptian prisoners is a memo of 1895 from Mr. Graham, now Director-General, Department of Public Health, but then S.M.O., Suakin. The object of this memo was to obtain a better diet for the civil convicts (*see* Table I) in order to improve their general health and their ability to work. He concluded that the ration then issued was not sufficient for the maintenance of good physical condition on any other than light labour. The diet suggested was practically the soldiers' ration with an addition of fifty dirhems of bread and twenty-seven dirhems of potatoes (ten dirhems roughly equals one ounce).

In the year 1898 there were notes from the Inspector-General of Prisons and Director-General, Sanitary Department, animadverting on the insufficiency of the dietary and of its total absence in many prisons.

About the same time Professor Wilson, of Qasr el 'Aini Medical School, sent in reports on relapsing fever, and proposals for diets (Table I). As far as I can gather there was no special report from the late P.M.O. Prisons on diets, although a new scale of diets was drafted and put in practice during his tenure of office.

In 1902 a Commission was again formed to consider prison diets. Owing, however, to the cholera epidemic, the Commission was dissolved. At the end of this year I reported on the diets and proposed improved scales of diets. Chiefly owing to financial reasons, these were not put in force until 1905. But after 1903, it was arranged that no prisoner should be kept on the "non-labour" diet for more than one month. With some alterations the dietary proposed in 1902 and put in force in 1905 is that of to-day. The chief alteration and one which reduced the cost (it was estimated at the time that there would be a saving of L.E. 878 on the year's outlay) was the substitution of fifty dirhems more bread in Diets Nos. I and II (originally bread 200 and 250 dirhems respectively) for four and eight dirhems of cheese. In Diet No. III the bread was not increased, but the rice was increased from four to twelve dirhems to replace the cheese.

In my opinion this change in the diets, although it to a certain extent increased their potential value and made them appear slightly more nutritious, lessened their value, especially in Diets Nos. I and II, and for this reason, Diet No. I has now no ingredients derived from animal sources, and the quantity in Diet No. II is considerably lessened.

Since 1909 millet bread (price at Tura seven and $7\frac{7}{10}$ milliemes per oke, wheat bread $10\frac{1}{4}$ milliemes) has been substituted for wheat bread at Beni Suef. Since 1911 millet bread has been substituted at Tura, Abu Zaabal, Delta, and Cairo prisons.

In the present year it will be supplied to Alexandria and Assiût prisons. So the price of bread has been and will be reduced (and also its proteid value slightly), but the price of millet is rising.

Prisoners now on Diet No. I remain on it, irrespective of the length of sentence.

There appears to have been a slightly different diet supplied to Tura, Gîza (and women's) prisons about 1899 and also another dietary scale suggested. I have not, however, included these, as there was very little information to be had.

Table I therefore shows the following dietaries :—

(1) Civil convicts, Suakin 1895, and Graham's proposed diet.

(2) Egyptian prison diets shown in Prison Regulations of 1899 with Wilson's proposed diets. It will be seen that the actual prison dietaries were based on Wilson's on a considerably reduced scale.

(3) Diets found in Prison Regulations of 1902, "Parker's Diets."

(4) Present diets.

(5) Diet of Army in peace.

It will be seen that practically we have four diets:—

(*a*) The bread diet given to indigent prisoners in Markaz prisons, and also for a week to contravention prisoners in Cairo. As prisoners are now confined in Markaz prisons for a period up to three months, I have already called attention to the necessity of giving them a more liberal diet.

(*b*) Non-labour diet given to unemployed prisoners; but these prisoners really do a certain amount of work (cleaning cells, wool spinning, etc.).

(*c*) Industrial diet for less active work than (*d*); but in a number of the trades, *e.g.* blacksmith's, bread making (mixing), the work is certainly severe.

(*d*) Hard labour diet given only to convicts employed on third class labour and prisoners in central prisons employed on earth work—if sanctioned by the Inspector-General.

There is a considerable resemblance between the three "hard labour" diets, *viz.* Graham's, Wilson's and the existing one.

All these dietary scales have been made out quite independently. Wilson's industrial and his other diet for prisoners "up to a month" are more generous than our present diets in the supply of animal food. So also is Graham's "hard labour" in this particular, as the large proportion of fat is obtained from butter, *i.e.* from an animal source.

It will be seen that our "hard labour" diet is more generous than that of the Army in peace time (theoretically only, as our bread is millet, and there is considerably less absorption than from wheat bread; *see* "Scientific Memoirs," No. 8, of the Government of India). This is the case in practically all prison dietaries, and is so in order to provide the fuel necessary for labour. The peace diet of armies is calculated on the basis of a man with light or moderate labour; even in peace time I understand that Egyptian soldiers on special work get an extra fifty dirhems of bread. On active service and in war time special dietaries are given, subject of course to the exigencies of war.

The soldier can purchase extra food—the prisoners cannot (*i.e.* the Egyptian prisoners).

In the Egyptian soldier's diet, he gets butter (with a little palm oil); the convict and other prisoners get a vegetable oil which is by no means appreciated. In fact, the amount had to be decreased owing to complaints. In 1910 the oil cost thirty-nine milliemes per oke, whilst the soldier's butter cost eighty-eight milliemes the oke.

Practically all prisoners taking the hard labour diet now have millet bread, and this so reduces the price that the cost of this ration works out at a fraction of a millieme less than the soldier's ration (*see* Table III).

Table II shows approximately the theoretical values of the various diets in force. Values are also shown of English, Scotch, French, and Indian prison dietaries, with some examples of English Army diets in peace. It will be seen: (1) that the English and Scotch dietaries compare a good deal more favourably with the English Army ration than ours do with the Egyptian Army ration, and this table does not show the far larger proportion there is of animal food in these diets compared with Egyptian prison diets; (2) that the prison dietaries of other nations are superior to those of Egyptian prisons.

In considering Egyptian prison diets, it must be remembered that they consist wholly or very largely of food derived from vegetable sources, *viz.*:—

Diet No. I, animal food: nil.

Diet No. II, animal food: six per cent proteids, three per cent fats, nil starches.

Diet No. III, animal food: eighteen per cent proteids, ten per cent fats, nil starches.

That is to say the amount lost by non-absorption is greater in the case of our Egyptian prison dietaries than is that of other nations.

Table III, to which reference has already been made, shows the daily cost of the various diets; the cost of fuel, etc., is not included.

In 1902 (*see* Prisons Report) I gave a *résumé* of the reasons why food and the various kinds of food were necessary. Food is necessary to repair wear and tear, to supply energy for the work, and to furnish heat for the body: "internal work"; to furnish energy for performance of labour: "external work." Food consists of: (1) water; (2) salts; (3) proteids or nitrogen containing foods; (4) fats; (5) starches.

It is not necessary to discuss water and salts, which are indispensable. Proteids are indispensable as they are the only foods containing nitrogen (needed to build up the tissues of the body).

It would, however, be a very expensive and wasteful diet which only contained proteids, as not only would there be too much nitrogen, but the work entailed on the body in getting rid of the excess would be considerable and lead to exhaustion and disease of the special organs concerned.

Fats and starches are to a certain extent interchangeable; owing to their bulk, however, more than a certain amount of starchy foods cannot be taken (550 to 650 grammes about); starches are more digestible, bulkier, and of less energy value than fats (*see* Table II). Fats are dearer than starches. They (fats and starches) are used to save the proteids from being used for other than their special functions, and to supply what energy is required besides that supplied by the consumption of the proteids.

As regards work, it is a well known fact that, however perfect the machine, for the work done, a considerable amount of energy of the fuel (food) is lost in the form of heat. The work done by a steam engine *at most represents only one-eighth of the potential energy* of its fuel.

In the case of the human body it represents about one-sixth. Certain standards have been laid down showing what amount of potential energy is necessary in the food, *e.g.* for man without muscular work; with light work, and so on, the amount of potential energy (generally expressed in calories) increasing with the amount of work and allowing for the inevitable loss of five-sixths of its potential value.

Why is it there have been so many memos and reports on the prison dietaries? The answer is not far to seek. Formerly the prisoners were decimated by disease, and ill-health was prevalent amongst them.

At Tura Convicts Prison the average mortality per thousand for the ten years ending 1900 was eighty-two. In some years this rate had been considerably exceeded.

The general prison death-rate was high, and if one compared it with the outside mortality at the same ages as the prison population, it proved to be still higher (corrected mortality).

Infectious diseases were almost endemic, and although due allowance must be given to other causes, overcrowding insanitary dwellings, etc., still insufficient food and consequent weakening of the body prepares a very suitable soil for entrance of disease.

General debility, tuberculosis, scurvy, etc., were all writing their warning on the wall. Moreover, as many prisoners stayed but a comparatively short time, any results of underfeeding did not necessarily show in prison.

It was in order to maintain the prisoners in good health that the present diets were introduced. Care was taken to prevent them being too liberal and also as far as possible to give only cheap foods.

The following mortality figures should be studied :—

	Total Mortality per Thousand on Average Population.		Mortality per Thousand on Average Population excluding that from Infectious Diseases.	
	All Prisons.	Tûra.	All Prisons.	Tûra.
1900	23·0	22·0	21·0	22·0
1901*	17·4	19·0	16·3	19·0
1902	30·65	20·0	22·0	16·0
1903	25·7	14·9	20·4	14·9
1904	19·8	18·46	18·0	18·46
1905†	19·3	17·98	16·3	15·48
1906	11·9	9·5	11·3	9·5
1907	12·3	8·5	11·1	8·0
1908	13·6	7·5	11·1	7·0
1909‡	12·4	6·1	11·3	5·1
1910	14·4	9·7	13·2	8·4

That is to say that since the introduction of the new diets, the total death-rate, and the death-rate excluding infectious diseases, has been considerably lower than it was before.

* Parker's diets introduced to Central Prisons. First year in which attempt made to feed all prisoners in Convict Central Prisons.

† Existing diets introduced.

‡ Millet bread introduced at Beni Suef.

And this cannot all be laid down to other improved sanitary conditions, for, although all new central prisons were only completed in 1905, seven of them were practically completed in 1903, and Tura prison, as regards the prisoner's blocks, had been completed some years. Nor was overcrowding diminished. In fact, the average population of the last period was considerably greater than that of the earlier period.

It must be clearly understood that diet alone will not stop the spread of infectious diseases nor obviate the evils of overcrowding. In 1909 and 1910 I called attention to the fact that the death-rate from pulmunary tuberculosis, "consumption," which had fallen considerably after the introduction of the existing dietary, was again on the rise. I pointed out that the overcrowded state of the prison must be reckoned as a factor in this. Here are the figures which I can reasonably give as showing the favourable effect of the existing dietary as well as a warning against overcrowding :—

	Average Prison Population.	Mortality per Thousand on Average Population from Pulmonary Tuberculosis.	Number of released on Medical Grounds suffering from Pulmonary Tuberculosis.
1905*	12,118	4·12	15
1906†	11,730	2·2	10
1907†	11,421	0·7 to 0·8	8
1908	12,226	1·6	5
1909‡	13,420	1·7	10
1910	12,843	2·1	12

Total admissions yearly :—

1904	148,939
1905	140,364
1906	131,729
1907	110,822
1908	128,670
1909	128,280
1910	117,892
1911	116,453

In conclusion, it is now agreed that prisoners should be sufficiently fed, and that the diet (except in cases of very short sentences and as a severe and temporary disciplinary measure) should form no part of the penal system.

From an economical point of view, if you want to get work out of a prisoner, you must give him a sufficient supply of food.

No one knowing the amount of fuel (food) required for an engine to do a certain task, would suggest that the engine must do the work on half the amount. With underfeeding there is increased susceptibility to disease and also actual disease.

If there is excessive illness in a prison, not only is there the loss entailed by lessened output of work, but there is the disarrangement of the prison routine and discipline, the extra cost of the treatment, etc., difficulties scarcely realized by those not familiar with the administration of large institutions.

Finally ill-health to any extent amongst the prison population is always a menace to the public health outside.

(*Signed*): R. G. Kirton,
P.M.O.

January 16, 1912.

* Introduction of dietary.

† Note that for two years following introduction of improved dietary the average prison population dropped (*see* also yearly total admissions).

‡ Millet bread introduced.

Table I.

Daily Ration, Egyptian Diets, Prison. Army (peace time). Weights in dirhems (1 dirhem = 3·12 grammes or 48·15 grains; 10 dirhems roughly = 1 oz.).	Convicts at Suakin, 1895.	Proposed by Graham.	Wilson's proposed Diets, 1898. A, B, November 1 to April 1 on alternate days. C, D, April 1 to November 1 on alternate days. The figures above in black type show actual prison diets in 1898 or 1899, probably based on Wilson's but considerably reduced, except in case of bread diet. A, B, C diet given on first, second, and third days, and so on, i.e. the same diet given every third day. Hard Labour.				Industrial.				5 days to a month.	**8 days to a month.**	4 days or less / **7 days or less**	1901 (?) to 1905. In 1903, 24 extra dirhems fresh vegetable given once a week. Bread Diet.	No Labour.	Industrial.	Hand Labour.	Present scale proposed in 1902, put in force in 1905. At first cheese was given in lieu of 50 dirhems bread, Diets Nos. I and II, and 8 dirhems rice, Diet No. III. Owing to administrative difficulty this was given up in a short time. The vegetables have been increased as that prisoner gets fresh vegetables twice a week. 1 dirhem *dugga* is given daily in Diets **Nos.** I, II, III. Bread Diet.	Industrial.			Army in time of peace and Guard Company Police.
			A A	**B** B	**C** C	— D	**A** A	**B** B	**C** C	— D	— A	**Alternate days.** B	B		I	II	III		I	II	III	
Bread	300	300	**300** 300	**250** 250	**250** 300	— 250	**300** 300	**225** 225	**225** 300	— 225	**250** 250	**175** 175	**250** 25	250	200	250	300	250	250	300	300	250
Meat	15	35	**35** 35	— 25	— 35	— 25	**30** 30	— 15	— 30	— 15	— 10	— 10	—	—	—	4	10	—	0	38	38	35
Fat as butter (*musly*) in army diet and old prison diets; *as* oil in existing or previous prison diets since 1901.	4	6	**20** 23	**10** 10	**16** 18	— 8	**14** 16	**8** 12	**8** 16	— 10	**6** 6	**6** 6	—	—	5	10	12	—	6	8	8	6
Rice...	5	20	**25** 20	**20** 20	**20** 25	— 20	**20** 20	**20** 10	**20** 10	— 10	— —	**15** 15	—	—	15	20	20	—	15	12	12	20
Lentils	20	20	— —	**40** 15 or beans	— —	— 15 or beans	— —	**30** 15 or beans	— —	— 15 or beans	**30** 20 or beans	—	—	—	12	12	18	—	24	18	18	20
Beans	20	20	— —	— —	**40** —	— —	— —	— —	**30** —	— —	—	—	—	—	—	12	12	—	24	24	24	20
Onions	10	10	**5** 5	**5** 5	**5** 5	— 5	**5** 5	**5** 5	**5** 5	— 5	**5** 5	**5** 5	—	—	4	6	6	—	4	4	4	5
Salt...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fresh vegetables	0	Amount not stated.	**25** 25	**25** 25	**25** 25	— 25	**25** 25	**25** 25	**25** 25	— 25	**25** 25	**25** 25	**25** 25	25	24	24	24	25	32	32	32	45
Lime juice	—	In summer.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Potatoes	0	27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cooked together to make a cake. Flour	—	—	— —	**50** 50	**50** —	— 50	— —	**50** 50	**50** —	— 40	— —	**40** 40	—	—	—	—	—	—	—	—	—	—
Cooked together to make a cake. Suet or oil	—	—	— —	**5** 10	**5** —	— 10	— —	**5** 10	**5** —	— 8	— —	**8** 8	—	—	—	—	—	—	—	—	—	—

Prices in 1910.—*Kortom* oil supplied to Prisons, 39 milliemes per oke; *musly* supplied to Army, 88 milliemes per oke.

TABLE II.—Table showing approximately Constituents and Energy Value expressed in Calories of certain Diets.

The calories = amount of heat necessary to raise one litre of water 1° centigrade :—

1 gramme of Proteid on burning produces 4·1 calories.
1 „ of Fat „ „ 9·3 „
1 „ of Starch „ „ 4·1 „
Weights stated in grammes.

No allowance made for non absorption of food which is greater in vegetable than mixed diet, consequently Egyptian diets appear better than they should, compared with Egyptian Army diets, *e.g.* butter from animal source (except in case of hard labour diet), meat. So also in European prison diets, but not so much as in case of Egyptian prison diets.

		Proteid.	Fats.	Starches.	Value in Calories.
Egypt	Prisoners. Bread diet...	39	11·7	390	1,861
	Non labour I	79	33	506	2,702
	Labour II	92	43	572	3,122
	Hard labour	102	48	572	3,230
	Army in peace time	116·6*	39·5	512·05	2,491
Standard extracted from Dunlop report on prison dietaries, Scotch.	Male prisoners unemployed ...	90	30	440	2,400
	Convicts less active labour... ...	120	50	550	3,200
	Convicts more active labour ...	150	65	550	3,500
Actual diets ...	Male light labour, Scotch	153·98	50·62	536·08	3,300
	Male light labour, English	141·47	59·25	546·68	3,373
	Male hard labour ... Scotch ...	165·44	56·54	566	3,525
	Male hard labour ... English...	177·46	86·08	641·56	4,159
English soldier in peace time receives (1) free issue of 12 oz. meat and 1 lb. bread, calori value 1515. (2) In addition 3*d*. a day which is posted. (3) What he likes to spend from his pocket in food. But at cot eign price on for service and in India (1) the meat is increased to 1 lb., making the value of (1) up to 1636 calories.	† **A.** Typical diets supplied for (1) and (2) at Aldershot.				2,909
	‡ **B, C.**—In India...				3,116
	§ **C.**				3,090
Values of other prison dietaries		—	—	—	—
French		104 * ‖	—	—	2,700*
Bengal *Jails* ...	Bengal ordinary, Scale I	100 ¶	24	651	3,302
	Bengal ordinary, Scale II	113 **	25	695	3,544
Behor ordinary, Scale 1-6		From 115 to 128	From 27 to 46	From 666 to 739	From 3,452 to 3,970

* Qasr el 'Aini, "Report on Diets," 1902.

† **A.**—Breakfast : fried liver 6 oz., bread 6 oz., tea and sugar.
Dinner : beef 5½ oz., pease soup 7½ oz., potatoes 16 oz., bread 5 oz.
Tea : bread 4 oz., dripping 1 oz.
Supper : porridge 2 oz., sugar.

‡ **B.**—Breakfast : fried bacon 3 oz., bread 7 oz., tea and sugar.
Dinner : meat 5 oz., or Irish stew, including haricot beans and lentils 1½ oz., potatoes 10 oz., bread 5 oz.
Tea : bread 4 oz., jam, tea, sugar.
Supper : fish and potato pie, 8 oz.

§ **C.**—Breakfast : bacon 3 oz., eggs 2, bread 4 oz., tea and sugar.
Dinner : beef 5½ oz., Yorkshire pudding 4 oz., potatoes 8 oz., bread 4 oz.
Tea : currant cake 5 oz., tea and sugar.
Supper : curried fish 4 oz., bread 3 oz.

Note that all these diets contain a considerable quantity of food delivered from animal sources.

‖ This is the value of the diet without canteen allowance, *viz.* 1½ lbs. of bread to two meals a day ; morning meal, vegetable soup ; evening meal, plate of vegetables. Meat given on Sundays and fête days, and on Thursdays in case of long sentence prisoners. A supplement of bread of special quality is served with the soup. From the canteen he can purchase 1½ lbs. of bread daily, and a portion of potatoes, cheese, butter, milk, salad, fruits, beef. He must not buy more than 20 centimes' worth of bread nor 15 centimes' worth of the other articles, and by these allowances the diet is made ample. By the extra alone the proteids can be brought up to 170 grammes and the energy value in calories to 4000. The French prisoner is paid for his work.

¶ The average weight of the Bengal and Behor prisoners in about 50 kilos., that of the Egyptian prisoner a little over 60 kilos. Besides these diets, there are also a number of permission diets.

** Apart from these energy values, etc., these and the other prison diets are much more varied than are the Egyptian prison diets, a matter of importance in the case of long term prisoners.

N.B.—These are the theoretical values ; the actual values can only be obtained by finding out and substracting the loss from non-absorption. Hence a diet with a higher theoretical value may actually, owing to loss by non-absorption, be of much less value than one which is of lower (theoretical) caloric value.

