

# THE RELATIONSHIP OF SOIL FERTILITY AND PSYCHIC REACTIONS

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Reprint from *Virginia Medical Monthly*,  
Vol. 72, Pages 114-120, March, 1945.

Man's optimal growth, development, and functions require optimal nutrition. The source of nutrition for zoological life is the product of the soil and the sea. The quality of the soil's product is dependent on its fertility. Thus, soil, as a source of man's food, becomes a concern of the physician. I quote the United States Department of Agriculture's 1938 Year Book for a description of fertility of the soil: "The quality that enables a soil to provide the proper compounds, in the proper amounts and in the proper balance for the growth of specified plants, when other factors, such as light, temperature, and the physical condition of the soil, are favorable." Soil fertility, as described by Howard,<sup>1</sup> "is the condition which results from the operation of nature's round, from the orderly revolution of the wheel of life; from the adoption and faithful execution of the first principle of agriculture—there must always be a perfect balance between the processes of growth and processes of decay. The consequences of this condition are a living soil, abundant crops of good quality, and livestock which possess the bloom of health."

As doctors we are interested in the biological assay of nutrition. A soil is fertile when the plant or animal there produced sustains man in a state of optimal health.

*The Interrelation of Soils and Plant, Animal and Human Nutrition* was the title of an address by Auchter,<sup>2</sup> in which he said: "Our knowledge of many aspects of the interrelations between soils, plants, animals and human beings is limited, but some of the work that has been done in recent years gives us fascinating glimpses of the possibility and importance of further discovery. I would go so far as to say that we can now see the outlines of a whole new field of biological, or, shall I say, agricultural, research. From what is already known, this phase of agricultural research should lead to a new orientation of agricultural thinking. Certainly it suggests profound implications for human welfare."

While we are engaged in the most colossal de-

struction of man, and his resources that history records—World War No. II—the question in every pondering mind is "why"? It is the why's of human conduct, both normal and abnormal, both of the individual and of the mass, both in the present and in the past, that have stimulated the scientific investigations of psychiatrists and others. The psychobiology of the group is only the multiplication of the individual's psychobiology—reduced somewhat in its capacity. The psychopathology is tempered in its extremes by the reaction of millions, or increased in its intensity by small mobs. The etiological factors functioning in the individual are a controlling factor in group behavior.

Psychiatrists have recorded their meditations on mass psychiatric behavior—Hall<sup>3</sup> in his discussion of the manic depressive syndrome of the mass, White,<sup>4</sup> during World War No. I, wrote of psychiatric factors in causes of war, and regarded war as a mass regressive reaction. Stevenson<sup>5</sup> in 1941 suggested "that war be regarded as a mass psychosis caused in large part by emotional disorders and adjustment difficulties somewhat similar to those causing individual psychosis, and as such offered a most important field for psychiatric effort."

A recent psychiatric study of the German problem has been made by Brickner<sup>6</sup> in his book—*IS GERMANY INCURABLE?* In order to cure we should understand. Brickner's approach to the problem of Germany's millions was that of a modern psychiatrist skillfully getting the complete picture of his patient. The history revealed the onset of illness years before Hitler. The illness manifested its symptoms of lust for power, abnormal reverence of the military, and ideas of persecution. The neuropathology was that of paranoia. Brickner, with his appreciation of the malignancy of paranoia, suggests that an attempt to cure German culture be made by giving the Teutonic mind a more healthy emotional development. "How it should be done is a job for experts in a dozen different fields—anthropology, law, sociology, nutrition, transport, propaganda, psychology, economics, as well as psychi-

atry—the psychiatrist is expert in only one of those.”

This war has presented the physician, and especially the psychiatrist, with facts about the health of our male population of draft age. The prevalence of neuropsychiatric disorders demands that we think in terms of therapy for the disorders and prevention for the next generation. In the mobilization of our armed forces, neuropsychiatric disorders have been the cause for the rejection of 8 to 10 per cent of the men examined for military service. In spite of this screening at the Induction Stations, 30 per cent of those discharged from the army are discharged for psychiatric reasons.<sup>7</sup>

What are the causes of nervous disorders? Of course, it is not always necessary to know the cause in order to treat, but it is a help. However, the prevention of these disorders is dependent on our understanding of the etiology. There are known factors that make the individual a likely candidate for a neurosis. First of these is his heredity. This we can do little about except to teach him to practice good hygiene. In order that we may impart this knowledge to our patients and to potential patients, we psychiatrists must have a clear concept of what constitutes good hygiene.

