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Once again, I have tried to maintain the typography, if not the overall format, since the original was in two-column medical journal format, and in a font that I am not familiar with. But this is pretty close.

FEEDING THE GERMAN ARMY

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IN RECENT reports the great efficiency of the German Army has been ascribed not only to its excellent arms and the best of training but also to use of special methods of nutrition. It is important to know what parts of such reports are propaganda and what are the facts. It is the purpose of this paper to describe the nutrition of the German Army and the general directions in which it is further being developed. As a great deal of ground must of necessity be covered, one cannot go into many details or show many of the practical aspects involved.

The science of nutrition had progressed at a rapid pace when the new German government began with the upbuilding of its conscripted army. A host of special problems ap. peared and were promptly submitted to the leading physicians. Special institutions for their study were established, while schools and oourses were set up to distribute the new knQwtedge. In order to avoid costly mass experiments, physicians acted with extreme caution in the introduction of new methods.

Physical conditions in the new German Army were far less rosy than propaganda would have liked them to appear. Reports in the medicomilitary and medical literature show that even of the most carefully selected men of the Luftwaffe 20 per cent suffered from C hypovitaminosis; army physicians found great difficulties in combating pyorrhea and other dental diseases by means of artificial vitamin C and yeast concentrates.[1] Also, among the powerfully built marines Kruttke[2] found many cases of vitamin C deficiency with gingivitis and paradentosis. In a more complete summary Rietschel[5] explains that scurvy and stomatitis with paradentosis are different diseases, confirming the earlier studies of Salle, Tobler, and others.

In addition, two types of illness are especially in evidence: constipation and the nervous soldier-heart, approximately the same manifestations as in neurocirculatory asthenia[3].

At the examinations for military services in Kiel in 1934, the number of perfect specimens at 12.6 per cent was frightfully low,[4] considering that that district is among the healthiest of the country. As a result the requirements for fitness had to be somewhat reduced below the usual standards. Even then only 55 per cent of those examined in Kiel were accepted for service in 1935.[6]

This human material, physically and nervously even below the average of former years, now had to he strengthened with all available means; increased efficiency was demanded, even new records of performance.

Theory and Practice

The nutrition of the German soldier is based on the requirements of a manual laborer with about 3,500 to 4,000 calories. According to Tyszka, the American laborer requires 2,800 to 3,000 calories. Poty reports that the American soldier receives 3,500 calories in wartime.

The theoretically calculated average consumption for the recruit is 3,800 calories and that of the man in the field, 4,100. But ‘not the quantity of the food must be evaluated, but its quality and specific effect.’ [8a] There is a clear recognition of the fact that calorie values are useful only for academic calculations. Motorized soldiers require fewer calories than infantry. On the other hand, unless he is well nourished the motorized soldier easily becomes nervous sometimes even to the point of psychosis.[7] For this reason a good and abundant early breakfast is required, especially when traveling, consisting of strong coffee with much sugar and buttered sandwiches with sausages and eggs. Exhausted troops lacking appetite must undergo cold ablutions in the early morning to stimulate the desire to eat.

The ‘change to the vegetarian side’[8b] has become a leading motive, thought to be important not only for increasing efficiency but also for the defense against diseases and their cure. Dattner[9] noticed improvements and cure of neurotic and depressive conditions through a vegetarian diet. The relationship of animal to vegetable food is 18 to 24 per cent animal to 76 to 82 per cent vegetable, though this relationship fluctuates with different types of troops as well as with soldiers from different parts of the country.

The consumption of animal proteins always remains below the calculated maximum figures. 'Food richer in protein is necessary in proportion as work performance and the speed of work are increased and more elasticity, activity, and readiness for battle are required' (so-called 'schnellkraftleistung'); on the other hand, 'the long distance runner can rather get along with carbohydrates' (so-called 'dauerbeanspruchungen'). According to German calculations one-third of the total protein intake should be of animal origin, the theoretically calculated fluctuations being between 17 to 40 per cent. In reality, however, this proportion amounts to only 17 to 25 per cent for the various types of troops.