Table III.—Showing Ingredients (Weight in Dirhems) and Cost in Milliemes of Army Peace Diet and the Various Prison Diets.

	Army Peace Diet.		Bread Diet.			PRISON DIETS. No. I Non Labour.			No. II Labour.			No. III Hard Labour.		
	Quantity in Dirhems.	Price in Milliemes.	Quantity in Dirhems.	Cost Wheat Bread.	Cost Millet Bread.	Quantity.	Cost Wheat Bread.	Cost Millet Bread.	Quantity.	Cost Wheat Bread.	Cost Millet Bread.	Quantity.	Cost Wheat Bread.	Cost Millet Bread.
Bread	250	6·830	250	6·400	4·600	250	6·400	4·600	300	7·680	5·520	300	7·680	5·520
Musly (butter), Army. Fat as vegetable oil, prisoners	6	1·175	—	—	—	6	0·636	0·636	8	0·848	0·848	8	0·848	0·848
Meat	35	4·375	—	—	—	0	0	0	10	1·600	1·600	38	6·080	6·080
Lentils	20	0·510	—	—	—	24	0·672	0·672	24	0·672	0·672	18	0·504	0·504
Beans	20	0.447	—	—	—	24	0·552	0·552	24	0·552	0·552	24	0·552	0·552
Rice	20	0·627	—	—	—	15	0·465	0·465	10	0·310	0·310	12	0·372	0·372
Onions	5	0·067	—	—	—	4	0·044	0·044	—	0·044	0·044	4	0·044	0·044
Vegetables	45	0·422	25	0·250	0·250	32	0·320	0·320	—	0·320	0·320	32	0·320	0·320
Salt...	5	0·030	—	—	—	4	0·020	0·020	4	0·020	0·020	4	0·020	0·020
Duqqa	—	—	—	—	—	1	0·077	0·077	1	0·077	0·077	1	0·077	0·077
Total	—	14·483	—	4·850	6·650	—	9·186	7·386	—	12·123	9·963	—	16·497	14·337

N.B.—Bread and Meat. Army diet, if calculated on prison prices, would be :—

Bread, 6·400 milliemes; meat, 5·606 milliemes, *i.e.* a net increase of 0·861 milliemes on the daily ration.

APPENDIX II.

THE FOOD OF BEDOUIN.

Two varieties of bread are eaten, one known as *khobs* or *himsh*, the other as *goorse*. The former a thin flat cake roughly a foot in length and nine inches across and about half a centimetre thick. The sample I obtained weighed when dried 175 grammes, when fresh probably 250 (*i.e.* supposing it contained thirty-five per cent water).

This bread is made of a mixture of *dura* and wheat flour, two of former to one of latter. It is apparently very slightly leavened. The bread is baked on an iron plate over the fire.

Three loaves are eaten daily.

The other variety of bread is used on desert journeys. It is a flat cake very slightly leavened, made usually from wheaten meal. Its size is about seven inches in diametre, thickness about two centimetres. The weight of a sample (dried) was 298 grammes. Weight when fresh probably 400 grammes.

Three loaves are eaten.

This bread is cooked by burying in the sand underneath the fire used for preparing other food.

The *Bedouin*, to whom the note refers, own goats and camels, and live on the borders of the desert near the cultivated land. They cultivate a certain amount of *dura* from which the meal is obtained by grinding in one of the small stone hand-mills common in Egypt. The wheat is purchased.

The flour contains the greater part of the grain, but not all; after grinding it is sifted, and no doubt the coarse bran removed, the siftings not being used in making the bread, except a little which is used for powdering the surface of the uncooked loaves. The bread has a brownish grey colour.

On desert marches the flour is carried in a bag; about a kêla* sufficing for three men for four days. (Detail not certain).

My informant tells me that he and many of his friends often drink as much as four and a half rotls of milk daily, in three parts, at the morning, mid-day, and evening meals; but that he is personally fond of milk and perhaps drinks more than other people. There is no doubt, however, that the *Bedouin* use a considerable amount of milk.

Meat is eaten about once a week. Amount vague. A mixture of lentils, onions, and some butter is eaten twice or three times a week. The lentils being first boiled, the onion cooked with the butter, the whole being mixed when the lentils are soft.

Rice is eaten in considerable quantity, boiled with milk or milk and water, salt being added and sometimes butter—no sugar. Cheese appears to be eaten occasionally.

Butter, or *semna*, is eaten in considerable quantity. My informant, who confessed to liking butter, states that he eats half a rotl† of butter or a quarter of a rotl of *semna* daily. Oil is not used.

He thinks most people eat less butter than he does. Beans are seldom eaten.

The diet seems to be a rich one, but it is difficult to say definitely as the quantities are of course unreliable and rather vague.

The most interesting points are :—

(1) The large use of rice.

(2) The meat is eaten only once a fortnight in summer, and lentils are very seldom eaten in hot weather, being replaced by rice. Butter and *semna* are eaten to a less extent in hot weather than in cold.

The cutting out of lentils and diminution in the meat accords with statements I have received regarding the smaller use of beans in the hot weather in Egypt. This is of considerable interest in view of the known increase in the heat production induced by proteins.

My *Bedouin* informant tells me that lentils and meat cause sweating and thirst if eaten in hot weather. This is quite in agreement with what might be expected theoretically. It suggests what I should be inclined to propose, if found feasible, that a definite hot and cold weather dietary should be introduced.

I have to thank Miss N. Baird for her help in obtaining the information detailed above.

(*Signed*): W. H. Wilson.

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* Kêla = about 18 lbs.
† Rotl = „ 1 lb.

APPENDIX III.

NOTE ON TWO FAMILY BUDGETS.

A	B
Strong healthy man. Weight 168 lbs.	Not very robust man. Weight 128 lbs.
A carter.	A carter.
Family: wife, children, six years and two years. Counted as three adults (includes the man).	Family: wife, children, five years, three years and five months. Counted as three adults (includes the man).
Wages: 240 P.T. a month, 30 P.T. *bakshish.*	Wages: 200 P.T. a month, 60 P.T. *bakshish.*
Saves some money and sends money to his father.	Does not save. Occasionally assisted by his father.

The men purchase their breakfast and midday meal outside after going to work. Supper at home. Man assumed to use about one-fifth of cereales, one third other articles.

COMPONENT.	A				B			
	Monthly Amount.	Expenditure.	Daily Amount in Grammes.	Daily Amount Man only.	Monthly Amount.	Expenditure.	Daily Amount in Grammes.	Daily Amount Man alone.
		P.T.				P.T.		
Wheat	2 kêlas.	24	1,043	210	4 kêlas.	48	2,086	417
Dura	2 "	20	833	167	—	—	—	—
Meat	8 rotls (mutton).	32	120	40	8 rotls (beef).	24	120	40
Semna	2 rotls.	14	30	10	2 rotls.	14	30	10
Suet	2 "	7	30	10	4 "	14	60	20
Eggs	50	10	61·6	20	—	—	—	—
Vegetables	11 rotls.	10	165	55	22 rotls.	20	330	110
Petty expenditure mainly on food *	—	60	—	—	—	30	—	—
Ta'mia (5), 2½ milliemes † ...	—	—	—	61	—	—	—	Breakfast and Lunch. 61
Fûl medammis, 2½ milliemes ‡	—	—	—	200	—	—	—	200
Bread, 7½ milliemes §	—	—	—	750	—	—	—	500
Halâwa	—	—	36	12	—	—	36	12
Soap	4 rotls.	10	—	—	—	10	—	—
Petroleum	—	3	—	—	—	5	—	—
House rent	—	20	—	—	—	15	—	—
Tobacco	—	—	—	—	—	30	—	—
Clothes for one year	—	300	—	—	—	400	—	—

* Petty expenditure includes the man's expenditure on breakfast and lunch. The woman's expenditure on the household food, *e.g. halâwa*, beans occasionally.

† *Ta'mia* 5 (sample), weight 61 grammes and weighed dry 41 grammes (approximately).

‡ *Fûl medammis* (sample), weight 200 grammes, contained 158 beans, 158 similar beans weigh 65 grammes (dry uncooked). *Fûl medammis* contained approximately 10 grammes oil.

§ The sample loaf weighed 237 grammes and contained approximately 34 per cent water.

Food Value of Diets (the two Cases).

		A				B			
		Daily Amount.	Protein.	Fat.	Carbo-hydrate.	Daily Amount.	Protein.	Fat.	Carbo-hydrate.
Wheat		210	25	3·6	149	417	45·8	7	286
Dura		167	16·2	8·3	115	—	—	—	—
Meat		40	7·2	1·5	—	40	8	1·5	—
Semna		10	—	10	—	10	—	10	—
Suet		10	—	8	—	20	—	16	—
Eggs		20	2·6	1·8	—	—	—	—	—
Vegetables		55	0·5	—	1·5	110	1	—	3
Bread		750	48·7	7·5	375	500	32·5	5	250
Taʿmia 61 gram.	Beans	38	9·5	—	21·6	38	9·5	—	21·6
	Oil	3	—	3	—	3	—	3	—
Fûl 200 gram.	Beans	65	16	1	36·8	65	16	1	36·8
	Oil	10	—	10	—	10	—	10	—
Halâwa		12	—	—	12	12	—	—	12
Total			123·7	52·7	710·9		112·8	53·5	609·4
Available Protein Carbohydrate and Fat.			97·8	50	675·5		90	51·5	579
Heat value			410*	465	2,702		378	478	2,316
Total				3,567				3,172	

If the man is assumed to consume one-sixth of the total cereals as bread at his evening meal and to eat *taʿmia* every other day instead of each day (salad being often eaten instead), the figures are :—

A. Protein 89·1. Fat 47·5. Carbohydrate 628.
B. „ 82 „ 49 „ 520.

Total heat value: A. 3,328; B. 2,870.

The latter estimates appear to me to be the more probable. It has to be remembered that of the family of three, two consume only the cereals purchased monthly and live more largely on bread than the men who eat only one meal (supper) at home.

In another case of a man of fifty-five doing the work of a *farrash* in my laboratory, seven kêlas of wheat are purchased monthly. This is divided among the man who takes all his bread from the home supply, and five other persons who may be regarded as adults, besides two small children.

This allows 610 grammes of wheat to be made into bread for each adult. The available nutrient contents of which will be: protein 57·1; fat 9·2; carbohydrate 514.

The meat purchased is five rotls monthly for the family of five. I was unable to obtain the other details with sufficient accuracy to make out a diet sheet, and I am inclined to think that the estimated amount of wheat is perhaps in excess of the truth.

It may be noted in the Diet A that bread supplied 71 % of the protein; 36 % of the fat; 89 % of the carbohydrate.

If the diet in the last case contained other substances in the same proportion, its composition would be: protein 80; carbohydrate 566; with approximately 40 of fat.

W. H. Wilson.

* A: Biological value of protein 48·4, of which animal protein 9·8.
B „ „ „ 47 „ „ „ 8.

APPENDIX IV.

PHYSIOLOGICAL VALUE OF THE EXISTING DIETS.

To the President of the Committee on Prison Diets,

Sir,

In accordance with the request of the Committee, I beg to submit the following figures :—

On examining the details available it appeared necessary to determine as far as possible the actual food value of the existing diets; this I have done.

I have in this connection to thank Dr. Kirton for information he has been good enough to give me.

I have also taken the liberty of making some general remarks which have occurred to me, and of introducing a few details as to the food habits of the people.

The tables supplied are as follows :—

Table A. Composition of present Diet, No. III.
,, B. ,, ,, ,, No. II.
,, C. ,, food materials employed.
,, D. Comparison of Diets Nos. II and III.
,, E. Composition of revised Diet, No. I.
,, F. ,, ,, ,, No. II.
,, G. Comparison of Diets Nos. II and III with suggested alternative diets.

Table A.—Diet No. III.

The amounts are in grammes. 1 dirhem=3·12 grammes.

	Amount in Grammes.	Total Protein.	Available Protein.	Fat.	Total Carbo-hydrate.	Available Carbo-hydrate.
Millet bread	936	59	47·8	14	440	—
Meat	118·5*	23·7	22·5	4·7	—	—
Lentils	56·2	12·9	9	1·1	32	—
Beans	75	18·7	13·1	1·5	42·7	—
Rice	37·4	2·5	2·1	—	30	—
Onions	12·5	0·2	0·2	—	0·7	—
Vegetables	100	1	1	—	3	—
Oil	25	—	—	25	—	—
Total components	—	118	95·6	46·3	548·4	521
Heat value in kilogramme-calories	—	—	401·5	426	—	2,084
Total	2,911					

* Exclusive of bone.

Table B.—Diet No. II.

	Amount in Grammes.	Total Protein.	Available Protein.	Fat.	Total Carbo-hydrate.	Available Carbo-hydrate.
Millet bread	936	59	47·8	14	440	—
Meat	31·2*	6·3	6	1·2	—	—
Lentils	75	17·3	12·1	1·5	42·7	—
Beans	75	18·7	13·1	1·5	42·7	—
Rice	31·2	2·2	1·8	—	25	—
Onions	12·5	0·2	0·2	—	0·7	—
Vegetables	100	1	1	—	3	—
Oil	25	—	—	25	—	—
Total components	—	104·7	82	43·2	554·1	526·3
Heat value in kilogramme-calories	—	—	344·5	396·5	—	2,105
Total	2,846					

* Exclusive of bone.

The factors for the reduction of actual protein to available protein are : for meat, 95 per cent ; millet bread, *81 per cent (this figure is adopted as being the *minimum* for wheat flour bread); lentils, 70 per cent ; beans, 70 per cent; rice, 82 per cent (these may be regarded as the *maximum* values for unground materials)

The avai able value for carbohydrate is 95 per cent.

TABLE C.—**Basis of Calculation adopted.**

	Per Cent Protein.	Per Cent Fat.	Per Cent Carbo-hydrate.
Millet bread	6·3	1·5	47
Meat (without bone) ...	20	4	—
Lentils	23	2	57
Beans	25	2	57
Rice (polished)	6·8	0·4	79·4

The details are taken from Hutchison's "Food and the Principles of Dietetics."

In regard to millet bread, the analysis made by M. Pappel, of the Department of Public Health, has been adopted.

The amount of protein in beans of the same variety is very variable in different samples. It is therefore possible that the estimate of 25 per cent of protein may be in excess of the actual content of the beans supplied to the prisons. The 20 per cent of protein in meat includes gelatine.

TABLE D.—**Comparison of Diets Nos. II and III.**

	Diet No. III.	Diet No. II.	Difference.
Protein (available)	95·6	82	+ 13·6
Fat "	46·3	43·2	+ 3·1
Carbohydrate...	521	526·3	− 5·3
Heat value in kilogram. calories	2,911	2,846	+ 65

It may be noted in regard to the figures in Table D that a difference of 65 calories in energy value is so small that the two diets may be looked upon as of equal value from this standpoint.

The chief difference is in the amount of protein, the excess in Diet No. III coming entirely from animal sources. If, as appears to be the case, both classes of prisoners have been maintained in a state of good health on the diets given, the fact suggests either that the amount of labour actually performed (*i.e.* the expended energy) is not very different in the two cases, or that the capacity for extra work without any indications of ill-health is connected with the larger amount of protein in Diet No. III, or lastly, that Diet No. III is sufficient for that class of work, Diet No. II being in excess of the minimum requirements of the class of prisoners to which it is supplied.

It is also clear that prisoners doing a fair amount of work can be maintained in a condition of good health on a diet containing no more than 82 grammes of protein (= 12·7 grammes of nitrogen) daily.

My aim in making these remarks is to suggest that, provided a fair increase in the energy value of the hard-labour diet were made, a slight diminution in the amount of protein would be permissible.

Adopting Diet No. II as the basis of a revised hard-labour diet, it is clearly impossible to raise the protein content by 13·6 grammes (the difference between Nos. II and III) without, at the same time, largely increasing the total heat value, because to obtain this quantity of protein from vegetable sources a disproportionate amount of starch must be added.

This amount of protein (13·6 grammes) can be obtained by adding to Diet No. II 156 grammes (50 dirhems) of bread and 31·2 grammes (10 dirhems) of lentils.

* This was written before McKay's experimental results were available to me. He finds that no more than 55 per cent of millet protein is normally absorbed. *See* Appendix VI, p. 45, in the diets finally recomended the figure 55 per cent has been taken as the basis of calculation.

The diet table would be as follows :—

TABLE E.

	Amount in Grammes.	Protein Available.	Fat.	Carbo-hydrate.	Available Carbo-hydrate.
Millet bread	1,092	55·8	16·3	513	—
Meat	31·2	6	1·2	—	—
Lentils	106·2	17·1	2·1	60·4	—
Beans	75	13·1	1·5	42·7	—
Rice	31·2	1·8	—	25	—
Onions	12·5	0·2	—	0·7	—
Vegetables...	100	1	—	3	—
Oil	25	—	25	—	—
TOTAL components	—	95	46·1	644·8	611·8
HEAT value	—	399	424	—	2,447
TOTAL heat value			3,270		

An alternative diet might be constructed in which an addition of 50 dirhems bread and 8 dirhems cheese would be added, the diet table being as follows :—

TABLE F.

	Amount in Grammes.	Available Protein.	Fat.	Carbo-hydrate.	Carbo-hydrate Available.
Millet bread	1,092	55·8	16·3	513	—
Meat	31·2	8	1·2	—	—
Lentils	75	12·1	1·5	42·7	—
Beans	75	13·1	1·5	42·7	—
Rice	31·2	1·8	—	25	—
Cheese	25	5	4	—	—
Onions	12·5	0·2	—	0·7	—
Vegetables...	100	1	—	3	—
Oil	25	—	25	—	—
TOTAL components	—	95	49·5	627·1	595·6
HEAT value	—	399	455	—	2,381
TOTAL heat value			3,235		

NOTE.—The figures given for the components of cheese cannot be taken as more than a rough approximation. Should the suggestion be adopted an analysis of the type of cheese to be employed would be necessary.

I have constructed the above two diet tables in conformity with the request of the Committee.

It was assumed that a conversion of Diet No. II was required, which, while adding no extra meat, should have a nitrogen value equal to No. III.

It is obvious, however, that the energy value of the two alternative diets suggested is approximately ten per cent higher than the existing hard-labour diet.

I will add the following figures :—

The addition to Diet No. II of 50 dirhems of bread with no other change would give a content in available food materials of : protein 90, fat 45·5, carbohydrate 595·6, with a total energy value of 3,178 kilogramme-calories. Compared with Diet No. III this supplies 5 grammes less protein, 0·8 gramme less fat, 74·6 grammes more starch, and 267 calories more in heat value.

The question as to whether 90 grammes is a sufficient supply of protein is to a certain extent a matter of opinion.

I may, however, point out the protein content represents 13·9 grammes of nitrogen available for metabolism, which is actually 0·7 gramme more than is contained in the most liberal of the purely vegetarian diets suggested by Major McKay for the gaols of the United Provinces, the heat value being also greater.

I should like also to draw attention to the fact that by the use of ground lentils and beans in the place of the crude article an additional 7·4 grammes of protein would be made available for nutrition without any alteration in the quantities given.

It may be convenient if I bring together the above alternative suggestions to a tabular form for purposes of comparison.

Comparative Table of Food Values.

Diet No. 1 = Diet No. II + 50 dirhems bread + 10 dirhems lentils.
„ No. 2 = „ No. II + 50 „ „ + 8 „ cheese.
„ No. 3 = „ No. II + 50 „ „
„ No. 4 = „ No. II + 50 „ „ with lentils and beans ground but unaltered in quantity.

Table G.

	Protein.	Fat.	Carbo-hydrate.	Heat Value.
Diet No. II	82	43·2	526·3	2,846
„ No. III	95·6	46·3	521	2,911
„ No. 1	95	46·1	611·8	3,270
„ No. 2	95	49·5	595·6	3,235
„ No. 3	90	45·5	595·6	3,178
„ No. 4	97·4	45·5	595·6	3,209

It appears to me that the question which, if any one, of these alternative diets, should be adopted, or whether it might not be advantageous to replace part of the pulse or the rice by some other substance such as oatmeal ; together with other dietetic questions, to which I have incidentally drawn attention, might with advantage be referred to a small sub-committee for consideration. For example, it might be well to consider the possibility of a short experimental investigation of the actual nitrogen absorption on the existing diets.

In conclusion, I should like to make some general remarks which the examination of these diets and the minutes of the Committee have suggested to me.