We are prone to limit our concept of hygiene to mental hygiene—here I think we confuse the problem. Is there any way to separate mental hygiene from hygiene? Perfection of mental function and maximum capacity cannot be separated from perfection of body function. Thus, I regard our problem of mental hygiene as a part, and an inseparable part, of total human organism hygiene. It is hygienic living that may prevent the precipitation of illness in the less strong and less stable individual. It is good hygienic living, with special attention to defectiveness or other limitations, that may allow certain individuals to function in a manner satisfactory to themselves and to others.

Today psychiatric medicine has a great challenge. A large number of rejected selectees and discharged members of the armed forces have been told they have psychiatric disorders. These men—some of them, who were not conscious of their minor psychobiological disorders—are today looking for medical help. They are coming to psychiatrists for what they previously thought was a stomach, heart, or body ailment. There are not enough psychiatrists to handle all of those who have problems and who are now presenting themselves for help in our American communities. It is imperative that psychiatrists give to them—and to others from whom they may seek help—some understanding of their psychiatric problem and the things that can be done to aid in their rehabilitation.

This situation makes it imperative that we marshal all of our ability and review our knowledge of health and illness. Man starts life with potentialities given him by his inheritance. The full development of these capacities depends on his environment. His capacities to withstand trauma—to avoid susceptibility to infection—to survive infection—to evolve through situations—are dependent on his perfection of development. This perfection of development of man is primarily sustained by his food. The quality and quantity of nutriment either helps or hinders his development. The maintenance of man's capacity to function is dependent on several factors, but the one that is absolutely indispensable is nourishment. The health of man, and, consequently, his efficiency, is dependent on his state of nutrition. His psychobiology and some of his psychopathology are nutritionally determined.

This optimal health and its absence may have more importance than we have heretofore realized or emphasized in individual and mass personality reactions. The possession of this optimal health may be one of the factors in the rise of a nation to a world power. The loss of this optimal health and adjustability may be a factor in the decline of a people. An environment's biological assay is optimal when it produces the maximum growth, development, and function within the hereditary bounds of man, and when it gives him vigor and freedom from susceptibility to acute and degenerative diseases. Does it follow that mass maladjustment or mass psychosis of a nation may be the etiology of war as suggested by White and Stevenson? It is our observation that a person can get along better with himself and with others when well. Group, mass, or national adjustment is a multiplication of individual adjustment with or without complication.

We in psychiatry are daily pondering the multiple reasons for normal and abnormal psychic reactions. The membership of The Association for Research in Nervous and Mental Diseases, appreciating the importance of food, chose *The Role of Nutritional Deficiency in Nervous and Mental Diseases* as the subject for its 1941 symposium. The medical journals have many papers telling of recently acquired knowledge on almost every variety of deficiency—avitaminosis, hypoprotein anemia, and mineral imbalance, with therapeutic response when therapy is based on the proper rationale. The London letter in the *Journal of the American Medical Association*, January 29, 1944, told of postwar food planning. “Food experts who have advised the government during the war are now planning for the postwar era. They hold that such a commission will revolutionize agriculture and lay the foun-

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dation for prosperity in other basic industries. White bread, margarine, jam, and tea, regarded by large masses of people as a staple diet, will be discouraged. Instead, the people will be given an opportunity to increase their consumption of milk, eggs, fruit, vegetables, and meat. World food policy, with which Great Britain will be closely linked, will be directed to the same end."

It is the physician's responsibility to inform and to lead in a world food policy. We will either lead or be led. Our thought has to the present been chiefly concerned with the inadequate diet and its pathology. We are aware that inadequate nutrition leads to deficiency diseases and, one might add, an unhappy and weakened civilization. In order that we may be aware of what is being discussed by informed laymen, I refer to the procedures of the British Parliament.

*Soil and Health* was debated in the House of Lords, October 26, 1943, and again on February 2, 1944. The observations of doctors, agriculturists, and other scientists were quoted by informed statesmen. I quote from the speech of The Earl of Portsmouth in the second debate: "I should like today to confine my arguments as far as possible to the findings of a group of people who are scientifically qualified in the highest degree and who have had a long experience of the matter we are discussing. I refer to the group known as the Peckham Pioneer Health Service. They are, as your Lordships are probably well aware, a group of doctors who have investigated over a period of years an urban cross-section of our population. They have confined themselves to no particular class. So that their experiment and their experience may be not made invalid by special arguments, their experiment has been confined neither to very poor income ratios nor to the very high income ratios, but covers a very wide cross-section of the population and a very wide cross-section of occupation as well. The point they were searching for was to produce health, to have research into health and its relationships.