The total protein intake should not fall below 28 Gm. or 0.4 Gm. protein per kilogram of body weight. Experiments with higher protein values showed no improvement over the weight curves of these low-protein values.[8e]

Especial care is taken that milk and its staple products, such as all sorts of hard and soft cheeses including pot cheese, are used in increasing amounts.[8d] On the march, milk powder is preferred, for it keeps for eight months or even ten months if made of skimmed milk. The diet is considerably enriched by means of vegetable proteins, bread and potatoes constituting the main sources. The relationship of protein to carbohydrates is 1:10; that of fat to carbohydrates, 1:3.

According to the science of nutrition the daily requirement of fat is 50 to 70 Gm., with a minimum of 56 to 58 Gm. The daily average requirement for a soldier is calculated at 80 Gm. It is supplied as follows: 35 per cent from butter; 50 per cent from fat contained in meats, cheeses, cream, and sauces; and 15% from margarine and other cooking fats.[8e]

While the body can build fats synthetically, it has been shown by Stepp and others that it should not be long without the vitamins contained in milk and fats. The best fat is, of course, fresh butter with 0.4 to 20 vitamin D and 2 to 20 mg. carotene.

Carbohydrates with 627 Gm. (about 2,570 calories) daily average are the most important source of energy. The main sources are bread,[9] potatoes,[10] vegetables, fruits, legumes, and sugar. Bread alone supplies about 40 per cent of the carbohydrate calories.

Bread, therefore, remained an important nutritional problem for the German Army.[10] After much thorough study it was decided to retain the old-fashioned 'kommissbrot,' made of coarse whole rye, containing all parts of the grain except the outer hull. Hindhede and, more recently, Bickel and Heupke have ascertained that the human digestive tract may be accustomed, like that of animals, to absorb up to 75 percent of the protein contained in the bran. The recruit gets 750 Gm. of kommissbrot daily and, in addition—at least in the beginning—Swedish type of hard tack or graham bread. Kommissbrot contains all of the vitamins B_1 and E found in the grain, and no vitamins are artificially added to it. Scheunert found that flour containing 94 per cent of the grain still had all of the vitamin B_1 of the whole grain.[10] In white bread the vitamins are no longer in evidence, and the addition of bran to the white flour does not give the equivalent of a real whole grain bread.

The daily carbohydrate metabolism consumes a certain amount of vitamin B_1. With hard muscular work and increased metabolism the daily requirement of B_1 exceeds the normal consumption rate of 1 to 2 mg. For increased efficiency the soldier must, therefore, have a greater supply, but even this is easily furnished by a liberal consumption of kommissbrot.

The daily consumption of potatoes for the recruit is 1,000 Gm. and for the older soldier 800 Gm.[8f] This corresponds to 900 and 720 calories, respectively. It is the soldier's most important source of vitamin C, though much of that vitamin is lost during winter storage. In fact, the Germans have now begun breeding a special sort of potato which permits only the smallest possible storage loss of vitamin C. Cooking and steaming, of course, also reduce the vitamin C content. Steaming them in their jackets accounts for the smallest mineral loss; cooking them peeled, the greatest (up to 50 per cent when boiled in salted water). There is a loss of up to 100 per cent when peeled potatoes are exposed to the oxygen of the air.
Fresh vegetables are given in great quantities. Here the main problem is to prevent 'killing by cooking' and to make sure of the preservation of all mineral salts.[11,13] For mass consumption it has been as yet impossible to cook vegetables in their own juices (without the addition of water or steam). Experiments with certain short cooking processes have produced no practical results. It is emphasized that such strongly water-soluble substances as mineral salts and some vitamins (B_1 and C) can hardly be protected

during the cooking process and are dissolved in the cooking water. For this reason all of the cooking water of vegetables and potatoes must be used again for soups, sauces, etc., so that their contents of mineral salts will not be lost.[13] One is well aware of the fact that it is difficult to restore a deficiency of mineral salts in the body cells, though this is certainly possible even though it requires time, since various poisons must first be eliminated from the cells. In this connection the literature on transmineralization seems to have been of great interest.[12] As to canned and salted vegetables, the consensus is that 'vegetables salted for the purpose of preserving can hardly any longer be considered carriers of vitamins.'[8g]