The diet of the poorer classes of the population of Egypt is without doubt mainly vegetarian, consisting, as far as my observations indicate, of wheat, *durra*, millet, beans, lentils, fresh vegetables including onions, cheese, *halâwa* (a sweetmeat consisting of flour, sugar, and *simsim* oil), a small amount of meat, and milk when the *fellâh* owns cattle or goats and is unable to sell the product.

Bread in large quantities is the chief ingredient of the food. In Lower Egypt, when possible, wheaten flour is employed ; of late years, however, owing to the high price of wheat, *dura* or more often a mixture of *dura* flour with wheaten flour has taken the place of wheaten flour for the making of bread.

It may be said with some certainty that millet bread is never eaten in Lower Egypt. The *fellâh* is no doubt dietetically correct in his preference.

The probability is that good wheaten bread has a higher nutritional value than *durra* bread, and both than millet bread.

The mere fact that an article of diet is unpalatable reacts to some extent upon its food value from the physiological standpoint.

Beans are eaten either in the form of *ta'mia* (small fried cakes consisting of crushed beans with some herbs and other flavouring ingredients), or soaked for twelve hours and then boiled, the water in which the beans have been soaked being generally drunk before the first meal of the day. This pecnliar custom is similar to the Indian habit of drinking the water in which the rice has been boiled. The comparatively recent knowledge of the presence of vitamines in vegetable food materials suggests that such a habit may have a distinct physiological basis.

Lentils are consumed either as lentil *koshari*, a kind of rough purée of lentils containing rice and onions, or as lentil soup, containing uncrushed lentils, or lastly, boiled and crushed, forming a paste, which is eaten with bread. Vegetables are either eaten raw or with vinegar in the form of a salad, very rarely cooked.

Dr. Abdel Magid Mahmoud, my assistant, tells me that the town dweller would purchase about one and a half pounds of meat three times a month for a family of four, the meat being often the waste material (viscera) of the slaughter-house. Eggs are seldom eaten.

The food habits of a people are undoubtedly of importance in framing the diet system of any public institution ; on the other hand, owing to poverty or other causes, it is quite possible that the food habits of a large section of the population may be bad. It would scarcely be justifiable to adopt such habits simply because they happened to be prevalent in the country. The eating of half-cooked lentils and beans is without doubt physiologically wasteful, while conversely the custom of eating crushed beans in the form of fried cakes is physiologically economical. I merely give these rather vague examples in order to show that the food habits of a people require careful and somewhat rigid criticism.

The average amount of food eaten by an adult man in this country, apart from the fact that it would be difficult to arrive at with any approach to accuracy, would have a distinct interest if known. Its practical value in connection with the work of the Committee may, however, be quite easily over-rated ; since sufficient information exists in various countries to show what the minimum needs of the organism are under different conditions of life. Thus I think it may be stated approximately that the minimum available energy value of the food for *subsistence* (short periods) would be 1,800 kilogramme-calories ; no work 2,200 kilogramme-calories ; light labour 2,800 kilogramme-calories ; hard work 3,200 kilogramme-calories, with a doubtful minimum nitrogen value, for the last two, of 12 grammes.

To take such figures as a possible basis, to employ the foodstuffs of the country where good, and to introduce foodstuffs from without, where economically advantageous, would, in my opinion, be the correct method of procedure in framing any dietary system.

I have the honour to be,

Sir,

Your obedient servant,

(*Signed*) : W. H. Wilson.

APPENDIX V.

COMPARATIVE PRICES AND FOOD VALUES.

SIR,

I beg to submit the following tables constructed upon the basis of the contract prices at Tûra for food commodities supplied to the Prisons Department and from the information given in the February issue of the Statistical Department's publication.

Table I shows the price per kilogramme and the available quantities of proximate nutritive principles present as well as the available heat value, "available" meaning the amount of the nutritive substances after deducting the percentage which is known to pass through the intestine unabsorbed.

In the case of meat one-third is deducted for bone. The letter "T" opposite a commodity indicates that the figures represent the prison contract price (Tûra).

The deductions for non-absorption are:—

Carbohydrates: five per cent in all cases except milk.

Protein of milk, two per cent; of meat, five per cent.

Protein of cereals, twenty per cent; bread, nineteen per cent; pulse, thirty per cent.

The chemical compositions are mainly from tables in Hutchison's "Food and the Principles of Dietetics."

NOTE.—Table I, II, and III have been corrected on the basis of tables showing the composition and food value of different food materials given in the *Lehrbuch der Hygiene* of Rubner, Gruber and Ficher. (*See* Table I, page 54, Appendix VI.)

Comparative tables have been added showing the corresponding figures for October 1915.

TABLE I.—**Price and Food Value per Kilogramme.**

	Price per Kilogramme.	Available: Protein.	Fat.	Carbohydrate.	Heat Value of One Kilogramme.
	Milliemes.				
Wheat	8·26	96	17	675	3,258
Dura	8·21	78	54	655	3,443
(T) Millet	8·24	65	42	665	3,329
(T) Rice	11·22	65	4	760	3,425
(T) Lentils	11·13	193	20	548	3,240
(T) Beans	8·77	186	20	540	3,175
Fúl sudáni (crude)	12·4	190	450	168	5,620
(T) Beef (with bone)	35·65	127	27	—	778
(T) Mutton (with bone)	65·1	117	33·4	—	796
(T) Milk (*gamoos*)	20	59	76	40	1,107
(T) Bread (wheaten)	9·28	50	1·5*	475	2,295
(T) Oil	33·74	—	1,000	—	9,200

NOTE.—Basis of estimate for millet and *fúl sudáni*: millet weighs 135 kilogrammes to the ardeb, *fúl sudáni* 75 kilogrammes per ardeb. Of this 75 kilogrammes the husks weigh twenty per cent. The components do not include the husks, *i.e.* composition is that of shelled nuts.

Table II shows the amount of the above commodities which may be purchased for one piastre, with the corresponding available nutritive and heat values. (Food prices, February 1914.)

* Numerous analyses of the flour and bread used in Egypt tend to show that the figure for fat, 1·5 per cent, is much in excess of the normal content. The true content would be from 0·5–1 per cent in bread made from better grade flour. The figure 1·5 per cent is from analyses made some years ago of bread made mainly from Egyptian flour comparable to whole-meal flour.

TABLE II.—Amounts and Food Value per one Piastre.

February 1914.

COMMODITY.	Quantity in grammes.	Protein.	Fat.	Carbo-hydrate.	Heat Value.
Wheat...	1,210	116	20	817	3,934
Maize ...	1,218	95	65	800	4,197
Millet ...	1,184	77	50	787	3,932
Rice ...	891	58	3·5	678	3,056
Lentils	898	175	18	488	2,909
Beans ...	1,140	212	22	616	3,618
Fûl sudâni, crude ...	806	122	290	108	3,645
Fûl sudâni, shelled ...	645	122	290	108	3,645
Beef without bone ...	187	35	7	—	203
Mutton without bone	102	18	5	—	120
Milk (*gamoos*) ...	500	30	38	20	553
Bread *	1,077	53·8	16	511	2,471
Oil	300	—	300	—	2,760
Cheese, Maltese	200	25·6	25·3	—	345·6

October 1915.

COMMODITY.	Per cent difference in October 1915.	Quantity in grammes.	Protein.	Fat.	Carbo-hydrate.	Heat Value.
Wheat	−25	909	87	15	613	3,206
Maize...	− 1	1,204	94	64	792	4,156
Millet	+38	1,627	106	69	1,085	5,462
Rice ...	−27	653	47·5	2·2	495	2,236
Lentils	−11	800	154	16	365	2,592
Beans...	+13	1,291	230	26	696	4,088
Fûl sudâni, crude ...	−19	653	—	—	—	—
Fûl sudâni, shelled	—	527	99	235	88	2,952
Beef without bone...	—	—	—	—	—	—
Mutton without bone	—	—	—	—	—	—
Milk (*gamoos*)...	−25	1,000	50	15 (?)	475	2,295
Bread	—	—	—	—	—	—
Oil	—	—	—	—	—	—
Cheese, Maltese	—	—	—	—	—	—
Bread, retail price...	—	808	40	12	383	1,850

NOTE.—The prices of these commodities being contract prices, it is obvious that the amount bought for one piastre does not refer to retail purchasing.

The price of wheat, which is taken from the Statistical Department's publication, suggests the following inference :—

100 kilogrammes of flour will make 140 kilogrammes of bread. With unpaid labour (as in prison), therefore, 1,291 grammes of bread should be made for one piastre (price of fuel not allowed for). One kilogramme of wheaten bread would thus cost 7·7 milliemes.† It may be noted also that the increased money value per kilogramme of flour due to loss by grinding is partially covered by the sale of bran.

Price per Kilogramme.

COMMODITY.	February 1914.	October 1915.	COMMODITY.	February 1914.	October 1915.
Wheat...	8·26	11	Beef	35·65	—
Maize (*dura*)	8·21	8· 3	Mutton ...	65· 1	—
Millet ...	8·24	6·15	Milk	20	—
Rice	11·22	15· 3	Bread, wheaten ...	9·28	12·87
Lentils	11·13	12· 6	Oil...	33·74	—
Beans ...	8·77	7·73	Cheese, Maltese ...	50	—
Fûl sudâni ...	12· 4	15· 3			

* Contract price in 1914.

† At October 1915 price, one kilogramme bread would cost ten milliemes.

TABLE III.—**Food Commodities placed in the Order of their Cheapness of A, protein; B, fat; C, carbohydrate; D, energy, with Amounts of Elementary Components, the Basis being the Piastre's Worth.**

	February 1914.		October 1915.		February 1914.		October 1915.
A. Protein.		**A. Protein.**		**B. Fat.**		**B. Fat.**	
Beans	212	Beans	230	Oil	300	Oil	300
Lentils	175	Lentils	154	*Fúl sudáni*	290	*Fúl sudáni*	235
Fúl sudáni	122	Millet	106	Maize	65	Millet	69
Wheat	106	*Fúl sudáni*	99	Millet	50	Maize	64
Maize	95	Maize	94	Milk	38	Milk	38
Millet	77	Wheat	79	Beans	22	Beans	26
Rice	65	Rice	47·5	Wheat	20	Lentils	16
Bread	53·5	Bread	40	Lentils	18	Wheat	15
Beef	35	Beef	—	Bread	16	Bread	12
Milk	30	Milk	—	Beef	7	Rice	1·6
Mutton	18	Mutton	—	Mutton	5		
				Rice	2·2		
C. Carbohydrate.		**C. Carbohydrate.**		**D. Energy.**		**D. Energy.**	
Wheat	817	Millet	1,085	Maize	4,197	Millet	5,462
Maize	800	Maize	792	Millet	3,932	Maize	4,156
Millet	787	Beans	696	Wheat	3,903	Beans	4,088
Rice	678	Wheat	612	*Fúl sudáni*	3,645	Wheat	3,028
Beans	616	Rice	495	Beans	3,618	*Fúl sudáni*	2,952
Bread	511	Bread	383	Rice	2,962	Rice	2,163
Lentils	488	Lentils	365	Lentils	2,919	Bread	1,850
Fúl sudáni	108	*Fúl sudáni*	88	Oil	2,760	Lentils	1,637
Milk	20	Milk	20	Bread	2,471	Milk	553
				Milk	553		
				Beef	203		
				Mutton	120		

The cost of commodities is based on information as supplied in the monthly reports of the Statistical Department for the months of February 1914 and October 1915 respectively.

Food-values are estimated from the details given in Table I, Appendix VI, of this Report.

I attach also the following Table IV, which is the result of calculations I have made based on Rubner's observations on the minimum amount of protein from different sources necessary to maintain the nitrogen equilibrium, *i.e.* to supply the essential needs of the body in protein without the organism drawing on its internal supplies.

Rubner states that the minimum protein supply must be :—

TABLE IV.

30 grammes	if obtained from animal sources.
34 „	„ rice.
38 „	„ potatoes
50 „	„ pulse.
76 „	„ wheaten bread.
102 „	„ maize (*dura*).

It may be assumed that the same figure applies to *dura* bread or millet bread. For these figures I obtain the following coefficients :—

Protein of animal food	$\frac{1}{1}$
„ rice	$\frac{1}{1\cdot1}$
„ potatoes	$\frac{1}{1\cdot26}$
„ pulse	$\frac{1}{1\cdot66}$
„ bread (wheaten)	$\frac{1}{2\cdot5}$
„ maize or millet	$\frac{1}{3\cdot4}$

which can be used for reducing these food materials to what may be called their "meat value"* as regards protein by dividing the amount of protein contained by the coefficient. It is possible by this means to get an idea of the surplus protein present in a diet over and above what may be called Rubner's minimum of thirty grammes.

Working this out on a one-piastre basis, we obtain the results shown in Table V. The figures mean for example that in the case of maize we obtain only 28 grammes of protein capable of supplying the essential requirements of the body, in the absence of other sources of protein, while in the case of rice we obtain 53·5. Thus, whereas the protein requirements of the body could not be met from one piastre's worth of maize, a sum of rather less than six milliemes would purchase enough rice to cover the *minimum* requirements, even supposing there was no other source of nitrogen in the diet (the minimum requirement is of course the absolute physiological minimum below which the body begins to consume its own tissue protein).

TABLE V.—**"Meat Value" (Biological Value) in Protein of one Piastre's Worth of Material.**

COMMODITY.	February 1914.		October 1915.	
	A.	B.	A.	B.
Beans	120·4	2·5	133	2·25
Lentils	96	3·1	86	3·48
Rice	53·5	5·6	39·2	7·6
Wheat...	46	6·4	34·5	8·6
Beef	38	8	—	—
Milk	30	10	—	—
Maize	28	10·7	27·7	10·8
Wheaten bread... ...	24	12·5	18	16·7
Millet bread	19·5	15·3	—	—
Mutton	18	16·6	26·8	11·2

A = Meat value.

B = Expenditure in milliemes to obtain the minimum protein requirement in the absence of other sources of protein.

The details given seem to me to be of importance in connection with the nature of the foodstuffs and particularly in regard to the value of rice and the relative cost of wheat and millet bread. The tables should be compared with Table III. It is obvious that from almost every point of view millet bread is more costly than wheaten bread.

April 28, 1914.

I have the honour to be,

Sir,

Yours faithfully,

(*Signed*): W. H. WILSON.

* Referred to later as the "biological value" of protein.

APPENDIX VI.

MEMORANDUM AND TABLES ON PRISON DIETS.

Introductory Note.

As I understand it, the primary object of the Committee, to the President of which this report is addressed, was to determine whether any economy might not be effected in the prison dietary.

It became necessary first of all to ascertain whether the existing diets, Nos. I, II, III, were suitable and sufficient for the classes of prisoners for which they were intended.

This question is dealt with in Part I on "The Energy Requirements of the Prison Diets."

The amount of work performed by the different classes was determined as far as possible and the food requirements were estimated from the results on the basis of experimental and practical knowledge obtained elsewhere.

It will be seen that the existing diet, No. III, is found to be deficient, the proposed diet being more liberal; while in the case of Nos. I and II a slight diminution is suggested.

Secondly, it became obvious that the only means of effecting a serious economy was by diminishing the amount of meat in the dietary.

This point is discussed in Part II; reference may also be made to previous memoranda which I have presented and which contain certain data concerning the food habits of the people of this country. The daily amount of protein required is arrived at, a comparison being made of the standards adopted by various observers. The very valuable work of Major McKay on the prison diets of India is referred to. A comparison of the comparative value for human food of different proteins is made on the basis of scientific work bearing on the subject carried out in Europe.

On the basis of information derived from these various sources it is concluded that meat is not an essential part of the food provided that a sufficient amount of suitable protein can be offered in its place.

Part III contains the diets I suggest to replace those at present in use.

Part IV gives an experimental diet, containing no meat, in which the bread is enriched in protein by the addition of soya bean meal.

Part IV also contains details of an examination of the prison bread, with certain recommendations.

(*Signed*): W. H. Wilson.

PART I.

The Energy Value of the Prison Diets.

In regard to the daily supply of energy-producing materials required by the different classes of prisoners, the Committee consider that the value of the different diets expressed in heat units should be :—

No. I.	No. II.	No. III.
2,450	2,750	3,200

These figures represent the heat value in kilogramme-calories of the food after deducting the normal loss for non-absorption in the intestine.

It was originally thought that the energy requirements of the non-labour prisoners would be sufficiently met by an energy supply equal to 2,350 calories; it appears, however, that in addition to the work involved in cleaning out their cells these prisoners are also made to take one hour's walking exercise daily, and in some prisons are engaged on pumping water and other similar tasks.

In the following pages an attempt has been made to give as briefly as possible the reasoning upon which the above conclusion has been based.

It is necessary, before proceeding to estimate the energy requirements for different classes of labour, to establish as a basis the minimum for a man at rest (*i.e.* a man who is awake but at rest in bed).

A number of observations on the point are quoted by Tigerstedt (Nagel's *Handbuch der Physiologie des Menschen*, Vol. I, 1906, page 544), from which it may be concluded that the energy expenditure of a man of average weight under such conditions is 1·4 calories* per kilogramme per hour (mean of the twenty-four hours).

For a man weighing sixty-three kilos. (average of prisoners) this would amount to 2,116·8 calories. Taking into consideration the fact that the climate of Egypt makes less demand on the production of heat for the maintenance of the body temperature than would be the case in Europe, and the comparatively low protein content of the diet, the resting basis might fairly have been placed below the above figure; it is therefore obviously permissible to adopt 2,150 calories as the basis for a prisoner quite unemployed. There is evidence, as for example in Chittenden's investigations that the human organism can be habituated to economy in its demands for chemical energy; in view, however, of the fact that an optimum value for the conversion of chemical energy into external work has been adopted, and that there are a number of unknown factors, it would be unsafe to take a lower minimum as the basis of calculation.

Diet No. I.—*Non-Labour Prisoners.*

If the energy value of the diet be placed at 2,450 calories, this would give an excess of 300 calories; assuming that the external work represents one-third† of the energy intake, this would provide for 42,400 kilogramme-metres of work, half of which approximately would represent the one hour's walking exercise, supposing that the pace was four kilometres an hour.

If, as measured at Tûra, the distance travelled is a little over five kilometres, the energy expenditure would be 182 kilogramme-calories, representing 25,277 kilogramme-metres of work, leaving 118 calories representing the energy expended in various other ways during the day.

The cleaning of the cells does not represent much work, but if, in addition to the walking exercise, other labour of various kinds has to be performed, the work done would probably exceed the amount upon the basis of which the energy requirements are estimated. Where any work other than walking exercise is allotted the working prisoners should be exempted from exercise.

Diet No. II.—*Prisoners on First and Second Class Labour.*

The character of the work is shown in Sub-Appendix I. The nature of the work makes it impossible in most cases to estimate the absolute amount of work done. An attempt has been made in the case of weaving. The weaver sits before the loom, moving the machinery by means of foot pedals. He produces twenty metres cloth in the day. To make one metre 536 depressions of the pedals are required. As measured by the *Mamûr* of the prison the force required to depress the pedal is six kilogrammes. The range of movement is about twenty-five centimetres; the work done with the legs in weaving twenty metres would be:—

$$536 \times 20 \times 0{\cdot}25 \times 6 = 16{,}080 \text{ kilometres},$$

equal to 116 calories in energy expenditure.

In addition to the movements of the legs some work is done with the arms; the position of the man also puts a certain strain on other muscles. The figure 16,080 thus represents only a part of the total work.

In the blacksmiths' shop the work is in some cases hard for short periods, but is obviously very variable; the same may be said of the bakery, part of the work involved being the carrying of sacks of grain or flour.

Wolpert‡ has estimated indirectly from the respiratory exchanges the amount of work done in certain forms of industrial employment. He obtained the following results for eight hours of work:—

1. Draughtsman	32,000	kilogramme-metres.
2. Mechanic (light work)§	32,000	" "
3. Light shoemaking	36,000	" "
4. Heavy shoemaking	64,000	" "

These figures are of interest in connection with certain classes of industrial labour in the prisons.

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* Siven and Clopart, *Skand. Arch. f. Physiol.*, 1901, Vol. 11, page 354.

† Zuntz quoted from War Office report. Commission on Active Service ration.

‡ *Arch. für Hygiene*, Vol. 26, page 107, 1896.

§ Making brass screws.

Voit (1875), from statistics of the ordinary diet of labouring men in Germany, concluded that a normal diet for a man weighing sixty-seven kilos. doing "moderate work" would consist of 119 grammes protein, 56 fat, and 500 starch (gross values). After deducting a certain percentage for non-absorption, the energy value of the food would be 2,749 calories, or a mean on the twenty-four hours of 1·71 calories per kilogramme per hour.