"They have begun with the family as a unit. Arising from their work with the family, naturally the whole question of environment has come in and the most vital member of the family—the mother—has been the subject of their special attention. The noble Lord, Lord Woolton, the day before yesterday, made a most profound and interesting speech to a body called the Food Education Society, and he expressed a wish in that speech that hospitals might become the centres of positive health. With all due deference I feel that the term 'positive health' is there used in its wrong context, because positive health cannot begin with hospitals. Hospitals may

be magnificent centres for rehabilitation, for teaching a better way of life to those who have been invalids, but they cannot be centres of positive health. Positive health, in my opinion, and I believe in that of most of those who have thought deeply upon this question, must begin in the womb and indeed in the womb before conception starts, with the health and vitality of the mother. In that connection the doctors working in the Peckham Health Centre discovered that feeding the families in the Centre with the ordinary so-called balanced food diet bought from a shop was not enough. The vitamins and so forth in the ordinary analysis of such vegetables as spinach and in such food as milk were not there; the vitality was not there; and they were forced to turn then to their own farm. They were forced to grow the food themselves, so as to get the beginnings of positive health in the unborn child, and the methods upon which Lord Teviot and others spoke in the debate on 26th October last. They were forced to use not new methods but the ancient method of returning waste to the soil and creating humus."

In America the Year Book of Agriculture for 1938 is published under the title of SOILS AND MEN. Many other publications show that much is being done in America on the subject of nutrition—*Interrelations of Soils and Plant and Animal Nutrition*, SCIENCE, May 12, 1939; *Nutrition and Soil Conservation*, JOURNAL AMERICAN DIETETIC ASSOCIATION, June-July, 1938; *Effect of Soil Treatment on Vitamin Content*, BIOCHEMICAL JOURNAL, September, 1939; *Soils and Nutrition*, ANNALS ACADEMY OF POLITICAL AND SOCIAL SCIENCE, January, 1943; *Riboflavin in Soil*, SCIENCE, July 30, 1943, etc. These point to the relation between the vitality of man and the vitality of the soil from which he feeds.

Now, let us turn to certain observations offering themselves as indices of the relationship between inadequate diet and neuropathology, which cause both minor personality disturbances and mental symptoms. McLester<sup>8</sup> noted that many of the pellagrins were considered neurasthenic before the objective signs of pellagra became manifest. It is generally accepted that some cases of pellagra depend exclusively on a deficiency of nicotinic acid and that there is often an additional deficiency of thiamine. He suggested that many of the psychiatric symptoms of pellagra depend primarily on insufficient thiamine in the diet.

Tucker<sup>9</sup> says: "The story of pellagra is a long one and one which, in spite of the widely accepted vitamin deficiency theory as to its etiology and treatment, is still unfinished."

Spies-Aring-Gelperin-Bean<sup>10</sup> point out that pel-

lagrins show a multiplicity of complaints—fatigue, insomnia, anorexia, vertigo, burning sensations, numbness, palpitation, nervousness, anxiety, headache, forgetfulness, apprehension, and distractibility. These neurotic symptoms showed a prompt response to nicotinic acid therapy.

Jolliffe<sup>11</sup> and his co-workers were able to produce with a thiamine-poor diet a neurasthenic syndrome in four out of five experimental subjects.

Bowman and Wortis<sup>12</sup> state: "The brain is dependent for its normal functioning on a carbohydrate substrate, an adequate supply of oxygen, and various enzyme and coenzyme systems. A disturbance in any of these constituents interferes with brain metabolism and, therefore, with brain function. . . . Our present knowledge indicates that at least three of the vitamins already isolated are concerned with the proper metabolism of carbohydrates—the preferred foodstuff of normally functioning brain tissue. These are thiamine hydrochloride, nicotinamide, and riboflavin. They regard some neurasthenic syndromes, cortical dysfunction associated with acute peripheral neuropathy, Wernicke's syndrome, pellagra, and delirium tremens as clinical pictures that may result from thiamine and nicotinic acid deficiency.

Wilder,<sup>13</sup> in a discussion of symptoms and signs of thiamine deficiency, concludes: "Moderate prolonged restriction of thiamine but not of food calories is associated with states of emotional instability and changes of attitude and mood reflected by irritability, depression, quarrelsomeness, poor cooperation, vague fears progressing to agitation, restriction of activity, and multiple somatic complaints."