Summary and Conclusion

A. The emphasis is on potatoes prepared in many varieties, kommissbrot, cheese, milk, sour milk, rice, legumes, oat and barley products, flour and pastries, and vegetables and fruits of all sorts, the latter also preserved and cooked with sugar.

B. Meat is quantitatively, as well as with respect to its importance, in a secondary position.[14] Such parts as heart, liver, kidneys, and lungs are much used. Since the army gets foods without restriction, this lessened consumption of meat is not due to a shortage of meat or to any other economic necessity, but it is solely an important result of the newer knowledge of the science of nutrition. In fact, it was a difficult task to get the soldiers used to this new regimen.

C. Aromatic vegetables, such as fresh onions, tomato pulp, and other domestic products, are abundantly used—also liberal quantities of dried vegetables and fruits and many fresh salads, raw and mixed with cooked vegetables.

D. The consumption of spices is kept as low as possible; little salt and pepper are used in order not to replace the original taste of foods by a general and uncertain flavor. Especially recommended is the consumption of yeast extract, soybeans, and dried vegetables and vegetable powders.

The advantages of dried vegetables and of vegetable powders are so important that they deserve the following brief summary:

1. They are condensed in a relationship of 10:1—that is, 100 pounds of fresh vegetables are reduced to 10 pounds of dried.
2. They are ready to be cooked, absolutely clean, and without any waste.
3. They cook in one-half to two hours. Cabbage, spinach, and green beans are cooked in thirty to thirty-five minutes. Mixtures containing potatoes take longer.
4. All of the vital food elements are preserved. [(?) the author.]
5. They are considerably cheaper than canned foods.
6. Their transportation costs are much lower.
7. There is a considerable saving of time spent in preparation. For instance, in order to prepare fresh vegetables for 5,000 men, cleaning women have to begin work twenty-four hours in advance. This necessitates keeping the vegetables and potatoes thus cleaned in water until cooking time, with a consequent loss of vitamins and mineral salts.
8. There is a considerable saving in space: 1 cubic meter of dried and pressed vegetables is enough for serving 25,000 to 30,000 portions.[8h]
9. Ease of transportation (this might be particularly valuable if America were to assume the burden of feeding certain parts of Europe).
10. No bacterial contaminations—especially important where troops have no access to fresh, clean foods.
11. Dried vegetables and vegetable powders taste good.

The German military authorities seem to realize that much improvement is still possible and to this end certain general principles have been laid down.[8i]

a. The consumption of meat and meat products must not be increased.[13]

b. The consumption of fish should be increased,[15a] partly for reasons of national economy. At present the consumption of fish is about one-fifth of that of meat.[14]

c. There should be a more abundant consumption of milk and milk products.

d. The consumption of bread and potatoes should be increased.

e. Likewise, there should be increased consumption of vegetables and fruits.

It follows that the German army 'intends to fully exploit to the utmost such sources of food as are not yet fully used, and to change the nutrition as a whole still more to the vegetarian side.'[8j] In order to improve the preparation of foods so as to make them more to the liking of the soldiers, the waste contained in garbage cans is carefully scrutinized every day. The garbage can has thus become a valuable guide and great teacher in perfecting the daily menu.