Voit's description of moderate work is "work which is not so light as that of a tailor nor so hard as that of a blacksmith, but about equal to that of a mason, a carpenter, or a joiner"; for a man of sixty-five kilos. the corresponding figure would be 2,667 kilogramme-calories.

More recent investigations tend to show that, at any rate for northern European conditions, the energy value of such a diet is too low for the type of labour described by Voit as "moderate"; at the same time there is little doubt that a large part of the community investigated by Voit were living healthy lives on such a diet.

Tigerstedt* mentions one fact of considerable interest in connection with the above. In 1891 a diet almost identical with that of Voit was introduced into the Swedish prisons, the prisoners being allowed, however, to add to their food extras purchased with money earned by their work. The results were excellent until, for disciplinary or other reasons, the right to purchase extras was abolished.

Subsequent to the abolition of this right it was found necessary to increase the daily ration. As far as this case concerns the present investigation, it must not be forgotton that Sweden is a cold country and that in all probability the average weight of the Swedish prisoners is in excess of that of the Egyptian.

From the data given and the known character of the first and second class labour, it would appear that 2,750 kilogramme-calories is a sufficient but probably by no means more than sufficient estimate of the energy value required in Diet No. II.

On the basis mentioned above this allows 600 kilogramme-calories for the energy expenditure demanded by the class of work involved, including a small proportion for the minimum activity of the day's life when the men are not actually working. This figure (600 kilogramme-calories) represents 84,800 kilogramme-metres of external work. In regard to this it is probably unjustifiable to assume that work done mainly by the arms and upper part of the body has the same efficiency (in relation to energy expenditure) as work done in walking up an incline, or carrying a weight. One estimate of relationship of external work and chemical energy is that work done with the arms represents 22·6 per cent of the chemical energy, with the lower limbs 32·6 per cent. Assuming that one-fourth of the energy intake s convertible into work instead of one-third, the 600 calories would represent 63,600 kilogramme-metres of work.

There is reason to think that habit leads to a considerable increase in the efficiency of the conversion of energy into work. It is probable, therefore, that the 600 calories might represent a larger amount of external work than 63,600 kilogramme-metres. There is little doubt that the industrial labour of the first class for which the lower estimate of efficiency should be adopted is light labour, the amount of work done falling much befow the maximum amount, while for the harder labour of the second class the higher estimate of efficiency may be accepted. Under these circumstances it is justifiable to assess the maximum labour permissible on Diet No. II at 75,000 kilogramme-metres daily, averaged over the whole week, including five and a half working days, this amounts to nearly 59,000 kilogramme-metres. This leaves an excess of more than 176 calories, equal to 25,000 kilogramme-metres, to provide the energy requirements of a life which over and above the tasks performed is not completely sedentary, and allows something for unknown factors.

It is probable that the second class labour most nearly reaching or exceeding this maximum would be found in types *a*, *b*, *c*, *h*, *j*, and *k* (Sub-Appendix I), if we assume that the work is about equal to that of men who carry broken stones from the stone-breaking machines to the trucks, which is estimated at 76,300 kilogramme-metres (after deducting the four kilometres' walk which the hard labour convicts add to their work).

It may be that a careful examination of the different types of second class labour might suggest their transference to the third class with the corresponding diet, but in general there seems no reason to think that the energy requirements of prisoners on the first and second class labour will not be sufficiently provided for by a diet having a heat value of 2,750 calories.

Diet No. III.—*Prisoners on Third Class Labour.*

The character of work is given in Sub-Appendix I; the details of the quarrying work in Sub-Appendix II; and Mr. Craig's calculations as to the amount of work performed in Sub-Appendix III.

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* *Loc. cit.*, page 546.

A table is attached, which I have deduced from Mr. Craig's figures, showing the total amount of work in kilogramme-metres and foot-tons (for reference to other standards) and the corresponding expenditure of chemical energy on the supposition that the external work represents one-third of the energy made use of in its production.

The estimation of the daily energy requirements is based on the mean daily amount of work and not on the work done on any one day, there being five and a half working days in the week. This method is justified by its employment by the British War Office Commission appointed to investigate the food requirements of the English soldier on active service.

The energy value (available) it is proposed to place at 3,200 calories, giving an excess of 1,050 over and above the resting basis adopted, this excess representing 148,400 kilogramme-metres of work.

Table I.

This table gives the estimated amount of work done in kilogramme-metres and foot-tons, with the energy expenditure involved, in different forms of third class labour (*see* Sub-Appendix III), as deduced from Mr. Craig's calculations from the details obtained at Abu Za'bal convict establishment. Included in the figures is the work done in walking four kilometres (*i.e.* to and from prison).

Class of Labour.	Kilogramme-metres.	Foot-tons.	Energy expended in Calories.
2. Carrying stone from quarry to surface	117,100	378	843
3. Trolley type (*a*)	139,143	450	1,005
Trolley type (*b*)	144,413	486	1,041
4. Carrying stone *to* machines...	80,413	240	578
5. Carrying stones *from* machines to trucks	93,713	313	675
Comparison:—			
Work done by *fellâh* at *shadûf*...	110,000	355	792
English convict (treadmill)...	166,000	536	1,175
American convict	192,000	620	1,359
Maximum Possible Work.*			
	A.	**B.**	**C.**
(*a*) Draught work (trolley)	316,800	1,008	2,192 †
(*b*) Walking up an incline	302,000	975	2,132 †
(*c*) Carrying bricks	182,000	910	2,000 †
(*d*) Treadmill	259,000	836	1,832 †
(*e*) Windlass...	207,000	668	1,919 †
(*f*) Crank	173,000	555	1,632 †

Columns **B** and **C** are estimates I have made from Tigerstedt's figures in column **A**. *a*, *b*, *c*, *d*, energy expenditure estimated at three times the work; *e*, *f*, being chiefly done with arms and upper part of body, at four times the work.

* Tigerstedt, *loc. cit.*, page 545.

† From figures given by Gariel, *Traité de Physique Biologique*, I, page 1004 (1901). Blix, *Skand. Arch. f. Physiologie*, Vol. 15, page 122, 1903.

The convicts work for 5·5 days per week. The table shows the mean daily amount of work during the week.

TABLE II.

Class of Labour.	Kilogramme-metres.	Foot-tons.	Energy Available for External Work 3200 — 2150 = 1050.	
			Expenditure Calories.	Excess of Energy in Calories over Expenditure.
2	100,534	325	724	326
3 (a)	118,244	382	851	199
3 (b)	122,162	395	879	171
4	63,180	188	454	596
5	82,838	268	596	454

As in the case of the convicts on Diet No. II, the amount of labour involved in the different tasks varies very greatly, and if necessary the diet provided has to be adjusted to meet the requirements of those doing the maximum amount of labour.

If Table II above be consulted, it will be seen that the highest daily average of work done is that of the type 3 (*b*) trolley men, amounting to 122,162 kilogramme-metres; type 2 labour amounts to 100,534 kilogramme-metres; while that of type 4 labour (carriers to the crushing machines) works out at only 63,180 kilogramme-metres.

In regard to these figures the margin in type 4 labour is no less than 596 calories, obviously much more than can be required, even admitting that the factors measured only represent a part of the actual labour performed. In regard to type 2 labour, however, it has to be remembered that although there is an apparent margin of 326 calories, representing approximately 46,000 kilogramme-metres, there is a large amount of static work involved in gripping the heavy stones when raising them to the shoulder and in maintaining the load in position upon the small pad resting on the back of the neck and shoulders while carrying it to the surface.* To indicate how considerable this may be is shown by the fact that the amount of energy expended in maintaining a weight in a fixed position by muscular effort during a certain time is equal to about half† the energy used in raising the same through a height one metre in the same period of time.‡ It would be very difficult to estimate the value of the work done in this way even roughly; as indicated it may be very considerable. Taking this unknown factor into consideration, and the fact that allowance has to be made for the general energy requirements of the minimum activity over and above the resting condition, it would not appear that the margin of 326 calories is excessive. This work is regarded by the overseers as the most severe form of labour at the quarries, the general impression gained by watching the men at work certainly bears this out. In the summer, with a shade temperature of over 100° F., the heat of the sun and the intense radiation from the surrounding rocks which form the quarry wall provide conditions so different to those under which the efficiency of muscular work has been estimated as to make it difficult to assess the true energy expenditure. Fatigue increases the energy requirements for a given amount of work, while an amount of labour which is possible when the heat-regulating mechanism can easily deal with the heat production cannot be performed when the conditions are such, as for example in a warm humid atmosphere, that that mechanism has reached the limits of its capacity for heat dissipation. The dry desert air in the hottest season of the year, combined with the constant wind, favours evaporations of sweat to such an extent that the men working on the surface are probably unaffected by the heat; at the bottom of the quarry, where there is little of no movement of the air and the rock is damp, with in some cases, pools of water, this is by no means certain.

The only evidence against the heat producing any great effect on the men is that sunstroke or heat apoplexy does not occur at all commonly.

It is hoped that it may be possible to make some observations on the body temperature of convicts working under different conditions, with a view to determining how far the external temperature affects them.

With reference to the trolley work, it is possible that the tractile resistance has been over-estimated; if so, the work would of course be less than is here indicated. Without the use of a recording dynamometer, with which a record could be obtained of the tractile force used over the whole distance travelled, it would be impossible to get an accurate result; such an instrument is unfortunately not available. The general opinion of the prison authorities is that the trolley work is considerably lighter labour than that of class 2; the unknown factors are fewer. It may therefore be assumed that a margin of 171 calories meets the other daily requirements of convicts at this class of work.

* *See* remarks at the end of Sub-Appendix II, page 37.

† Johansen, 1908.

‡ F. Tigerstedt, *loc. cit.*, page 457.

The other figures do not need much discussion. The machine feeders and carriers, apart from the unpleasant nature of the work, are employed on much lighter tasks than either of the above two classes. It is probable that a diet having an energy value of 3,000 calories would be sufficient for men doing this class of work, allowing a margin for unknown factors and general requirements above the minimum of 435 calories in class 4 and 254 in class 5. It would be justifiable, if thought necessary, to give such prisoners a less liberal diet than that received by other classes of convicts on hard labour.

In regard to all the men working at Abu Za'bal it must be pointed out that if the prison was close to the work instead of at a distance of two kilometres, or if arrangements were made for conveying the men by light railway or other means to the quarries from the prison, they would be relieved of work equal to 17,413 kilogramme-metres daily, representing an energy expenditure of 121 calories, the inference being that a diet having an energy value of 3,080 would be sufficient under these circumstances. Whether the conditions of hard labour at Tûra justify the same diet as that suitable for Abu Za'bal it has not been possible to investigate.

A certain number of examples are given in Table I showing the amount of work in different types of labour as estimated elsewhere. The figures given by Tigerstedt (Table I A, page 31) represent the maximum amount of labour which can be performed from day to day. It is obvious that these figures very much exceed the estimated amount for Egyptian convicts; they imply a correspondingly liberal diet.

If the figure for the Egyptian *fellâh* working the *shadûf* be compared with that for convict labour, assuming that he has one day of rest in the week, the mean daily amount of labour is 94,000 kilogramme-metres with an energy expenditure on the one-third basis of efficiency of 679 calories.

The work with the *shadûf* is very largely arm work, having probably a lower factor of efficiency than that on which the estimate is based. The energy requirement would in that case be considerably greater than 679 calories; although it must be taken into consideration that the man is so habituated to the type of labour that the work is probably far more economical in its energy expenditure than the experimental work upon which the deduction as regards arm work is generally based (*see* item (*f*) Table I).

In regard to effect of habit on economy of working, Wolf shows* that in a trained draught-horse the work may represent as much as forty-seven per cent of the energy expenditure. It would seem probable that *shadûf* work is approximately equal to hard labour in certain classes at Abu Za'bal.

It will be seen from the above that the energy requirements cannot be met with a diet of a less energy value than 3,200 calories. A fair margin has been left; this is no more than sufficient, especially if it be considered that for five days of the week the work in one case (type *b*, trolley labour) appears to be equivalent to almost the whole of the 1,050 calories over and above the minimum resting requirement of 2,150.

The method of estimating the requirements on the basis of the mean daily output for the week is probably justifiable; at the same time it is a reason for allowing a somewhat wider margin than might be essential if the actual daily intake and output were made the basis of estimation.

In conclusion, I must draw attention to the fact that the medical authorities of the Prisons Department regard the existing Diet No. III as satisfactory, as judged by the rate of mortality; if must, however, be borne in mind that quite recently an important change has been made in the system of labour. Whereas formerly the convicts had to work for a fixed number of hours, no particular attention being paid to the amount of stone moved in the time, now each prisoner has to do a fixed amount of work which must be completed in the allotted time or may be completed in less if the man is a hard worker. It is understood that the output from the quarries has much increased under the new system, and it is therefore almost certain that the amount of work done on the existing Diet No. III was very considerably less in former years for which statistics are available than it is under present conditions. Another probability is that the prisoners until recently were able to add to their diet from outside sources. Taking these two probabilities into consideration, it is not unlikely that the mortality statistics will not be as favourable in the future as in the past.† For this reason and for the others discussed the increase in the energy value of the diet up to 3,200 calories is to be regarded as necessary.

The conclusions arrived at are that:—

Diet No. I should have a heat value of 2,450 calories.
" " II " " " " 2,750 "
" " III " " " " 3,200 "

and that on these figures the mean daily amount of work should not exceed:—

On No. I, 25,000 kilogramme-metres.
" " II, 60,000 " "
" " III, 120,000 " "

Yours faithfully,
(*Signed*): W. H. Wilson.

* V. Lanlanié, *Eléments de Physiologie*, page 539.
† *c. f.* Interim Report, page 2, paragraph 5.

Sub-Appendix I.

NOTE ON NATURE OF OCCUPATION IN 1st, 2nd, and 3rd CLASS LABOUR.

The prisoners receiving Diet No. I are those undergoing simple imprisonment or imprisonment without labour, and prisoners awaiting trial. The average duration of imprisonment in such cases is approximately three months (information from Dr. Kirton) and does not exceed six months. The work done consists as a rule in cleaning a cell and in one hour's exercise (walking) daily. This walking exercise, as carried out at Tûra, consists of half an hour in the morning and half an hour in the afternoon. Information obtained from the Governor of Tûra prison shows that the prisoners walk round a circle the circumference of which is thirty-two metres, 160 circuits being walked in the hour (eighty in the morning and eighty in the afternoon), the distance traversed being 5,120 metres. If the pace is the same* in the central prisons the walking exercise consumes 180 kilogramme-calories of chemical energy, representing 25,277 kilogramme-metres of work. In some prisons the prisoners on Diet No. I also have to carry out various other duties connected with the prison administration, such as pumping water.

Diet No. II is received by all prisoners in central prisons or imprisonment with labour, also in prison camps (road making, etc.) and by convicts on first and second class labour.

The character of the work is as follows :—

First class labour (eight hours daily, chains weighing one and a half kilos.) :—

(*a*) Tailors.
(*b*) Carpenters.
(*c*) Filers.
(*d*) Turners.
(*e*) Tinsmiths, and other trades.
(*f*) Servants.
(*g*) Orderlies.
(*h*) Cooks.
(*i*) Bakers.
(*j*) Gardeners.

Second class labour (eight hours daily, chains weighing one and a half kilos.) :—

(*a*) Digging and carrying earth and sand.
(*b*) Breaking and carrying stones.
(*c*) *Homra* and lime making.
(*d*) Moulding bricks.
(*e*) Kneading dough (done in gangs, not continuous).
(*f*) Gardening (heavy work).
(*g*) Laundry.
(*h*) Turning wheel for driving machinery.
(*i*) Blacksmith's work. Iron foundry.
(*j*) Weaving.
(*k*) Building work.

All convicts begin with third class labour and pass by good conduct marks to second class and then to first class labour. A convict would take at least four years to obtain sufficient marks to pass from the third to the second class.

Third class labour (eight hours in winter, nine in summer, chains weighing two kilos.) :—

(*a*) Loading and unloading boats, trucks, etc.
(*b*) Carrying earth, stone, and sand.
(*c*) Grain grinding by hand.
(*d*) Scavenging (*i.e.* emptying latrine buckets, etc.). (The unpleasant nature of the work compensates for the comparatively light labour).
(*e*) Pumping and drawing water.
(*f*) Quarrying stone.

Details of the types of labour involved in stone quarrying is given in Sub-Appendix II, which also includes the calculations by Mr. J. I. Craig, from data supplied of the actual amount of work done.

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* Since writing the above I am informed that the speed of walking at Tûra is greater than in the ordinary prison exercise, the latter being carried out at rather less than 4,000 metres per hour.

SUB-APPENDIX II.

NOTE ON THE THIRD CLASS LABOUR (QUARRYING) AT ABU ZA'BAL.

SIR,

I visited the quarries and prison at Abu Za'bal with the Inspector General, who was good enough to give me every facility for obtaining the desired information as to the character and amount of work done by the convicts.

As regards the work I obtained the following results :—

1. Quarrying proper, *i.e.* drilling and loosening the stones with the crowbar. The data which would be required to estimate the work done would be extremely difficult to collect; no observations were made on this point.

2. Carrying the quarried stone up to the trolley-sidings. This is probably the most laborious of the various types of labour performed. Detailed measurements were therefore taken, as far as time allowed, at the deepest of the three quarries.

The lowest point of the quarry is twelve metres below the level at which the stone is dumped. The longest distance to be traversed is eighty-nine metres, of which approximately one-third may be regarded as on the level, the remainder an incline of varying steepness. The path was winding and was measured by the engineer attached to the quarry along the line taken by the men.

The loads of nine men and the weight of the convicts themselves were taken. The minimum load was thirty kilogrammes, the maximum sixty-four kilogrammes; the average load carried being 47·5 kilogrammes. The weight of the convicts was: minimum fifty-four kilogrammes, maximum seventy-five kilogrammes; the average weight being 65·3 kilogrammes (including chains weighing two kilogrammes).

The numbers examined (nine) are too small to be satisfactory. It would be an advantage to get the average load carried by fifty convicts and the average weight of the same men. If these details were obtained, it would be of interest to have the load carried and weight of each individual recorded separately, in order that it might be ascertained whether the heavier men carried the heavier loads, and the reverse; this would give information as to whether the total work done was or was not the same in the men of weak and strong physique.

This is not perhaps essential to the purpose of the investigation, the figures given above probably representing the maximum of total work, as it has to be remembered that if, as is probable, the average load is somewhat higher than the figure (47·5) given above, the man has to carry his own weight a fewer number of journeys.

The total daily amount carried is one and a quarter cubic metres, weighing 2,125 kilogrammes. In other quarries, with a shorter distance to traverse and a lower vertical lift, the amount is one and a half cubic metres at 2,550 kilogrammes.

The details of the class of work are :—

(*a*) Total weight carried	2,125 kilogrammes.
(*b*) Distance carried	89 metres.
(*c*) Total lift	12 ,,
(*d*) Average weight of load	47·5 kilogrammes.
(*e*) Average weight of man	65 ,,
(*f*) Number of journeys = 2,125 ÷ 47·5 =	44·7
(*g*) Time taken to traverse the distance ...	2 minutes.
(*h*) Return journey without load downhill	89 metres.

The distance traversed in another part of the quarry at which work was going on was seventy-two metres, the height being slightly less (not measured). The height was measured by means of a levelling board, a measure being taken from the free end of the board vertically to a point on the incline; the board was then shifted to this point and the procedure repeated until the lowest point was reached. The men work nine hours in the summer months and eight in the winter.

A man who is expert at the work or able to carry a heavy load may, however, complete his allotted task in a shorter time; he is then allowed to cease work.

3. Trolley driving. There are two types of trolleys, *viz.*:—

(1) Holding one cubic metre, weight of stone	1,700	kilogrammes.
Weight of trolley, empty	470	,,
(2) Holding three-quarters of a cubic metre, weight of stone ...	1,275	,,
Weight of trolley, empty	329	,,

A dynamometer was attached to a No. 1 trolley *loaded;* to the dynamometer a rope was attached of sufficient length to allow of a straight pull. Men were then put on to draw the trolley at about the usual walking pace over a short sketch of line fairly representative as to its curve and regularity of the whole. The dynamometer reading varied between about twenty-five and a little over forty, the needle oscillating for the greater part of the time slightly above and below thirty-five kilogrammes. This may be regarded as the mean resistance to traction of a trolley of a total loaded weight of 2,170 kilogrammes.