Elvehjem<sup>14</sup> reviews the *Relationship of Enzymes to Deficiency*, and states: "It is possible to conclude from this short review that certain vitamins may be constituent parts of certain enzymes and that these enzymes show a significant decrease during deficiency diseases."

Minot<sup>15</sup> opens his discussion of *The Problem of Nutritional Deficiencies* with this statement: "The present emergency is the most serious emergency in our history. A fundamental condition of a will to victory is a will to be healthy. This implies that food be taken to maintain optimal nutrition. With faulty food, there is faulty nutrition, faulty function, faulty structure, disease."

He concludes with the following statement: "The effects of food on vitality are fundamental and far-reaching. The benefit of better feeding usually becomes more evident after it has been continued throughout a large part of a life cycle and its effects may not be seen until a second generation. The great opportunity for utilization of modern knowl-

edge of nutrition is in the prevention of unstable nutritional states. The prevention is much simpler and vastly more economical than treatment after bodily defects have occurred. The problem of nutritional deficiencies is the prevention of partial deficiency; adequate nutrition is one of the first lines of defense of this nation."

The recognition of certain frank nutritional deficiencies and their cure represents progress in nutritional medicine. It is the minor, or subclinical, states that present an unsolved problem to the physician and the patient. The doctor is not in a position to recognize the latent syndromes and the patient does not appreciate his malnourished state. Therefore, the best therapy is the prevention of both the frank and the partial nutritional deficiencies with their interference of man's function—his psychic reactions. It is the prevention of abnormal psychic reactions that interests us in psychiatry.

We have in the above discussion referred to rather specific disturbances in normal psychic reactions when the individual is malnourished. Malnourishment is not limited to humans. Recent observations have shown pathological reactions in animals when they, too, have been malnourished. For instance, the paralysis, or so-called Bush sickness, of sheep in New Zealand was attributed to the lack of cobalt in the soils and thus in the plants, and the addition of cobalt to the soil is now preventing the paralysis. Nutrient disorders in plants occur and have been corrected by the addition of a specific nutrient to the soil—magnesium in sand drown of tobacco; manganese in chlorosis of tomatoes; boron in diseases of the cauliflower and sugar beet; zinc in pecan rosette; sulphur for the yellow of tea. These findings rather indicate that plants are dependent on the soil for a multiplicity of minerals and without them, or without the capacity to use them, they become sick. In addition, it is also pointed out that animals are affected by a deficiency of minerals in the soil. Is the nutrient value of plants to man dependent on the fertility of the soil? Does it follow that the nutrient value of animal products is also dependent on the fertility of the soil which grows food that the animals consume?

Soil fertility that is optimal for the production of quality foods depends not only on the minerals, its physical structure, tillage, moisture, sunlight, but also on the fauna and flora of the soil. The bacteria play an important part in making air nitrogen available to the plants and in the decomposition of humus. The fungi surround the rootlets and even penetrate them, forming what is known as the mycorrhizal association and what is described by

Howard as being the living fungous bridge which connects soil and sap.

McComb<sup>16</sup> and others in comparing mycorrhizal and non-mycorrhizal plants showed that the mycorrhizal seedlings contain four times as much phosphorus as the non-mycorrhizal plants.

There is further evidence that the type of soil fertility affects foods. Kellogg<sup>17</sup> in an article, *Soils and Nutrition*, makes this statement: "Soil conditions and soil management practices, including the use of fertilizers, influence . . . the mineral content of foods."

Recently K. C. Beeson<sup>18</sup> collected the available data on the mineral content of foods, especially as related to soil type and soil management practices. His tables show, for example, that lettuce may contain nearly 0.05 per cent or less than 0.001 per cent of iron. Vegetables of normal appearance may vary 100 per cent in their content of calcium. There are even greater differences in phosphorus, while copper, iron, and manganese may show variations of several hundred per cent. By selecting obviously abnormal specimens, far greater variations are found. Some of the differences are due to variety, some to environmental conditions, especially soil, and some to other causes.

The vitamin content of plants may also be influenced by the fertility of the soil, particularly the humus content of the soil, as pointed out by Carpenter<sup>19</sup> who states: "While studying the occurrence of vitamins in fungi, the question was raised as to whether there was a possibility of finding vitamins in soil. . . ."

"The work was confined to riboflavin and this vitamin was found in many 'local soils'.

"From work done at present, we believe that occurrence of B2 is correlated with the amount of organic matter in the soil . . . and that some plants take up vitamins from this source as they absorb essential mineral elements."