The question of vitamins assumes a position of pre-eminent importance in relation to the problem of increasing efficiency. Since increased efficiency is predicated on increased metabolism and oxidation, the consequent consumption of increased quantities of vitamins must be insured.[8k] Rietschel's suggestion of preferring natural vitamins is accepted as far as possible. In enriching the diet with natural vitamins the relationship in which these vitamins occur in nature must be chosen, for vitamin tables and the results of studies of vitamin metabolism are still too uncertain.[16] The addition of artificial vitamins to fresh or preserved foodstuffs is rejected. Rejected likewise is that the field kitchen be supplied with an assortment of vitamin concentrates. The Swiss army has experimented with an artificial vitamin preparation (Guigoz 3 consisting of vitamins C and B, mineral salts and iron, dried yeast 10 per cent, and glutathione). The results have been poor.[15b] Dalldorf's statement, 'A dollar will buy more vitamins in the market than in the drugstore,'[15c] may be considered the Leitmotiv in solving the vitamin problem for the German army.

As everywhere in the living body, so in its relationship to vitamins harmony must exist; vitamins must be in their proper relationship to each other as well as to the hormones[17] and mineral salts.[16]. If this factor is overlooked, the water-soluble vitamins C and B may act against the fat-soluble A and E. For instance, to restore balance, A hypervitaminosis may be compensated by an increase of the B and C reserves. Finally, even A and B may act against each other. The interpretation of clinical reports becomes increasingly difficult because lack of vitamin D in the diet may create similar phenomena as an excess of A. In 1936 an American radio lecturer induced mothers to give their children more codliver oil. But with vitamin D these children also received too great a dose of vitamin A, and thus experimental scurvy was produced despite the fact that these children had an abundant supply of orange juice. The lesson was that excessive doses of vitamin A suppress the function of vitamin C.

In German experiments with artificial vitamin C tablets (Redozon tablets) increased sport performances could be obtained by girl students without damage, but only temporarily. Ragnar Berg was the first to emphasize that the effectiveness of vitamins depends on a surplus of alkali foods.[13] I found in my own studies that the replenishment of the mineral metabolism with the potassium group is a prerequisite for the vitamin replenishment and consequent increased efficiency of the cells.[12] This has become a basic principle of nutrition which is now being practically carried out by way of increased consumption of vegetables and fruits, of whole grain bread, and in the utilization of the cooking waters of vegetables, potatoes, etc.

The German authorities have only reluctantly developed special diets intended to accomplish special physical and technical performances. The following brief summary emphasizes only certain characteristic features:

1. Recruits receive, in general, an excess quantity of foods; even so, 70 per cent of them lose weight during the first half year because of the unaccustomed physical requirements.

2. Members of the air corps get preference in everything.

3. The troops in the field receive the largest quantities of everything, but infantry on the march gets almost as much.

4. A special preparation of fruit and grape sugar, powdered meat, fat, milk protein, vitamins of vegetable origin, and fruit essence is given to overcome dryness of the throat and thirst.

5. Most troops carry with them a lemon powder to improve the drinking water—5 Gm. being sufficient for 1 pint of water.

6. Motorized troops receive more refreshments, such as lemonade, and smaller quantities of food at more frequent intervals. They also get more frequent rest periods.[8l]

7. Soldiers in forts and below the surface get food especially rich in vitamin D, such as smoked fish, sea fish, butter, eggs, fat cheeses, milk, yeast extracts, etc.

8. Soldiers in submarines and fortified positions receive foods that are especial1y durable and take little space, such as vegetable and potato powder, milk powder, and vitamin D supplements as under No.7.

9. Parachutists get liver sausages, Swedish-type hardtack, and vitamin C tablets.

10. Troops serving in the tropics, especially, get many fruit preserves frozen at low temperatures[18] and milk powder.

11. Troops serving in the arctic receive (following Friedjoff Nansen) a mixture of meat and vegetable powders, milk powders, and dried pressed fruits.