The trolley is pushed by three men on a distance of 250 metres, nineteen journeys being made. The men (three) have to load the trolley, and judging by the weight of the trolley they have to lift between them 1,700 kilogrammes from the ground into the trolley, a height of about 1·25 metres, nineteen times during the day. The trolley is pushed back empty. The traction resistance of No. 2 trolley measured in the same way was found to be twenty-five kilogrammes.

The details are:—

Trolley No. 1.

(*a*) Weight of trolley, loaded...	2,170	kilogrammes.
(*b*) ,, ,, ,, empty...	470	,,
(*c*) Distance traversed, loaded	250	metres.
(*d*) ,, ,, unloaded	250	,,
(*f*) Number of journeys	19.	
(*g*) Weight of stone to be raised into trolley	1,700	kilogrammes.
(*h*) Height to be raised	1·25	metres.
(*i*) Number of men employed on work ...	3.	
(*j*) Average weight of men	65	kilogrammes.
(*k*) Resistance to traction of loaded trolley	35	,,

Trolley No. 2.

(*a*) Weight of trolley, loaded...	1,640	kilogrammes.
(*b*) ,, ,, ,, empty...	326	,,
(*c*) Distance (the same as in No. 1).		
(*d*) Weight of stone to be raised into trolley	1,275	kilogrammes.
(*e*) Height to be raised	1·25	metres.
(actually probably less, as the trolley edge is lower).		
(*f*) Number of men employed	2.	
(*g*) Weight of each man	65	kilogrammes.
(*h*) Resistance to traction of loaded trolley	25	,,

Note.—The resistance to traction of the empty trolley was not measured, but may be taken as very roughly proportional to the weight.

4. Carriers of stone to crushing machines:—

3·69 cubic metres of stone are raised to the shoulder and carried fifteen metres level with a short rise of two metres at the end.

Details:—

(*a*) Total weight carried	6,393	kilogrammes.
(*b*) Distance traversed	15	metres.
(*c*) Lift to shoulder	1·4	,,
(*d*) Height lift	2	,,
(*e*) Number of journeys	134.	

(It is assumed that the weight carried averages 47·5 kilogrammes; it is very probably more owing to the short distance to be traversed, which would reduce number of journeys. It might be worth while, if the work is found on calculation to be apparently excessive, to get details as to the average load.)

5. Feeders. Estimate of work not attempted. Work consists in transferring the load from shoulders of men to hopper of machine. No lift or walking. Four men deal with 170 cubic metres daily.

6. Stone carriers (broken stone in baskets):—

2·4 cubic metres of stone are raised to the shoulder about 1·4 metres and carried a distance of seventy metres on the level.

(*a*) Weight lifted	4,080 kilogrammes.
(*b*) Height lifted	1·4 metres.
(*c*) Distance traversed	70 ,,
(*d*) Journeys	86.

In this case also the average load is probably more than 47·5 kilogramme-calories. As the stone is carried in baskets, each man's load is therefore more likely to equal. This would reduce the number of journeys, the same remarks applying as in the last case (4).

In both cases it should be noted that the men have to walk back unloaded over the same distance that they traversed loaded, the weight of the men being taken as sixty-five kilogrammes average.

The object of the investigation being to find the *maximum* regular work, with a view to testing by it the sufficiency of the existing diet, the figures given above may be safely taken for the purpose, as there is little doubt that any errors will give an excess rather than a deficiency in the estimate of work done as compared with the true amount.

Other types of work were examined; in most cases it was obviously less arduous than the types on which notes were taken. In the case of raising water by pumping an investigation might be interesting.

Ten to twelve men turn a capstan working a pump raising water into a tank at the top of a building. The men are said to walk a total distance of thirty kilometres. The work done is difficult to estimate, as the weight is thrown to a certain extent on the capstan bar; the amount of water raised is not known, and the distance traversed is uncertain.

In addition to the work specified above the men have to walk a distance of two kilometres (not in the case of pumping last mentioned) to and from the prison. There is a slight rise in the ground of the prison to the quarries, amounting probably to not more than ten metres as far as could be judged by a very rough estimate. The work done must, however, be added to the day's work.

It should be noted that a half day's work only is done on Thursday and no work on Friday. The weight of the men includes the weight of the chains (two kilogrammes) and the shoulder pad on which the stone rests during transport.

As my visit was in a sense a private visit arranged with the Inspector General, whom I have to thank for a most interesting morning spent at Abu Za'bal, I am sending this note to him before transmission to you, fot his approval and concurrence.

I am, Sir,

Yours faithfully,

(*Signed*): W. H. Wilson.

REMARKS.

I received the impression that a certain proportion of the men, particularly those engaged in carrying at the quarry, had the appearance of malnutrition. An average weight of sixty-five kilogrammes would not suggest this, and of the nine weighed two weighed seventy-five kilogrammes and one seventy. If these are abnormal weights, the average on such a small number would be unduly raised.

I was struck by the fact that the manner of carrying the stones resting on a small pad fixed above the shoulder blades, the stone being prevented from falling off by the hands, makes it impossible for a convict to carry a reasonably heavy load unless he can get one or two pieces of large size. If the pieces are small the man has to make a larger number of journeys with a light load. If it be remembered that each journey involves an amount of work at least equal to that of carrying a load of sixty-five kilogrammes, it is obvious that the amount of labour could be diminished comparatively simply without diminishing the output of stone.

I mention this on the ground that if, as seems probable, the existing diet were regarded as insufficient for this class of labour, anything which would facilitate the work might be cheaper to adopt than a considerable increase in the diet.

(*Signed*): W. H. Wilson.

Whittingham Pasha has pointed out that the character of the labour at the machines (feeders and carriers) is very unpleasant, owing to the large amount of stone dust; this no doubt is important from the hygienic standpoint, but does not affect the amount of work done.

Sub-Appendix III.

CALCULATIONS ON DATA OF SUB-APPENDIX II.

Stone-carrying.

Data :—

Average load	47·5 kilogrammes.
Average weight of man	65·3 „
Distance walked	89 metres.
Vertical lift	12 „
Weight of stone per day	2,125 kilogrammes.
Number of journeys	44·7 say 45.
Time to traverse distance	2 minutes.

The man lifts 112·8 kilogrammes 12 metres 45 times, or does 60,912 kilogramme-metres of work.

It is now assumed that the work done in walking is one-fifteenth of that of lifting the same weight vertically. Therefore the labour of transferring 65·3 + 47·5 kilogrammes through a distance of 89 metres 45 times is $\frac{112{\cdot}8 \times 89 \times 45}{15}$ ... ... or 30,118 kilogramme-metres.

The work of walking unloaded downhill will be much less,* say one-thirtieth of that of vertical lifting, or $\frac{65{\cdot}3 \times 89 \times 45}{30}$ ... ... or 8,718 „ „

The work of transferring his weight to and from the quarry is $\frac{65{\cdot}3 \times 4{,}000}{16}$ ... ... or 17,413 „ „

In all ... ... 117,100 kilogramme-metres.

Apparently this is done in 45 × 2 × 2 minutes + say 60 minutes for coming and going + say ⅓ of 45 × 2 × 2 minutes for rests, or in five hours say.

The British convict on the treadmill used to do 166,000 kilogramme-metres in six hours, and the American convict, on a better diet, 192,000 kilogramme-metres.

The *shadûf* worker does 90,000 kilogramme-metres of actual lifting and say 20,000 kilogramme-metres coming and going, or say 110,000 kilogramme-metres. The American estimate of the actual work of lifting by the *shadûf* is 96,000 kilogramme-metres.

The general result is that the convict, in this case, does much the same amount of work as the *fellâh*.

Trolley driving. (1) Heavy Trolley; (2) Light Trolley.

Data.	Heavy Trolley.	Light Trolley.
Weight of loaded trolley...	2,170 kilogrammes	1,640 kilogrammes
Weight of unloaded trolley	470 „	326 „
Distance travelled	250 metres	250 metres
Number of journeys...	19	19
Weight of stone raised	1,700 kilogrammes	1,275 kilogrammes
Height...	1·25 metres	1·20 metres†
Number of men to a trolley	3	2
Average weight	65 kilogrammes	65 kilogrammes
Resistance of loaded trolley to traction	35 „ weight	25 „ weight

* Negative work is about equal to the static work involved in maintaining a given weight, *v.* Tigerstedt *loc. cit.* (W. H. W.).
† Dr. Wilson puts this as rather less than for the heavy trolleys, and so 1·20 metres has been taken.

(1) The work done per man in pulling or pushing the loaded trolley is $\frac{35 \times 250 \times 19}{3}$ ... ... or 55,400 kilogramme-metres.

That for the empty trolley may be taken as proportional to the weight, or $\frac{7 \cdot 6 \times 250 \times 19}{3}$ ... ... or 12,000 ,, ,,

The work done in lifting the stone is $\frac{1,700 \times 1 \cdot 25 \times 19}{3}$ or 13,400 ,, ,,

The work done in transferring the man's own weight is $\frac{65 \times 250 \times 2 \times 19}{15}$ ... ... or 41,200 ,, ,,

In all ... ... 122,000 kilogramme-metres.

(2) The corresponding figures here are :—

$\frac{25 \times 250 \times 19}{2}$ ... ... or 59,400 kilogramme-metres.

$\frac{5 \times 250 \times 19}{2}$ ... ... or 11,900 ,, ,,

$\frac{1,275 \times 1 \cdot 20 \times 19}{2}$ ... ... or 14,500 ,, ,,

$\frac{65 \times 250 \times 2 \times 19}{15}$ ... ... or 41,200 ,, ,,

In all ... ... 127,000 kilogramme-metres.

To these must be added 17,413 kilogramme-metres for walking from and to the prison.

This result agrees as well as can be expected with that obtained from stone-carrying, considering the totally different nature of the work.

Carrying stones to crushing machines.

Data :—

Weight carried	6,393 kilogrammes.
Distance	15 metres.
Lift	2 ,,
Number of journeys	134.

Work on vertical lift 6,393 × 2 ... ... or 12,780 kilogramme-metres.

Work done in lifting stone to shoulder 6,393 × 1·4 metres ... ... or 8,950 ,, ,,

Work on raising own weight 2 metres 65 × 2 × 134 metres ... or 17,420 ,, ,,

Work on transfer of stone $\frac{6,393 \times 15}{15}$ ... ... or 6,393 ,, ,,

Work on transfer of own weight $\frac{65 \times 15 \times 2 \times 134}{15}$ ... ... or 17,420 ,, ,,

In all ... ... 63,000 kilogramme-metres.

Carrying stone in baskets.

Data :—

Weight lifted	4,080 kilogrammes.
Height of lift	1·4 metres.
Distance traversed	70 ,,
Number of journeys	86.

Work done in actual lift 4,080 × 1·4 ... ... or 5,700 kilogramme-metres.

Work done in transport of stone $\frac{4,080 \times 70}{15}$ ... ... or 19,000 ,, ,,

Work done in transport of man $\frac{65 \times 70 \times 2 \times 86}{15}$ ... ... or 52,200 ,, ,,

In all ... ... 76,900 kilogramme-metres.

The work here also appears to be small.

(*Signed*) : J. I. Craig.

May 9, 1914.

Note.—In all the above cases work is done in raising the body when lifting the load from the ground ; roughly estimated this probably varies from 700 to 1,400 kilogramme-metres, according to the class of labour.

THE PROTEIN REQUIREMENT.

This is probably the most difficult and at the same time the most contentious question with which we have to deal.

This will be readily understood if the various standards which have been adopted by different authorities be considered.

Chittenden,* as the result of a prolonged series of experiments on a number of men leading active lives, came to the conclusion that the nitrogen requirement of an ordinary man was 0·12 gramme per kilogramme of body weight daily. McKay recommends for the Indian prisoners of the United Provinces 0·21 gramme of nitrogen per kilogramme (the average weight of the men being 55 kilogrammes). The diet of the English hard-labour convict contains protein equal to 0·34 gramme of nitrogen per kilogramme (as estimated from the content of the diet in protein, the weight being assumed to average 70 kilogrammes).

If these figures be applied to the problem before us, the Egyptian prisoner having an average weight of 65 kilogrammes would receive :—

On the Chittenden scale	47·24	grammes protein daily.
,, ,, McKay scale	82·7	,, ,, ,,
,, ,, English hard-labour scale	125	,, ,, ,,

(the numbers being grammes of protein used in the body).

If the various experimental diets which have been found successful, and the diets adopted in public institutions be examined, a similar discrepancy will be found to exist. The following may be quoted :—

	Protein.	Heat Value.
Siven†	39	2,444
Hirselfeld†	45	3,462
Chittenden (Fletcher)	45	1,606
Hindhede (1913)	60	3,000 (?)
Kumagawa†	54·7 (veg.)	2,640
McKay (Diet No. II *b*) 1910–1911	78·5	3,168
English hard labour	177 (gross)	4,168
British Army active service recommended (1912) ...	200	4,378

Between the low protein diets and the high are Voit's‡ well known dietaries, which contain for moderate work 104 grammes and for hard labour about 120 grammes available protein.

It might be thought that some definite experimental evidence could be found showing the necessity of such high protein intakes as those mentioned ; it is, however, doubtful whether any physiological knowledge exists demonstrating the value of such an excess of protein to the organism.

The extensive series of experiments carried out by Chittenden in America about ten years ago, and the quite recent investigations of Hindhede in Denmark, both tend to show that the amount of protein required daily by men leading active lives and often engaged in hard physical work is about half that usually deemed necessary.

In view of these discrepancies I will give the following extract, which I have translated, from Rubner's *Wandlungen in die Volksernahrung* (1913).

" The older view that for hard labour about 120 grammes of protein and for light labour about 100 grammes are necessary has been found to be approximately correct. These figures are not a minimum, but considerably above it, as ought to be the case in any satisfactory regime.

" The figures must not, however, be taken as applying to all nations or to the range of people in one nation ; they apply really to the type of food habit of the people whose normal diets were studied by Voit and upon which he based the figures of his standard diet."

The basis of the prevailing opinion is in fact largely the statistical information which has been collected in European countries as to the quantity of protein an adult man consumes daily (when free to eat what he desires) in different classes of life and under different conditions of labour. And it seems, as might be expected, that the gradual and considerable increase in the daily amount of protein consumed (as judged of by the great increase in the consumption of meat per head of the population in various countries) has been reflected in the dietaries of public institutions.

* "Physiological Economy in Nutrition," 1904.

† Quoted from Chittenden, *op. cit.*

‡ Voit, *Zeitschrift für Biol.*, Vol 12, page 21, 1876.

In view of the varied opinions mentioned above, it may be of interest to consider very briefly the known facts regarding the need of protein to the animal organism, as far as these facts have a bearing on the subject in hand :—

1. Protein is not consumed in the production of energy provided a sufficiency of carbohydrate and fat is available ; that is to say, that, given a sufficient amount of food, the loss of nitrogen is not increased by muscular exertion.

2. Any excess of protein over and above that required for meeting the wear and tear of the tissues is used as fuel, having for the purpose about the same value as starch, or is stored up as fat or carbohydrate into which it is converted, the organism having a very slight power of storing protein as such.

3. The experiments of Rubner and K. Thomas* have shown that the minimum amount of protein required by a man of average weight to maintain nitrogen equilibrium (*i.e.* to live without drawing on the proteins of his own tissues) is equal daily to thirty grammes of animal protein (*e.g.* from meat and milk), the vegetable proteins varying in value for this purpose. Thus, while thirty grammes of meat protein could be replaced by thirty-four of protein from rice, it would require no less than 102 grammes of protein from *dura* (maize). A list of the " biological values " of the protein of different food materials is given in Table I, page 54.

The function of the protein in the body (after growth has ceased) are various, but may be shortly stated to be the replacement of the wear and tear of the tissues and the supply of components of the secretions as far as these are not reabsorbed and used again.

4. The nearer the intake is to the minimum the longer the organism takes to rebuild any damaged tissues or to make up for a temporary deficiency in the protein supply.

5. A high protein intake appears to increase the defensive powers of the tissues against disease. For example, in the treatment of phthisis a large amount of protein appears to be essential in the diet. Bardswell and Chapman in their work on the subject state that 154 grammes (gross) of protein should be taken daily ; it is interesting to note that they regard the source (animal or vegetable) of the protein as immaterial.

6. The experiments of Chittenden and others tend to show that the human organism tends rather rapidly to become habituated to a low protein intake (in some of Chittenden's subjects the biological value of the daily protein was below Rubner's minimum).†

7. An excess of protein in the food leads to a speeding-up of the metabolism, as indicated by an increased heat production apart from any increase in external work. Protein acts as it were as a forced draught to the metabolic furnace. This is presumably due to its producing in some way a higher level of muscular tone. Possibly it, in some way, facilitates the discharge of energy and so increases the capacity for work. This increased production of heat is accompanied by an increased flow of blood to the skin and an equivalent increase in the discharge of heat. This increased heat dissipation is carried out at moderate air temperatures almost entirely by radiation or conduction from the surface of the body, with a large excess of protein the limits of regulation by this means are reached during rest, the extra heat produced by muscular exertion being dissipated by sweating.

It appears to be a well recognized fact among the people of this country that lentils and beans are to be avoided or eaten sparingly in the summer ; it ought to be possible to obtain statistics as to the sale of these two commodities in the hot and cold seasons respectively. I have drawn attention to this in a note on *beduin* food habits. (Appendix II.)

8. In addition to the low biological value, the vegetable proteins are absorbed from the human digestive tract less well than are the animal proteins. This is dependent in all probability more on the structure of the food materials than on the nature of the protein. The more completely the food materials are disintegrated artificially the larger is the percentage absorbed. The percentage absorption of protein from various sources is given in Table I, page 54.

The conclusions to be drawn from the above are briefly as follows.

A minimum amount of protein is required daily, over and above which a certain excess is desirable ; this minimum is different for different proteins and is measured by the biological value of the protein. In determining therefore the requisite amount of protein it is essential to take into consideration the biological value of the protein components of the diet and fix the daily quantities on this basis rather than on the nitrogen content. In determining the amount of protein the defective absorption of vegetable proteins must be allowed for.

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* From Rubner, " Die Lehre vom Kraft und Stoffwechsel," in *Handbuch der Hygiene.* Rubner, Gruber and Ficher, 1911. *Also* Rubner, *Wandlungen in der Volksernahrung*, 1913.

† Estimated from diet sheets given in Chittenden's work *loc. cit.*

The minimum requirement of protein is the same for a man at work as for a man not doing work; theoretically, therefore, the biological value of the protein offered in the diet should be the same for all classes of labour.

As the protein supplies certain daily needs of the organism independent of the work done, the day's supply, whatever its amount, being completely used, the value of the protein in the diet should vary as little as possible from day to day, and should not vary much in different meals.

The specific dynamic effect of protein and the known food habits of workers in hot climates makes it probable that a low protein intake (within certain limits) is advantageous in the hot season of the year.

The question as to what should constitute a safe margin of protein above the minimum is not easy of solution.

Leaving out of consideration the bread diet, the three diets for other classes of prisoners appear to contain as at present constituted (millet bread) respectively :—

	Diet No. I.	Diet No. II.	Diet No. III.
Protein	59·2	69·7	83
Biological value	31·2	38·7	53·34*

There appears to be no reason to doubt that the health results among the prisoners on Diet No. II at Tûra have been good on the diet offered, which would suggest that the value of protein exceeding the minimum by 8·7 grammes daily is sufficient. Assuming that the wheaten bread in use up to about 1911 contained as much as five per cent of available protein (which from evidence the sub-committee have collected it probably did not), the three diets contained the following :—

	Diet No. I.	Diet No. II.	Diet No. III.
Available protein	70·2	82·7	96
Biological value	35·4	44·2	57·8

In connection with the question it is of interest to consider other dietetic systems.

It may be noted in regard to Chittenden diets that in many cases they are almost entirely vegetarian, and that the biological value of the protein is close to or even in some cases below the minimum (the statement is on the basis of estimates I have made from the details published in "Economy in Nutrition"). The varied character of the food and the large number of different substances in small quantities entering into its daily composition, combined with the surroundings of the individuals experimented on, would make the system an unsafe basis of comparison.

I have unfortunately been unable to collect any details of Hindhede's system. It is, however, mainly vegetarian, the diet containing in addition to bread, apparently, a considerable amount of potato, a little milk, and some vegetable fat. Its protein value is very low; it is, however, to be noted that the protein of potato has a high biological value. The interest of this particular regime is that it has been suggested that its application in the Danish prisons would lead to a great financial economy, the cost of the diet for an adult in active life being in Denmark from (in English money) 2¼*d.* to 3¼*d.* a day.