These findings point to the fact that riboflavin and minerals in the plants may depend on the humus and mineral content of the soil. Such observations suggest that the quality of the plant is dependent on the fertility of the soil; thus optimal soil fertility predetermines that the plant will have the potential source from which it can possess optimal food value.

The writer pointed out in a recent paper—*The Effect of Agricultural Practices on Health and Disease*—that the diet of the Northern Chinese, although inadequate in vitamins A, C, and D, calcium, and in total calories, biologically assayed higher than our American diet if the presence and absence of degenerative diseases were considered.

This suggested an x factor in the produce that was grown by the Oriental agricultural practices, where natural manures are used, and that there is some lack of nutrition in the produce grown by our Occidental agricultural practices, where artificial fertilizers are used.

Howard<sup>1</sup> states: "The principle followed, based on the Liebig tradition, is that any deficiencies in the soil solution can be made up by the addition of suitable chemicals. This is based on a complete misconception of plant nutrition. It is superficial and fundamentally unsound. It takes no account of the life of the soil, including the mycorrhizal association—the living fungous bridge which connects soil and sap. Artificial manures lead inevitably to artificial nutrition, artificial food, artificial animals, and, finally, to artificial men and women."

We have referred to psychopathology resulting from inadequate diet. We have recorded observations that show foods may also have had an inadequate diet and, therefore, are inadequate in their potentialities to nourish man as they themselves are malnourished.

In order to prevent deficiency diseases, and especially the subclinical ones, our program will have to be educational. First, the agriculturist must produce the food that is more consistently high in quality. Second, people should be informed what positive health is, and that it must be treasured and guarded with good hygiene. This requires good habits—eating and others. The modern science of nutritional medicine will have to evolve to the stage of prevention. This requires that we know not only the nutrient needs of the human body but the source from which and the means by which it may be obtained. The prevention of deficiency diseases is going to be an educational program—first, of the consumer; second, of the farmer. When the buyer demands and is willing to pay for a quality product, the production of such a product becomes economically sound. It will be then and then only that we shall be able to buy quality foods that have the capacity to give optimal nutriment to our bodies.

There seems to be a correlation between deficiency diseases and some pathological psychic reactions. Malnutrition is etiological of deficiency diseases; deficiency in nutrition is due in part to soil deficiency—poor fertility; deficiency in soil fertility is the source of food poor in quality and, therefore, inadequate to maintain optimal health. Thus, soil fertility becomes a factor in the psychobiology of man.

We in medicine are interested in optimal health, and in psychiatry we are vitally concerned with malnutrition as it affects psychobiology. It is for

this reason that we find ourselves today interested in the source of malnutrition—soil, an impoverished soil, as a cause of an impoverished people with psychopathological complaints.

In order to treat, we will have to understand health and disease of the soil. A fertile soil is alive with its bacteria, fungus, and protozoa. The maintenance of this microscopic life seems to be as vital for the plant as the intestinal flora is for man's nutrition. The nutrition of this microscopic life in the soil demands that we concern ourselves about its environment—the food supply, the oxygen supply, and the physical condition of the soil. The optimal health of the bacteria, the fungus, the protozoa, and the earth worms takes on vital importance in the maintenance of a food supply to human beings that is adequate in quality as well as in quantity. Today when the soil is being called on to furnish nutrition to large urban populations and to produce so much raw material, especially at this time for synthetic rubber and fuel, the maintenance of soil fertility becomes a greater problem.

The ancient agricultural practices of supplying the soil with nutrition for its life by returning all things and the refuse of all things to the soil is no longer practiced, or, perhaps, possible. The multiple demands of protoplasmic growth seem to be best satisfied by natural manures. However, if chemical substitutes must be used, let us supply more completely the protoplasmic need. At the same time the effect on the microscopic life in the soil which is vital to man's vitality must not be destroyed.

Man's interference with the perfect balance between the natural processes of growth and decay may be largely responsible for the predicament of our malnutrition. Howard<sup>1</sup> states that "the agriculture of ancient Rome failed because it was unable to maintain the soil in a fertile condition. The farmers of the West are repeating the mistakes made by Imperial Rome. The soils of the Roman Empire, however, were called upon only to assuage the hunger of a relatively small population. The demands of the machine were then almost non-existent. In the West there are relatively more stomachs to fill while the growing hunger of the machine is an additional burden on the soil. The Roman Empire lasted for eleven centuries. How long will the

supremacy of the West endure? The answer depends on the wisdom and courage of the population in dealing with the things that matter. Can mankind regulate its affairs so that its chief possession—the fertility of the soil—is preserved? On the answer to this question the future of civilization may depend."

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Reprint No. 70B

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