The problem of increasing the performance of the soldiers is, however, a complex one, necessitating the solution of numerous special problems. Included among these are the physiologic principles of fatigue and recuperation. Meyerhoff-Hill's point of view that the lactic acid contents of the muscles correspond to the degree of fatigue and that general fatigue is due to increasing acid content in the blood has been generally retained. However, during the last ten years certain fundamental studies have been reported by the Prague and Viennese schools which proved that during exertion the muscle cells lose potassium, and sodium takes its place. Thus, the potassium contents of the muscle of well-rested rats averages 439 mg. per hundred cubic centimeters, but only 414 mg. per hundred cubic centimeters after twenty-four hours of running. Fatigue increases the sodium content from 109 to 117 mg. per hundred cubic centimeters. The potassium loss due to fatigue is not limited to the muscles of skeleton and heart but affects the other organs as well, as shown in Table 1.

TABLE 1*

	Number of Animals	K, mg. %	Na	Ca	Cl	K/Na	Number of Animals	K, mg. %	Na	Ca	Cl	K/Na	Duration of Running
Muscles	29	439	109	11	40	2.38	31	414	117	12	35	2.09	18 hr.
Heart	29	411	125	11	..	1.94	31	394	142	10	..	1.64	18 hr.
Liver	29	428	99	8	69	2.55	31	350	117	9	60	1.76	18 hr.

* From Eppinger: Arch. f. exper. Path. u. Th. Bd. 133: 509-524.

In other words, for the problems of fatigue and recuperation the mineral metabolism rather than the simple food metabolism with glycogen plays the decisive role. In fatigue, therefore, a light transmineralization occurs because of changes in the 'directed permeability' of the cell membranes and walls of the capillaries. The result is: PO_4 and Ca leave the cell and enter the blood, lymph, and the connective tissues, while Na, H_2O, and C1 go from the blood into the cells of muscles, nerves, liver, etc.

Roller[19] describes the fatigued cell as follows: 'edema of the cell, cloudy swelling, increasing distance of the cell from the capillary, and protein excretion into the interstices.' The entire regulatory mechanism of the cell suffers, the wall separating it from its liquid surroundings becomes permeable, and gradually the tension between the cell contents and its surroundings declines. It is as yet undecided in what stage the greater potassium loss of the cell occurs, but it is certain that there exists at once a relative impoverishment of potassium. There follow changes in the limiting surfaces between nucleus and protoplasm. If this pathologic event is accelerated, serous inflammations begin. The cell membrane is assisted in its function by an intermediary substance located between the cell and the nourishing capillary. This substance aids the parenchyma cell in permitting the exit of used-up substances and in keeping harmful substances out. The normal cell membrane retains a high-potassium content within the cell and prevents sodium and other substances from entering.

Needless to say that sodium and its derivatives are no longer given for fatigue and in inflammations, for the temporary relief is followed by increased weakening.

Another important problem was how soldiers could be helped to eliminate fatigue-creating substances. Investigations with the capillary microscope have shown that the capillary system performs a great part of this task and that only after restoring the function of the capillaries can fatigue-induced edema of the cell

be overcome or inflammation be cured. The daily intake of all protoplasmic poisons has, therefore, been reduced to a minimum, including the consumption of nicotine, alcohol, tea, and hot spices, as well as excessive metabolic stimulation from protein overfeeding. It is well known that sport performances cannot be combined with the consumption of alcohol, much less record performances that burden all body organs to the utmost.

In conclusion, it may be briefly emphasized that the preference for a vegetarian nutrition by the German army is based on the extensive fatigue studies by Keller,[20] Eppinger,[21] Kaunitz,[22] Roller, and others. Keller has developed the classification of mineral salts into potassium and sodium groups within the animal and vegetable kingdom and found their electrical transformation in 'biologic milieu.' Of course, they are not the only powerful biologic forces, but their great significance for practical usefulness has been demonstrated, among others, by the increased efficiency of the soldiers nourished with the help of this knowledge.

One moral remains to be added: it is a terrible tragedy and paradox that the accomplishments of the new technic in the science of nutrition should now be used without limitation for the demolition of human life. Far better fields could be found for putting this progress to work than causing death and destruction.

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