It would be of great value if this system could be studied and accurate details obtained.

McKay's† investigations are of special importance, as in framing the Indian prison dietary he was dealing with a population (in the United Provinces) of very similar food habits to those of the Egyptians, the main difference being in the average weight of the individuals, namely fifty-five kilogrammes, as compared with a probable sixty-five kilogrammes here.

He finds that the average protein intake of the population of the plains of Lower Bengal is 0·116 gramme per kilogramme, equal to 37·5 grammes protein daily; of the United Provinces 0·168 gramme nitrogen equal to 57·5 of protein. The said dietaries formerly in force contained 0·205 of nitrogen per kilogramme. McKay recommends a dietary containing 0·21 gramme of nitrogen per kilogramme of body weight, considerably more, that is, than the amount he estimates as the average for the free population. In regards to this he writes:—‡

"(1) We believe that it is for the welfare of the prisoners and probably to the advantage of the State that the level of nitrogenous interchanges should be such as to provide liberally for the waste of everyday wear and tear.

"(2) It being already the policy of the Government of the country to provide dietaries that are superior inside the gaol to those obtainable by the same class of people outside the gaol, it is the business

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* If millet protein is taken as having the same value as maize protein, the biological value would be reduced by approximately 2·5 in the case of No. I and by 3 grammes in the case of Nos. II and III.

† McKay, "Scientific Memoirs of the Government of India." Vol. 37, 1910; Vol. 48, 1911.

‡ *Ibid.*, page 127.

of the Government to determine any change in its policy; from a physiological standpoint we cannot defend any lowering of the present level." He continues :—

" Physiologists of the Chittenden school would hold that the dietaries are excessive and that they might be reduced all round by one-third or more with advantage. . . . While acknowledging the force of the different arguments for the reduction of the level of protein metabolism, we have had sufficient evidence in our work in India to confirm us in the opinion that a liberal supply of Protein (absorbable) is the all-important element of a diet, without which, no matter how plentiful the other constituents may be, physical fitness, capacity for work, and the power of resisting disease cannot be expected."

It appeared worth while to quote the above as the question at issue is almost identical with that which we are attempting to solve.

McKay's remarks are of particular interest if it be noted that the amount of protein for which he is contending is no more than eighty grammes daily, derived entirely from vegetable sources and having a biological value of only 33 (I have estimated this from the composition of McKay's Diets I *a* and II *b*). McKay ascribes the somewhat better physical development of the people of the United Provinces as compared to those of Lower Bengal to the fact that the former consume a daily average of 57·5 grammes protein per head, the latter about 38. It is a curious fact that, if the origin of the protein be examined in the two cases, we find that in the former it is from cereals and pulse, in the latter very largely from rice. Roughly estimated from the details supplied by McKay, the biological value of the 57·5 grammes protein would be about 25 and of the 38 grammes 30·5. This inversion is of course due to the high biological value of rice protein, and no doubt explains how it is that the people in question are able to live on such an apparently deficient amount of protein as thirty-eight grammes. It must be remembered also in regard to the low value of 25 in the first case that the average weight of the individuals is probably fifteen per cent less than those for whom thirty grammes would be the minimum.

If the various figures above be considered, it will be seen that considerable stress has been laid on what Rubner designates the biological value of protein, and although, as far as I am aware, this has not hitherto been taken as the basis of estimating the protein requirements, it appears to me to be the correct method to pursue in dealing with a dietary in which protein of vegetable origin is bound largely to predominate. The amount of absorbable or available protein, and much more so the gross amount of protein in the diet, may therefore be regarded as subsidiary considerations, seeing that the total quantity is made up of fractions of protein of very varying values.

The absolute amount of available protein is therefore a secondary consideration dependent on the types of food material introduced into the dietary.

It will be seen on consulting Table II that all the dietaries hitherto in use, with the exception of No. III and No. II of 1905 onwards, contained protein between 70 and 80 in available amount and having a value of less than 40. Diet No. II used at Tûra during the last three years also had a protein biological value of less than 40, the diminution being due to the introduction of millet bread. As regards the hard labour Diet No. III introduced in 1905, it is suggested (by Dr. Kirton) that its high protein value, due to the introduction of a considerable amount of meat, accounts for the greatly improved mortality statistics from 1905 onwards. It would require a statistical investigation of a much wider range than has been attempted to confirm such a suggestion.

It may also be pointed out that approximately half the prisoners at Tûra, those in fact serving the longest sentences, have not had the advantage of this diet, receiving Diet No. II, the biological value of which is at present 38·5. As far as I can learn, the health of those on Diet No. II was not inferior to that of the other prisoners receiving No. III.

There is very little evidence to show that the protein requirements of the one class of convict is in reality greater than that of the other.

This being so, it is suggested that protein having a biological value of 40 is a sufficient daily provision.

To fix the protein value of the diet at a lower figure than this for long-term prisoners might be justified by comparison with certain low protein systems. It would, however, be an experiment of a rather dangerous character. It may be the case that in this country and in India a large part of the population live their lives out with a mortality in persons over the age of fifteen years, as shown in my report on the health conditions of Tûra convicts, 1898, scarcely greater than it was within the same age limits in England at that date, on a diet of a much lower protein value than 40. The life in prison with forced labour and a fixed diet, without the ability to vary the conditions, will probably put a far greater strain on the human organism than that to which any free man is likely to expose himself; it is therefore wiser to leave a margin considerably in excess of that which might be sufficient under less strenuous conditions.

In regard to the short term prisoners, whose average stay in prison is approximately three months and seldom exceeds six months, it is safe to adopt a figure nearer the minimum. A protein value of 33 is therefore suggested for Diet No. I.

The excess of energy value required in Diet No. III will imply the addition of food materials containing protein. Its protein value will therefore be higher.

It is, therefore, proposed that the protein value of the three diets should be :—

	Biological Value of Protein.
No. I	33
No. II	40
No. III	45

The available amount of protein corresponding to these figures will be :—

	Available Protein.
No. I	60
No. II	80
No. III	90

These figures must not be regarded as a fixed amount, they might be less or more according to the source of protein.

It may be as well, in order to avoid the suggestion that the diets can be classed with those of very low protein content, the suitability of which for men living under the conditions of prisoners has still to be proved and is perhaps open to question, to give the gross amount of protein the three diets would contain. It would be approximately as follows :—

	Gross Protein.
No. I	76
No. II	102
No. III	114

In constructing the diet sheet the amount of protein may be a little less than the above figures. The biological value will, however, be adhered to as far as possible.

It may, in conclusion, be stated that although the figures given represent a sufficiency, an addition to the protein within reasonable limits would probably be of value, at least in the cold season ; and provided this could be done without additional cost to the State, beyond a quite insignificant amount, it should in the opinion of the sub-committee be attempted.

(*Signed*) : W. H. WILSON.

THE SOURCE OF PROTEIN IN THE DIETARY.

The foodstuffs at present in use in the prisons are identical with those consumed by the general population and can be readily purchased here.

It is therefore not proposed to alter the constitution of the dietary to any great extent.

In regard, however, to the meat ration in Diet No. III there appears to be no sufficient reason for retaining more than is sufficient to add variety to the meals on different days.

The advantage of meat, apart from the high value of its protein, is that it stimulates the digestion and gives, owing to the many different ways in which it can be prepared for consumption, a large power of relieving the monotony of the diet. In addition to this, fresh meat has certain properties which are called in general antiscorbutic and which are dependent on its containing substances known as vitamines, which have within quite recent years been shown to exist, their existence being known more by the pathological effects of their absence from the food than by any very accurate knowledge of their nature or physiological action in the body.

Some of these substances are destroyed by prolonged cooking ; it is known at least that the antiscorbutic property of meat and vegetables is lost by prolonged cooking or by complete desiccation. It is quite possible that many more of these substances exist than the few at present known.

It is therefore probable that the meat of Diet No. III, given, as it is, always in the same form after boiling for three hours, has probably lost most of its stimulating properties such as they are, and possibly much of its value in all other respects with the exception of its nutritive value.

Sufficient of the vitamine substances is contained in most vegetable materials in their natural state, and it is probably for this reason that fresh vegetables and fruit are of importance in the diet, and particularly a certain amount of raw vegetables. It may be here mentioned that the Egyptian is in the habit of eating most vegetables in a raw state.

Apart from the fact that the population of Egypt is mainly vegetarian, it will be seen from the above that there is no sufficient reason for retaining more than sufficient meat to assist in reducing the monotony of the diet and adding to a certain extent to the biological value of the protein content.

It would appear that 31·2 grammes as at present given in Diet No. II might be regarded as sufficient, any other addition of animal protein such as that of cheese being given more to assist in the even distribution of the protein and to add variety than for any other reason. The complete abolition of the meat ration, in my opinion, would have as its chief objection the difficulty of providing a dietary which would not be unduly monotonous, without at the same time raising the cost of the rations.

As regards the possibility of finding other cheap sources of protein, the residues from oil and starch factories are available. As regards the latter, the flour, containing a large percentage of proteins of high value obtained from potatoes after the extraction of the starch, has been used as a means of enriching bread. It has not, however, been possible to obtain information as to the cost or composition of the material; details should if possible be obtained.

In regard to the former some very successful experiments were made by the Prisons Department upon the addition to the bread of soya bean meal from which most of the fat had been extracted; a palatable bread of good quality was obtained. The composition of this material is protein 40·6 per cent, starch 30 per cent, fat 2·1 per cent, salts 5 per cent.

The biological value of the protein may be assumed to be the same as that of pulse.

The absorbability of the protein is stated by Lipski* to be 80·5 per cent, other estimates are somewhat higher.

Table I gives the composition and value of the material. The price would apparently be about eight milliemes a kilogramme.

The addition of five per cent of the soya meal to the bread in the place of five per cent of wheat flour would raise the available protein content to 5·8 per cent, the biological value by 0·5 per cent, lower the carbohydrate value by 1·7 per cent, and the total heat value of the diet, supposing that about 1,000 grammes bread was given daily as suggested in Diet No. III, by 3·5 calories, an amount which might be disregarded. The cost of the bread would be slightly diminished (approximately to the extent of 0·2 millieme a kilogramme).

The biological value of the whole Diet No. III would be raised to about 50. It will be seen, therefore, that the diminution in the meat could be met to a great extent by the introduction of this cheap material, or, if ten per cent of the meal were added, almost entirely made up for. This addition to the bread, if found satisfactory on a small scale, might with advantage be adopted; its use would render possible a diminution of the lentils or beans during the summer months, the loss of heat value being made up by an increase in the rice.

(*Signed*): W. H. Wilson.

THE BREAD RATION.

In estimating the nutritive value of the various diets hitherto in use, the wheaten bread has been assumed to contain five per cent of available protein, having a protein biological value of two per cent.

The carbohydrates have been assessed at 50 per cent, of which 47½ per cent are assumed to be absorbed. The loss of carbohydrates (five per cent over the whole diet) is perhaps a rather high estimate. This figure has been taken as it is the mean of the results obtained by Rubner for bread made of very coarsely ground flour and that made with fine flour.

For millet bread the analysis originally obtained from the Public Health Department has been taken; it appears to vary slightly from the mean of Mr. Lucas's results. The available value of the protein has been taken as being the same as that found for the same cereal by McKay† in his experiments on Indian prisoners: namely, an absorption co-efficient of 55 per cent only, the biological value being assessed at the same figure as that for wheat protein.‡

The bread ration provides 70 per cent of the energy value of the daily food and nearly half the available proteins. It will be seen, therefore, how important it is that its composition should be uniform. If the analysis presented by Mr. Lucas in the attached Table VI be examined, the gross amount of protein will be found to be very variable; this is to a considerable extent due to the varying amount of water. For example, a sample (No. 3) of bread from Tûra analysed by Mr. Lucas shows only 5·44 per cent of

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* Li-yu-King and L. Grandvoinnet, *Le Soja, sa Culture, etc.*, page 115.

† McKay, *loc. cit.*

‡ Maize protein would possibly be a more correct analogy.

gross protein. If the content of the water had been about 35 per cent (34·6 per cent) as it should be if the standard laid down by the prison authorities be followed, namely, that 146 kilogrammes of bread are obtained from 100 kilogrammes of flour (*see* attached letter from the Inspector General of Prisons), the gross content of protein would be seven per cent, giving an available content of protein of 5·25 per cent, slightly in excess of the five per cent scale adopted.

On the other hand, in Sample No. 4 of wheaten bread (hospital) from Tûra examined in October 1913 by the Public Health Department, the gross protein content on the same basis was approximately 5·6 per cent, giving an available protein value of 4·2 per cent only.

It is obvious that a deficit of eight per cent of protein is a serious matter in a diet in which the total protein is not much more than sufficient.

On examining the table of flour analyses it will be seen that in one case (No. 13), the protein content as estimated from the nitrogen was 7·83 per cent, in another (No. 24) 9·62 per cent, while the gluten determinations (No. 11) show an extreme variability from the very low content of 5·8 per cent to the high content of 15·2 per cent.

To obtain an available protein content in the bread of five per cent the flour should contain 9·6 per cent of protein estimated from the nitrogen.

From the above it is clear that samples of flour should be submitted for analysis before being used for the making of bread; it would be well also if from time to time samples of the wheaten bread were sent for analysis, so that any deficiency might be detected and corrected. It would be advisable also that the contracts for wheat should contain some proviso as to its quality.

A deficiency in the protein content of the flour might be corrected by the addition of the necessary amount of soya meal.

As regards the character of the samples, these were, in the case of both the millet and wheaten bread from Tûra, under-baked, especially so in the latter; the bread also in general appeared to be insufficiently leavened and to contain too great an excess of bran. The two samples of wheat bread from Minia and Shebîn el Kôm respectively were undoubtedly of much better quality than the samples from Tûra and Manshîa prisons.

The part of the report dealing with the source of protein may be referred to in reference to the enrichment of bread with soya bean meal.

There appears from the analysis (No. 4) of wheaten bread from Tûra to be a remarkable deficiency in the content of fat. In estimating the nutritive value of the diets fat has been assumed to be present to the extent of 1·5 per cent.

If Mr. Pappel's analysis is correct, this is nearly three times the true amount. In order to determine the average amount of fat in wheaten bread made from the type of wheaten flour employed at Tûra, it is advised that during the summer the analysis of a certain number of samples of wheaten bread and flour should be carried out; ten samples of bread and a smaller number of flour would be sufficient to determine this point. It would be of interest if the protein content was determined at the same time.

The samples should be taken at intervals during the next four months.

Attached to the report is some correspondence belonging to the Prisons Department in regard to soya bean flour and also the account of the experiments carried out with the flour by that department. It will be seen that very good bread was made, containing 12½ per cent of soya bean meal and that fair bread was made containing equal parts of soya bean and *dura* flour. It is possible that an even better result would have been obtained with wheaten flour.

NOTE.—The reasons for replacing millet bread by wheaten bread have been already submitted to the Committee. *See* table showing relative nutritive value of the two kinds of bread (Table V, page 57).

SUGGESTED DIETARIES.

If the conclusions of the theoretical portion of this Report be brought together, the following statements must form the basis of the proposed diets :—

		No. I.	No. II.	No. III.
1.	Energy value (calories)	2,450	2,750	3,200
	Biological value of protein (grammes)	33	40	45
	Amount of available protein (grammes)	60	80	90

It is understood that the amount of available protein (*i.e.* the amount of protein estimated as being absorbed from the protein offered) is subsidiary to the biological value of the protein and that an excess of protein (available or in relation to the biological value given) is not excluded and would no doubt be advantageous if found possible without increasing the cost of the diet.

2. Millet bread shall be replaced by wheaten bread made from flour fairly free from bran. *Helba* may be added if thought desirable.

3. The meat ration should be reduced in Diet No. III to 47 grammes daily, or 31·2 grammes if a suitable amount of protein can be otherwise obtained.

Table IV, page 56, shows the suggested alternative diets.

Those marked A, B, C,—A being No. III, B the No. II, C the No. I—are the dietaries I should regard as preferable. Either 1, 2, or 3, No. III, and 1 or 2, No. II, might be used separately, but would not be so satisfactory as the combination suggested.

If for any reason it was thought impossible to distribute the *ful sudâni* or cheese, these might be left out but the diet would not be so satisfactory. In the case of No. III Diet the No. III (1) would then be the best diet and in the case of No. II the No. II (2). The diets would of course be cheaper.

The values of the diets would be respectively :—

	Protein.	Biological Value.	Fat.	Carbo-hydrate.	Calories.
No. III A.	89·2	45·28	48·9	588·3	3,218
No. II B.	78·175	40·95	47·8	522·7	2,861
No. I C.	65·29	32·904	36·	450·4	2,440·3

The cost would be respectively : A. 12·0015 milliemes ; B. 9·9819 milliemes ; C. 7·7270 milliemes.

Diet No. III.

If the composition of the existing Diet No. III on the wheaten bread basis be examined (*see* Tables II, III, and IV, pages 54, 55, 56) and the result of removing all but 47 or 31·2 grammes of meat be determined, the following figures result :—

	Protein.	Biological Value.	Energy Value.	Cost.
				Milliemes.
(*a*) Existing Diet No. III	96	57·8	3,058	15·413 *
(*b*) „ with 47 grammes meat	82·5	44·3	2,983·5	11·590
(*c*) „ with 31·2 grammes meat	79·5	41·3	2,963·5	10·245

The quantities to be made good to attain the desired value would be :—

	Protein.	Biological Value.	Calories.
(*b*)	7·5	0·7	216·5
(*c*)	10·5	3·7	236·5

1. Taking the lower figure for meat, *i.e.* 31·2 grammes daily, the following figures would result from adding twenty-five dirhems of bread (quarter of a loaf) = 78 grammes, and 18·8 grammes lentils (*i.e.* bringing the diet to the same scale as the No. II with the exception of bread and rice).

* This figure, 15·413 milliemes, is based on the cost of *millet* bread, it being desired to compare the cost of the actual existing diet. The basis of estimation of cost and other factors will be found in Table V, which has been corrected and slightly enlarged from Table III of a former note.

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
C.	79·9	41·3	2,963·5	10·245
78 grammes bread	3·9	1·56	179·4	0·5325
18·8 „ lentils	3·6	2	60·1	0·2092
	87·4	44·88	3,203·0	10·9867

Reduction of cost on present diet = 15·413 – 10·9867 = 4·4263 milliemes.

The diet almost exactly conforms to the scale adopted.

It has the merit of simplicity as the actual alterations in the dietary, with the exception of the extra quarter loaf, are very small.

There are, however, objections to increasing the lentils, especially in summer; the diet is also perhaps somewhat monotonous and difficult to distribute, as regards its nitrogen, over the three meals. It is, however, a diet which might be adopted without any reasonable fear of its being found insufficient; it is, therefore, introduced as the first proposal (No. III [1], Table IV).

2. The following diet would be in some ways more satisfactory, the protein having a higher biological value, there being more fat, in which the above diet is possibly somewhat deficient, and having more variety.

In the place of the extra lentils, cheese is introduced. The following are the essential details:—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
C.	79·9	41·3	2,963·5	10·245
78 grammes bread	3·9	1·56	179·4	0·5325
25 „ cheese	3	3	49·4	0·8
	86·8	45·86	3,192·3	11·5775

The diet would contain four grammes fat more than the first. Reduction in cost = 15·413 — 11·5775 = 3·8355 milliemes.

From the apparent reduction must be deducted in 1 and 2 0·294 milliemes, the difference in the price of 936 grammes wheat and millet bread.

Then No. 1 would effect a reduction of 4·1523 milliemes.

No. 2 „ „ „ „ 3·5615 „

NOTE.—The above figures for the total cost of diet must be reduced by 0·06 milliemes. The price of salt 0·02 and *duqqa* ·077 is not included.

It is suggested that the cheese and extra bread should be given with the early morning meal.

3. In order to introduce more fat and provide a substitute for the cheese there appears to be no reason why *fûl sudâni* (the ground nut, *Arachis Hypogæa*) should not be taken advantage of.

The following would be the details:—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
C.	79·9	41·3	2,963·5	10·245
78 grammes bread	3·9	1·56	179·4	0·5325
25 „ *fûl sudâni*	4·25	2·62	137·7	0·4342
	88·5	45·48	3,280·6	11·2117

Reduction of cost on present diet = 15·413 — (11·2117 + 0·274) = 3·9273 milliemes.

The 25 grammes *fûl sudâni* might be given crude with the morning bread—ten dirhems form roughly a small handful of the unshelled nuts—or experiments might be made as to the possibility of boiling the nuts, mixing with rice and serving them as one of the alternative cooked rations.

It is to be noted that the *fûl sudâni* adds 11·25 grammes of fat to the ration—an important consideration in view of the fact that there is some deficiency of fat. It is probable, however, that it would be unsatisfactory to give this article daily.

4. It is, therefore, suggested that the three diets should be distributed over the week, cheese being given on two mornings, ground nuts on three, and on the other two days on which neither ground nuts nor cheese were given, twenty grammes of onions (or other fresh vegetable) should be eaten with the morning bread.

The cost of twenty grammes of onion would be 0·0681 milliemes. Adding this to suggested No. I Diet the total cost, excluding *duqqa* 0·077 and salt 0·02, would be 11·2683 milliemes.

If the suggestion were adopted :—

No. 1 would be given on 2 days of the week.
No. 2 ,, ,, ,, ,, 2 ,, ,, ,, ,,
No. 3 ,, ,, ,, ,, 3 ,, ,, ,, ,,

The average daily cost of the diet would be 11·4852 milliemes, a reduction of 3·8678 milliemes daily.

If the *duqqa* were discontinued, or given occasionally, it would mean a further slight reduction.

The mean daily composition of the diet is given in Table IV.

Diet No. II.

The problem in this case is different to that in regard to Diet No. III, the value of which it was desired to improve while diminishing the cost.

Diet No. II has to be reduced from an energy value of 3,010 (on a wheaten bread basis) to 2,750.

The value of the diet is as follows :—

Protein.	Biological Value.	Calories.	Cost.
			Milliemes.
82·7	44·2	3,010	10·845 (millet bread basis).

1. If 78 grammes bread and 18·8 grammes lentils be deducted from the diet the following results :—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
Existing Diet No. II (wheaten bread)	82·7	44·2	3,010	10·845
78 grammes bread	3·9	1·56	179·4	0·5325
	78·8	42·64	2,830·6	10·3125
18·8 grammes lentils	3·61	2·01	60	0·2092
	75·19	40·63	2,770·6	10·1033

10·845 − (10·1033 + 0·253) = 0·4887 milliemes reduction.

2. If the meat ration were abolished and the diet left as it is, the composition would be :—

Protein.	Biological. Value.	Calories.
76·7	38·2	2,972

The reduction in cost would be 1·394 miliemes.

Whether this diet would be found too monotonous it is hard to say; it might be made a subject of experiment, an attempt being made to vary the mode of cooking the beans and lentils to a greater extent than at present.

The protein value is almost identical with that of the existing millet bread diet and the energy value somewhat higher.

The diet does not quite reach the protein standard suggested, but the slight deficiency is probably justified by the unnecessary high energy value. The latter could not be reduced without further reducing the protein. The difficulty of giving three-quarters of a loaf of bread would be obviated.

3. The effect of reducing the meat to five dirhems, giving one meal containing meat a week, would be as follows, the bread being reduced as in No. 1 :—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
Existing diet (wheaten bread)	82·7	44·2	3,010	10·845
15·6 grammes meat	3	3	19	0·844
	79·7	41·2	2,991	10·001
78 grammes bread	3·9	1·56	179·4	0·5325
	75·8	39·64	2,811·6	9·4695

10·845 — (9·4695 + 0·253) = 1·1225 milliemes.

There is, in my opinion, no serious objection to this diet; in regard to protein it is better than the existing millet bread diet; its heat value is above the minimum suggested; this is, however, not objectionable. The chief difficulty is the administrative one of distributing to the prisoners three-fourths of a loaf when they have been accustomed to a whole loaf. By altering the size of the loaves to 286 grammes, the three small loaves would be equal to two and three-fourths of the present size.

The diet could be improved by the addition on *alternate* days of twenty-five grammes *fûl sudâni* (No. II 1, Table IV).

NOTE.—The effect of this on the Diet No. III would be that the men would get three and a half loaves instead of three and a quarter; the ration would thus contain 1,001 grammes of bread instead of 1,014, a difference which might be disregarded.

The effect on the suggested diet would be :—

	Protein.	Biological Value.	Calories.	Cost (daily).
				Milliemes.
Suggested diet	75·8	39·64	2,811·6	9·4695
12·5 grammes *fûl sudâni*	2·375	1·31	68·8	0·2171
	78·175	40·95	2,880·4	9·6866
Duqqa				0·077
			Milliemes	9·6096

The advantage of this addition would be in part the increase in protein, in part the increase of 5·5 grammes daily in fat. The reduction in the cost of the diet would be 0·9824 milliemes.

The heat value of the diet is 130 calories in excess of the standard adopted and there is of course no objection to this on dietetic grounds; the addition, however, cannot be regarded as essential.

Failing the suggested improvement, it would be advisable to give* with the morning meal raw onion or other fresh vegetable to the value of 0·085 milliemes (equal to twenty-five grammes of onion). Whether the *duqqa* should be given as well is a question which might be left to the consideration of the responsible authorities; the *duqqa* or some other condiment might be usefully employed in varying the character of the dietary. The cost of the dietary + 0·085 would be 9·5545 milliemes, the reduction in cost being 1·0475 milliemes.

The energy value of the diet would be 61 calories in excess of the 2,750 suggested; in view of the fact that for some classes of work this is not excessive, no further reduction is advised.

* No. II 2. Table IV.

Diet No. I.

The present value of the Diet No. I is as follows on a wheaten bread basis :—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
Existing Diet No. I	70·2	35·4	2,689	8·338

The desired reduction could be effected almost exactly by diminishing the bread ration by 100 grammes. Thus :—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
Existing	70·2	35·4	2,689	8·338
—100 grammes bread	5	2	229·5	0·6827
	65·2	33·4	3,459·5	7·6555

the reduction on the cost being 0·6827 milliemes.

Without, however, baking special loaves for Diet No. I alone, which would probably be difficult to carry out, this would mean distributing two and one-sixth loaves as the bread ration. There would be no great difficulty in cutting a loaf into six equal parts, but as this might be regarded as an objection the following alternative is suggested :—

	Protein.	Biological Value.	Calories.	Cost.
				Milliemes.
Existing	70·2	35·4	2,689	8·338
— ¼ loaf = 78 grammes bread	3·9	1·56	179·4	0·5325
	66·3	33·84	2,509·6	7·8055
— 15·6 grammes rice	1·01	0·936	51·4	0·175
	65·29	32·904	2,558·2	7·6305

giving a reduction of the cost of the diet of 0·6075 milliemes.

It would have been preferable in some respects to have effected a reduction on the beans or lentils this, however, could not have been done without further reducing the protein.

Should it be thought difficult to distribute a quarter loaf—the bread ration being two and a quarter instead of as at present two and a half loaves—the only solution would be that suggested above of reducing the size of the loaves to 286 grammes and distributing two and a half as at present but of the smaller size. If this were done the ration would contain thirteen grammes bread more than suggested, would have a heat value of about thirty calories more, and slightly more protein than in the proposed modifications.

It should be noted that in the provincial prisons where bread is supplied by contract at 9·28 milliemes a kilogramme the reduction in the cost of Diets No. I and No. II would be respectively about 0·2 milliemes more than the amount stated, namely :—

1·3225 milliemes in the case of No. II.

0·9075 „ „ „ „ No. I.

SUGGESTED EXPERIMENTAL DIET No. II.

General Remarks.

In presenting the suggested diets the object has been to provide a regime which could be adopted at once. It is, however, hoped that the necessary information regarding other food materials such as soya bean meal, the residues of arachis oil factories and oatmeal may be obtainable. Sufficient has been said in regard to the addition of the first substance to the diet in the section of the report dealing with the bread ration. The possibility of introducing a purely vegetarian diet has been considered, the basis of which would be soya meal (ten per cent) wheat flour bread.

Diet No. III would contain 1,000 grammes of this bread.
,, No. II ,, ,, 800 ,, ,, ,, ,,
,, No. I ,, ,, 600 ,, ,, ,, ,,

the remainder of the dietary being made up of the present components with a possible addition of oatmeal or oatmeal and millet flour mixed and served boiled as "stirabout" or porridge with the early morning meal.

In regard to the above the following details regarding oatmeal should have been added to the table of food values :—

	Available Protein.	Biological Value.	Fat.	Available Carbo-hydrate.	Heat Value.	Price in Milliemes.	Absorbability of Gross Protein.	Factor for Biological Value.
100 grammes oatmeal ...	12	4·8	7	64	277	1·5 (2*d*. per lb.)	78	$\frac{1}{2{\cdot}5}$

The soya meal bread loaves might be made of such a size that each would weigh 200 grammes ; this would considerably facilitate distribution.

Assuming that twenty-five grammes of oatmeal with or without an equal quantity of millet or maize meal were given as a morning meal, the diet on a vegetarian basis would be cheaper than the dietary suggested. This would very probably also prove to be the case, even though occasional meat meals were given in addition.

The morning porridge could replace the cheese and nuts suggested, in view of the high nitrogen value of the soya meal bread.

I shall be glad to co-operate in the construction of such a dietary if the Committee decide for experimental purposes to get the necessary information and order a sufficiency of the materials.

I give here a table showing the composition of a Diet No. II drawn up on the vegetarian basis.

Experimental No. II Diet. Soya Meal Bread and Oatmeal.

COMPONENTS.	Quantity.	Available Protein.	Biological Value.	Fat.	Carbo-hydrate.	Heat Value.	Cost.
	Grammes.						Milliemes.
Ten per cent soya meal bread...	800	53·6	24	12	356	1,794·4	5·356
Oil	25	—	—	25	—	230	0·844
Rice	50	3·25	3	0·4	38	165	0·5606
Lentils	75	14·5	8·03	1·5	40·4	240	0·834
Beans	75	14·15	7·75	1·5	40·4	239	0·698
Oatmeal	25	3	1·2	1·75	16	94	0·375
Onion	12·5	—	—	—	—	—	0·0425
Vegetables...	100	1	5	—	3	16·5	0·322
Duqqa...	2 days.	—	—	—	—	—	0·022
Salt	12·5	—	—	—	—	—	0·02
	—	89·5	44·48	41·95	493·8	2,778	9·0339

This diet conforms to the standard but cannot be considered very liberal. If instead of 800 grammes bread, 856 (as in suggested Diet No. II) were given, the rice being 31·2 instead of 50, the heat value would be about 2,850 and the cost 9·2115 milliemes.

It might be useful to give more onion or *duqqa* in the diet to allow of more flavouring. This diet ought, however, without any addition, to be sufficient.

There are certain general remarks which may be made.

Some observations made at Tûra by the Governor of the prison show that the bean ration as distributed is most uneven, there being in some cases a difference of more than thirty per cent in the quantity of beans distributed to individual convicts. This is due to the fact that the beans are given with a large amount of liquid, the whole being stirred up and ladled out. It would be preferable to have the beans and liquid in separate vessels and to use a ladle known to hold the correct amount of beans when full.

It is in fact the great objection to the bean ration that as distributed at present it is quite possible for a prisoner to get thirty per cent less than the estimated amount.

The lentil ration is much more satisfactory in this respect, being in the form of a purée easily distributed in equal quantities.

The meat should be minced by a machine sufficiently finely to be distributed with some sort of measuring ladle. At present I feel sure that there are the same irregularities as in the bean ration. A mincing machine would in fact save time, as at present the meat is cut up into cubes by hand.

As regards the oil, here again some measuring contrivance should be adopted. The oil should not be poured into the soup vessel, stirred up and ladled out with the beans and liquid ; it is highly improbable that it is at all evenly distributed.

This question of accurate distribution is of great importance and should be studied with a view to the introduction of a better system than exists at present.

Lastly, the Inspector-General is, I understand, desirous of increasing the morning meal. This should undoubtedly be done. At present the convicts have a fairly heavy meal at 11–12 a.m., another at 6 p.m. At 5.30 a.m. they receive one loaf of bread and some *duqqa*, that is, they go for practically eighteen hours with one loaf. In the suggested diets improvements have been introduced in this direction. It would, however, be more satisfactory if some beans, lentils, or porridge were given. For example, the Egyptians are in the habit of eating *fûl medammis** with the breakfast. This might well be introduced, the midday meal being diminished in amount as is customary in the country. At least half an hour should be allowed for the morning meal; the present arrangement is most unsatisfactory from the dietetic standpoint.

In regard to the dietary arrangements suggestions have not been made ; this should not be difficult. It must, however, be particularly noted that the amount of protein should be as nearly as possible equal on different days.

I have the honour to be,

Sir,

Yours faithfully,

(*Signed*) : W. H. Wilson.

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* Boiled beans mixed with some oil after cooking.

TABLE I.

100 Grammes of Food Materials.	Available Protein.	Biological Value of Protein.	Fat.	Carbo-hydrate Available.	Energy Value in Calories.	Cost in Milliemes per 100 Grammes.	Absorption Coefficient on Basis of Available Protein (estimated)	Coefficient Biological Value of Protein.
Wheaten bread...	5	2	1·5¶	47·5	229·5	0·6827	75	1/2·5
Millet bread*	3·4	1·36	1·5	45	212·5	0·6577	55	1/2·5**
Five per cent soya meal wheat bread	5·8	2·5	1·5¶	45·8	226	0·6760	75·25	1/2·32
Ten per cent soya meal wheat bread	6·7	3	1·5¶	44·5	224·3	0·6695	75·7	1/2·25
Meat (beef)	19	19	4	—	120	5·347	95	1/1
Oil	—	—	100	—	920	3·374	—	—
Rice	6·5	6	0·4	76	330·5	1·122	80	1/1·1
Lentils	19·3	10·7	2	54·8	324	1·113	70	1/1·8
Beans	18·6	10·3	2	54	317·5	0·877	70	1/1·8
Fresh vegetable	1	0·5	—	3	16·5	—	—	—
Cheese	12	12	16	—	197	3·2	95	1/1
Cheese (Maltese) †	12·84	12·84	12·68	—	172·8	5	—	—
Cheese (skim milk) † ...	21	21	1·23	—	—	3	—	—
Dura	7·8	2·3	54	65·5	344·3	0·82	75	1/3·4
Millet ‡	4·45	1·78	2·8	66·5	309·9	0·82	55	1/2·5**
Milk (buffalo) §	5·9	5·9	7·6	4·0	110·7	2	—	—
Soya bean meal	32	17·8	2·1	28·5	269	0·8	80	1/1·8
Dried dates (*'agwa*) ...	1·9	0·9	0·6	47	253	2·44	—	—
Fûl sudâni (shelled) ...	19	10·5	45	16·8	562	1·787	70	1/1·8
Potatoes	1·6	1·27	0·15	20	91·4	0·6	80	1/1·26
Oatmeal	12	4·8	7	64	377	1·5 (?)	78	1/2·5
Wheat...	9·6	3·8	1·7	67·5	325·8	0·933	75	1/2·5
Olives	0·8	0·3	20	5	216	—	—	—
Halawa	1	0·4	25	66	507	—	—	—

TABLE II.

DETAIL.	COMPONENTS.									
	Bread.	Meat.	Oil or Butter.	Rice.	Lentils or Beans in some cases.	Beans.	Onions.	Fresh Vege-tables.	Flour.	Cheese.
A. Old hard labour previous to 1898	936	43·6	12·5	43·6	52	26	12·5	78	—	—
B. Hard labour No. III, in use 1898-1899	832	36·3	58·1	67·4	41·6	41·6	15·6	78	104	Mean Composition.
C. Industrial No. II, in use 1898-1899	790	31·2	41·6	62·4	31·2	31·2	15·6	78	104	
D. No. I, 1898-1899	661	—	265	23·4	46·8	—	15·6	78	62·4	
E. Bread, 1898-1899	780	—	—	—	—	—	—	78	—	—
F. No. III, 1900-1905	936	31·2	37·5	62·4	57·1	37·4	18·7	75	—	—
G. No. II, 1900-1905	780	12·5	31·2	62·4	37·4	37·4	18·7	75	—	—
H. No. I, 1900-1905	624	—	15·6	46·8	37·4	—	12·5	75	—	—
I. Bread, 1900-1905	780	—	—	—	—	—	—	78	—	—
J. No. III, 1905, present ...	936	118·5	25	37·4	56·2	75	12·5	100	—	—
K. No. II	936	31·2	25	31·2	75	75	12·5	100	—	—
L. No. I	780	—	18·7	46·8	75	75	12·5	100	—	—
M. Bread	780	—	—	—	—	—	—	78	—	—

* From analysis by A. Lucas.

† " " Public Health Department Laboratories.

‡ " " McKay, *loc. cit.*

§ " " Kœnig "Chemie der Menschlichen Nahrungs und Genussmitteln," Vol. II.

¶ Numerous analyses of the flour and bread used in Egypt tend to show that the figure for fat, 1·5 per cent, is much in excess of the normal content. The true content would be from 0·5-1 per cent in bread made from better grade flour. The figure 1·5 per cent is from analyses made some years ago of bread made mainly from Egyptian flour comparable to whole-meal flour.

** The biological value of millet protein is taken as being equal to that of wheat protein; there is no experimental evidence on this point. *See* p. 45, foot-note.

TABLE III.

Diet hitherto in Use at Egyptian Prisons, with Suggested Modifications.

DETAILS.	Available Protein.	Biological Value of Protein.	Protein from Animal Sources.	Fat.	Available Carboydrate Gross, less Five per Cent.	Energy Value in Kilo.-calories.
No. III Diet :—						
A. Before 1898...	72·9	37	8·28	29·7	524	2,786
1898-1899	77	39·5	6·89	86	569	3,436
1900-1905	74	37·5	6	56	546	3,056
1905 (wheat bread)... ...	96	57·8	22·5	46	547	3,058
1911 (millet bread)	83	53·34	22·5	46	521	2,987
Suggested A	89·2	45·28	7	48·9	588·3	3,218
No. II, 1898-1899	68·5	34·5	6	56·5	529·5	2,978·5
1900-1905	57·1	25·4	2·5	48	460	2,561
1905 (wheat bread) ...	82·7	44·2	6	43	553	3,010
1911 (millet bread) ...	69·7	38·7	6	43	526	2,844
Suggested B	78·175	40·95	3	47·8	522·7	2,861
No. I, 1898-1899	49	21·5	—	38·5	404	2,216·5
1899-1905	42·8	20	—	28·5	345	1,890
1905 (wheat bread) ...	70·2	35·4	—	37	499	2,680
1911 (millet bread) ...	59·2	31·2	—	37	480	2,556
Suggested C	65·29	32·9	—	36	450·5	2,442
Bread Diet 1898-1914	38	16	—	12	375	1,803
Millet bread Diet 1911	27	11	—	12	354	1,679
For Comparison :—						
McKay's Diet, I (*a*)*	82	36	—	30 (?)	532	2,810
„ „ I (*d*)*	78·5	33·3	—	28 (?)	598·3	3,168

* For same class of prisoners as Egyptian Diet No. III.

Table IV.—Comparison of Existing and New Diets as Recommended.

COMPONENTS.	DIET No. I.				DIET No. II.						DIET No. III.						
	Existing.		Proposed.		Existing.		Proposed.				Existing.		Proposed Alternative Diets.			A. Mean Daily Ration. (1) For two days. (2) For two days. (3) For three days.	
	Amount in Grms.	Cost in Milliemes.	Amount in Grms.	Cost in Milliemes.	Amount in Grms.	Cost in Milliemes.	Alternative Diets. Amount in Grms. 1	2	Mean Daily Ration. 1 and 2 on Alternative Days. Amount in Grms.	Cost in Milliemes.	Amount in Grammes.	Cost in Milliemes.	Amount in Grammes. 1	2	3	Amount in Grms.	Cost in Milliemes.
Bread (wheaten)	780	5·325	702	4·925	—	—	856	856	856	5·8349	—	—	1,014	1,014	1,014	1,014	6·920
Bread (millet)	—	—	—	—	936	6·116	—	—	—	—	936	6·116	—	—	—	—	—
Meat (beef)	—	—	—	—	31·2	1·668	15.6	15·6	15·6	0·834	118·5	6·336	31·2	31·2	31·2	31·2	1·668
Oil	18·7	0·631	18·7	0·631	25	0·844	25	25	25	0·844	25	0·844	25	25	25	25	0·844
Rice	46·8	0·525	31·2	0·350	31·2	0·350	31·2	31·2	31·2	0·350	37·4	0·409	37·4	37·4	37·4	37·4	0·409
Lentils	75	0·834	75	0·834	75	0·834	75	75	75	0·834	56·2	0·625	75	56·2	56·2	61·6	0·6856
Beans	75	0·658	75	0·658	75	0·658	75	75	75	0·658	75	0·658	75	75	75	75	0·658
Onion	12.5	0·0425	12·5	0·0425	12·5	0·0425	12·5	32·5	21	0·068	12·5	0·0423	37·5	12·5	12·5	19·6	0·0585
Fresh vegetables	100	0·322	100	0·322	100	0·322	100	100	100	0·322	100	0·322	100	100	100	100	0·322
Fûl sudâni ... ... (*Arachis Hypogæa*).	—	—	—	—	—	—	25	—	12·5	0·217	—	—	—	—	25	10·7	0·1912
Cheese	—	—	—	—	—	—	—	—	—	—	—	—	—	25	—	7·1	0·2272
Duqqa	—	0·077	—	0·077	—	0·077	—	—	—	0·038	—	0·077	—	—	—	—	0·022
Salt	12·5	0·02	12·5	0·02	12·5	0·02	12·5	12·5	12·5	0·02	12·5	0·02	12·5	12·5	12·5	12·5	0·02
Cost with *duqqa*	—	8·4345	—	7·8595	—	10·9315	—	—	—	10·0399	—	15·4493	—	—	—	—	12·0255
Cost without *duqqa*	—	—	—	7·7825	—	—	—	—	—	10·0019	—	15·3725	—	—	—	—	12·0035

TABLE V.—Effect of Replacing Millet Bread by Wheaten Bread, with no Other Alteration.

DETAILS.	Protein.	Fat.	Carbo-Hydrate.	Heat Value.	Biological Value of Protein. Relation to Minimum.*
Existing bread diet	27	12	354	1,644	11 — 19
Ditto wheaten bread	38	12	373	1,766	16 — 14
No. I diet	56	37	480	2,495	29·3 — 0·7
No. I wheaten bread	67	37	499	2,616	33·7 + 3·7
No. II existing	66·6	43	526	2,784	36·9 + 6·9
No. II wheaten	79·6	43	553	2,945	42·3 + 12·3
No. III existing	80·6	46	521	2,851	51·9 + 21·9
No. III wheaten	93·6	46	547	3,010	56·3 + 26·3

In this table millet (*Sorghum vulgare*) is given the available protein value of 55 per cent; wheaten bread protein is assumed to be available to the extent of 75 per cent, the value given by Rubner for medium quality wheaten bread; Atwater's figures are considerably higher, and if we assume that 81 per cent of the protein is available, the figures would be as follows:—

DETAILS.	Protein.	Fat.	Carbo-Hydrate.	Heat Value.
Bread diet	42	12	373	1,783
No. I	71	37	499	2,633
No. II	83·2	43	553	2,959
No. III	96·8	46	547	3,024

Compare with Dr. Kirton's diets (*see* above).

TABLE VI.—Results of Analyses.

Number.	SAMPLE.	N × 6·25 Protein.	Gluten.	Fat.	Carbo hydrate.	Ash.	Fibre.	Water.	ANALYST.
		%	%	%	%	%	%	%	
1	Wheat bread (Minia)	6·75	—	—	—	—	—	35·6	Lucas.
2	" " (Shibin el Kôm).	7·25	—	—	—	—	—	38·8	"
3	" " (Tûra)	5·44	—	—	—	—	—	50·0	"
4	" " (Hospital)... ...	5·56	—	0·48	—	2·29	0·54	35·6	Pappel.
5	Millet bread (Tûra)	5·92	—	—	—	—	—	42·5	Lucas.
6	" " (Manshia)... ...	6·69	—	—	—	—	—	31·8	"
7	" "	6·19	—	1·53	—	2·40	0·80	41·9	Pappel.
8	Wheat flour (Lower Egypt)...	— —	9·4 13·9	— —	— —	— —	— —	— —	Lucas, 6 samples.
9	" " (Upper Egypt)...	—	10·6	—	—	—	—	—	" 1 sample.
10	" " (Russian)	— —	8·8 13·6	— —	— —	— —	— —	— —	" 7 samples.
11	" " (Egyptian) ...	— —	5·8 15·2	— —	— —	— —	— —	— —	" 8 "
12	" " (Indian)	— —	12·3 13·2	— —	— —	— —	— —	— —	" 2 "
13	" " (Tûra)	7·83	—	—	—	—	—	8·3	"
14	Millet flour (Tûra)	9·12	—	—	—	—	—	9·0	"
15	Wheat " (French)	—	17·0	—	—	—	—	—	"
16	Flour	10·12	10·3	—	—	0·71	—	13·1	Pappel.
17	"	11·75	13·0	—	—	0·47	—	12·0	"
18	"	11·93	12·7	—	—	0·47	—	12·3	"
19	" (Russian)	10·68	10·8	—	—	0·60	—	13·3	"
20	"	10·25	10·3	—	—	0·86	—	11·8	"
21	"	10·31	10·6	—	—	0·84	—	11·6	"
22	"	11·62	12·1	—	—	0·50	—	11·8	"
23	"	11·87	12·6	—	—	0·57	—	12·1	"
24	" (Egyptian)	9·62	9·5	—	—	0·68	—	13·2	"
25	" (Russian)	10·25	10·1	—	—	0·60	—	13·4	"
26	" "	10·18	10·2	—	—	0·58	—	13·4	"
	" (Soya bean)	40·48	—	2·1	—	5·3	—	10·1	Lucas.
	Lentils (Egyptian)	27·6	—	1·00	58·2	3·1	4·5	5·5	Beam.
	Beans	26·6	—	—	—	—	—	—	Lucas.

* Minimum biological value of protein should be 30 grammes, *v.* page 41, 3.

APPENDIX VII.

MEMORANDUM.

It has been found that certain inconveniences would result from confining the proposed experiment in prison diets to the months of June, July, and August, and that it would be desirable to have experience of the effect of placing prisoners on the diets proposed during other than the hottest months of the year.

Three alternative schemes have been proposed of which details are given below.

The question will be discussed at the meeting called for Tuesday next, May 11.

A.—*Present Scheme.*

Selection of convicts and filling in of details from prisons register by prison authorities before May 15.

May 15 to May 31—Preliminary medical examination.

June 1—Feeding three different diets commenced.

June 1 to August 31—Fortnightly medical examinations.

September 1 to September 15—Ultimate medical examinations.

Extra prison staff required from May 15 to September 15; experimental staff (medical and clerical) May 15 to September 15.

I am informed that the extra prison staff will cost L.E. 55 per month.

Cost for four months of extra prison staff		L.E. 220
Experimental staff.—Medical assistant at	L.E. 20	
Second medical assistant at	15	
Clerk	8	
Travelling expenses	6	
	49	
For four months		196
Total		L.E. 416

B.—*Scheme postponed till Autumn.*

Selection of convicts and filling in of details to be ready by September 25, 1915.

September 25 to October 7—Preliminary medical examination.

October 7 to January 7—Feeding experiment with fortnightly medical examinations.

January 7 to January 21—Ultimate medical examination.

Staff and expenditure as in A.

A report on results would be available early in February.

C.—*Extended Period. Modified Scheme of Experiment.*

Selection of convicts and filling in of details by May 15.

May 15 to June 1—Preliminary medical examination.

June 1—Feeding commenced; continued till December 1.

June 1 to June 30—Fortnightly examinations as laid down.

July 1 to October 15—Fortnightly examination to consist of weighing with one measurement, *e.g.* biceps, and noting of any change in conditions, one medical assistant being retained for this work. In my absence Dr. Kirton, or in his absence some other medical man shall be designated to whom reference could, if necessary, be made.

October 15 to November 30—Fortnightly examinations, full (the full assistant staff being required).

December 1 to December 15—Ultimate medical examination.

This report would be available early in January.

	L.E.
C. would involve extra prison staff for seven months at L.E. 55	385·00
May 15 to June 30, October 15 to December 15, full medical staff, three and a half months, at L.E. 49	171·50
July 1 to October 15. One assistant, with travelling expenses, three and a half months, at L.E. 23	80·50
Total	637·00

May 8, 1915.

CONDITIONS TO BE FULFILLED IN PROPOSED EXPERIMENTS.

THE PRESIDENT OF THE COMMITTEE ON PRISON DIETS.

SIR,

Dr. Kirton and I have considered the conditions required in such an experiment as that proposed. They are as follows :—

1. The experiment should be made on three groups of prisoners, each group to contain not less than fifty individuals.

2. After the selection of 150 convicts, the duration of whose imprisonment previous to the date, at which the experiments will commence, should in no case exceed four years or be less than two months, the whole group should be divided up on the basis of the information detailed below.

NOTE.—In making the selection it would be as well to include examples of all classes of prisoners (*fellahin*, professional, etc.) found among the prison population.

Information required :—

(*a*) Duration of imprisonment up to present date.
(*b*) Type of labour on which the man is at present engaged.
(*c*) Has the convict previous experience of quarry work ?
(*d*) Has he been on the sick list ; if so, how often ?
(*e*) Is he known to suffer from any disease ; if so, what ?
(*f*) Type of employment before conviction.
(*g*) Age.
(*h*) Weight.
(*i*) Height.
(*j*) Percentage of hæmoglobin.
(*k*) Presence of bilharzia.
(*l*). Presence of ankylostomiasis.
(*m*) Presence of albuminuria.
(*n*) Presence of glycosuria.
(*o*) Condition of lungs.
(*p*) Condition of heart.

The details *a, b, c, d, e, f*, would be supplied by the prison authorities.

The details *g. h, i, j, k, l, m, n, o, p*, would be filled in on a form by the medical man appointed to conduct the experiment. This preliminary examination is essential. It would probably not be possible to examine more than fifteen men daily, the examination would, therefore, take ten days. The details would be returned to Dr. Kirton and myself. The three groups of fifty would then be made up in such a manner that each group would contain equal numbers of similar types of individuals.

3. The men should all be engaged if possible on the same class of labour in the quarries. If this were not possible, an equal number of men from each group should be put on some other class of labour.

For example, supposing it were impossible to find continuous work in carrying stone from the quarry to the surface for more than 120 men, ten men from each group should then be put on some other class of labour, as for example, loading stone into trucks.

4. During the course of the experiment, which should continue for not less than three months, each convict should be examined once every fourteen days. This allows ten days during each fortnight on which examinations would be made, fifteen men being examined on each day. This would involve fifteen men being kept off work during the morning, Thursdays excluded, as the examination of men on Thursdays would involve these men having no work on that day. If there are no reasons to the contrary, one batch of men will be examined on Friday morning, Saturday being excluded, as it is thought that the complete day's rest on Friday would remove the effects which might be due to fatigue. Batches of men of fifteen each would therefore be examined on Sunday, Monday, Tuesday, Wednesday, and Friday, the same batch being examined on the corresponding day in each fortnight.

The details of the fortnightly examination would be as follows:—

(*a*) Weight.

(*b*) Chest measurement at level of nipples, the arms hanging at the sides during normal breathing.

(*c*) Circumference of calf three inches below lower edge of patella or at the largest part; the man standing with the heels five inches apart.

(*d*) Pulse rate and character of pulse.

(*e*) Ergograph tracing.

(*f*) General appearance.

It is estimated that such an examination would take fifteen to twenty minutes; with practice possibly less. The results would be entered up in a rough notebook and copied afterwards into a register kept for the purpose.

5. It would be essential that there should be no intermission in the work during the duration of the experiment.

6. A man off duty from accident or sickness for more than ten days at one period would be excluded from further participation in the experiment, as also would any man the state of whose health appeared to make his further participation unsatisfactory in the opinion of the persons conducting the experiment.

7. A prisoner included in the 150 who reports himself sick or suffers an accident should be seen by the medical man conducting the experiment in conjunction with the prison doctor and the question as to whether he is or is not fit to work should be decided by them conjointly.

8. The medical man conducting the experiment should from time to time be present at the issuing and distribution of the rations and should occasionally check the quantities issued to individuals.

9. The medical man conducting the experiment would be occasionally required to collect and examine urine or other material from selected cases.

It is clear from the above that anyone appointed to conduct this experiment would have to devote his whole time to the work, and both Dr. Kirton and I are of opinion that he should live at Tûra or wherever the experiment is carried out. We both consider that in some ways it would be more satisfactory to get the services of a competent Englishman, but that failing this it would be possible to find an Egyptian qualified, with supervision, to conduct the experiment.

The proposed diet sheets will be forwarded as soon as possible; it is, however, not possible to make a final selection of the appropriate diets until the present prices of the commodities involved have been obtained.

Yours faithfully,
(*Signed*): W. H. Wilson.

Note.—The groups are restricted to fifty, as it was thought that this number would probably be sufficient and that it would be difficult for one investigator to deal with more than 150 individuals. It would probably be advantageous to extend the number to 100 in each group; the results obtained from the larger number would be undoubtedly more conclusive. This would imply the employment of an assistant to the medical man conducting the experiment; the assistant should also have had a medical training, although the latter point is open to discussion.

In mentioning three months it is understood that if conclusive results are not visible in that time the arrangements made should permit of the extension of the period for a further three months.—W. H. Wilson.

DIETS TO BE MADE USE OF IN THE PROPOSED DIETETIC EXPERIMENT.

The President, Prison Diets Committee.

Sir,

I send herewith the detailed composition of the three diets in question, A, B, and C.

A is the existing Diet No. III, the bread being made of millet flour.

B is the diet suggested in my memorandum, containing a smaller amount of meat than does the existing Diet No. III.

C is the proposed diet contain no meat.

B and C containing wheat bread and not millet bread.

It will be seen that in spite of the high energy value as compared with A and B, the biological value of the protein in C does not reach the standard adopted in the memorandum referred to. To reach the figure 45, it would be necessary to add considerably to the leguminous elements of the dietary or to add a further fifty grammes of rice daily; the heat value of the diet would be raised to about 3,500, but the food would be objectionable owing to its excessive bulk. It has, therefore, been thought better to be contented with a biological value of 42 for the purposes of the experiment.

It has been suggested that in view of the low price of millet it might be advisable to replace the wheat bread in the experimental diets B and C by millet bread.

A saving could be effected on this head of 1·65 milliemes. Owing, however, to the low value of millet protein, it would be necessary to add twenty-five grammes of beans, ten grammes of lentils and twenty grammes of rice, the cost of which would be 0·894 milliemes. The balance would be a saving of 0·7589 milliemes. The diet would probably be unsatisfactory owing to the objectionably large quantities of beans and lentils.

I have introduced for comparison a diet sheet in which ten per cent of soya meal is added to the bread. It is obvious from the amount of protein, the biological value and the cost that this addition would produce a diet having great advantages as compared with those proposed.

I am, Sir,

Yours faithfully,

(*Signed*): W. H. Wilson.

Note.—The figures given represent the mean daily amounts of the various components. The daily distribution and the distribution of these components into meals will be carried out on very much the same lines as those adopted for the existing diet. This distribution will, however, require careful study and may entail some alteration in the diet sheets; such alteration will, however, consist mainly in a re-adjustment of the quantities of different components and is not likely to lead to any addition either in quantity or cost.

Mean Daily Composition of Proposed Diets.

COMPONENTS.	Existing No. III.		Proposed Small Meat.		Proposed No Meat.	
	Amount in Grammes.	Cost in Milliemes.	Amount in Grammes.	Cost in Milliemes.	Amount in Grammes.	Cost in Milliemes.
Bread (wheaten) ...	—	—	1014	7·52	1014	7·52
„ (millet) ...	936	5·42	—	—	—	—
Meat ...	118·5	6·336	31·2	1·668	—	—
Oil ...	25	0·844	25	0·844	25	0·844
Rice...	37·4	0·409	37·4	0·409	50	0·5606
Lentils ...	56·2	0·625	61·6	0·6856	75	0·835
Beans ...	75	0·658	75	0·658	75	0·658
Wheat ...	—	—	—	—	14·2	0·143
Onion ...	12·5	0·0425	12·5	0·0425	12·5	0·0425
Fresh vegetables ...	100	0·322	100	0·322	100	0·322
Fûl sudâni ...	—	—	10·7	0·1616	10·7	0·1816
Cheese ...	—	—	7·1	0·342	7·1	0·342
Duqqa ...	—	0·02	—	—	—	—
Salt ...	12·5	0·02	15	0·024	15	0·024
		14·6965		12·6989		11·4727

Comparison of Proposed and Existing Diets.

DIET No. III. MEAN DAILY.		Protein. Amount.	Protein. Biological Value.	Heat Value.	Cost.
Existing No. 3 Diet	A.	82·6	51·69	2,923·3	14·6989
Proposed containing a small amount of meat	B.	88·81	45·26	3,241·9	12·6967
Proposed no meat	C.	87·73	42·08	3,339	11·4727

	Amount in grammes.	Protein (available).	Biological Value of Protein.	Fat.	Carbo-hydrate.	Heat Value in Kilo. Calories.	Cost in Milliemes.
A.							
Millet bread	936	31·8	12·73	14	421·2	1,989	5·42
Meat	118·5	22·5	22·5	4·74	—	142·5	6·336
Oil	25	—	—	25	—	230	0·844
Rice	37·4	2·5	2·24	0·14	28·4	125·3	0·409
Lentils	56·2	10·8	6	1·12	30·3	182	0·6254
Beans	75	14	7·72	1·5	40·5	238	0·658
Onion	12·5	—	—	—	—	—	0·0425
Fresh vegetables	100	1	0·5	—	3	16·5	0·322
Duqqa...	—	—	—	—	—	—	0·022
Salt	12·5	—	—	—	—	—	0·02
	—	82·6	51·69	46·5	523·4	2,923·3	14·6989
B.							
Wheat bread	1,014	50·7	20·28	15·2	481·6	2,327	7·52
Meat	31·2	5·9	5·9	1·25	—	36·4	1·668
Oil	25	—	—	25	—	230	0·844
Rice	37·4	2·5	2·24	0·14	28·4	125·3	0·409
Lentils	61·6	11·8	6·59	1·23	33·2	196·5	0·6856
Beans	75	14	7·72	1·5	40·5	238	0·658
Onion	12·5	—	—	—	—	—	0·0425
Fresh vegetables	100	1	0·5	—	3	16·5	0·322
Ful sudâni	10·7	2	1·12	4·8	1	60	0·1816
Cheese	7·1	0·91	0·91	0·9	—	12·26	0·342
Salt	15	—	—	—	—	—	0·024
	—	88·81	45·26	50·02	588·5	3,241·96	12·6963

	Amount in grammes.	Protein.	Biological Value of Protein.	Fat.	Carbo-hydrate.	Heat Value in Kilo. Calories.	Cost in Milliemes.
C.							
Wheat bread	1,014	50·7	20·28	15·2	481·6	2,327	7·52
Oil	25	—	—	25	—	230	0·844
Rice	50	3·25	3	—	38	166	0·5606
Lentils	75	14·5	8	1·5	40·5	243	0·835
Beans	75	14	7·72	1·5	40·5	238	0·658
Wheat...	14·3	1·37	0·55	0·24	9·65	46·6	0·143
Onions	12·5	—	—	—	—	—	0·0425
Fresh vegetables	100	1	0·5	—	3	16·5	0·322
Fúl sudáni	10·7	2	1·12	4·8	1·8	60	0·1816
Cheese	7·1	0·91	0·91	0·9	—	12·26	0·342
Salt	15	—	—	—	—	—	0·024
	—	87·73	42·08	48·62	615·05	3,339·36	11·4747

Diet containing Ten per Cent Soya Meal Wheat Bread.
Introduced for Comparison.

	Amount in grammes.	Protein.	Biological Value of Protein.	Fat.	Carbo-hydrate.	Heat Value in Kilo. Calories.	Cost in Milliemes.
Ten per cent soya meal bread ...	1,000	67	30	15	445	2,240	7·3
Oil	25	—	—	25	—	230	0·844
Rice	50	3·25	3	0·2	38	166	0·5606
Lentils	75	14·5	8	1·5	40·5	243	0·834
Beans	75	14	7·75	1·5	40	238	0·658
Wheat...	14·3	1·37	0·55	0·24	9·65	46·6	0·143
Fúl sudáni	0.7	2	1·12	4·8	1·8	60	0·1816
Onions	2.5	—	—	—	—	—	—
Fresh vegetables	100	1	0·5	—	3	16.5	0·322
Salt	15	—	—	—	—	—	0·024
	—	103·12	50·92	48·24	578·45	3,240·1	10·8673

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