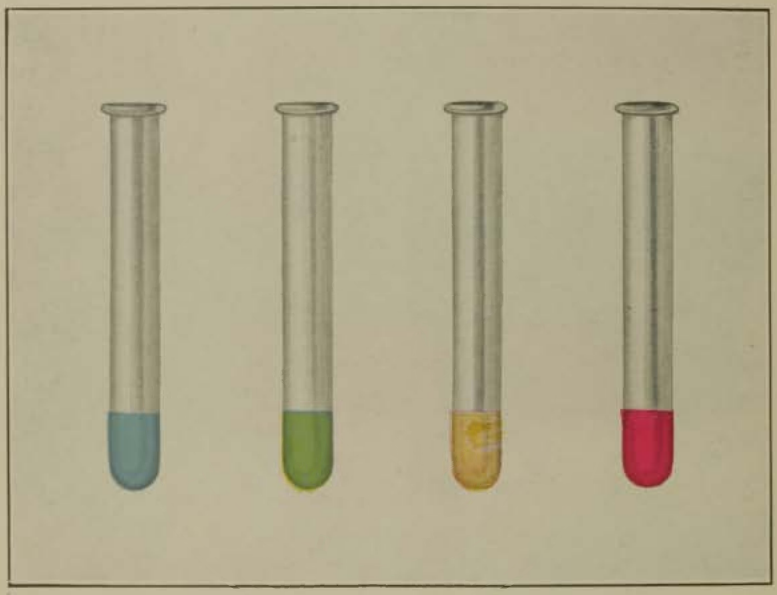
DIABETIC MANUAL

JOSLIN

Childrens dietary

April, 1938



None. Trace. About 1%. Over 2%.

The Benedict Test for Sugar in the Urine.

DIABETIC MANUAL

FOR THE

MUTUAL USE OF DOCTOR AND PATIENT

BY

ELLIOTT P. JOSLIN, M.D.

CLINICAL PROFESSOR OF MEDICINE, HARVARD MEDICAL SCHOOL; MEDICAL DIRECTOR GEORGE F. BAKER CLINIC AT THE NEW ENGLAND DEACONESS HOSPITAL; CONSULTING PHYSICIAN, BOSTON CITY HOSPITAL, BOSTON, MASS.

SIXTH EDITION, THOROUGHLY REVISED

Illustrated

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TO

THOSE INDIVIDUALS WHO HAVE CONQUERED DIABETES

BY LIVING LONGER WITH IT

THAN THEY WERE EXPECTED TO LIVE WITHOUT IT

PREFACE TO THE SIXTH EDITION.

INSULIN rescued the diabetic and set him on his feet, but protamine insulin has given him an opportunity to live almost like a normal individual. Today a broader career is opening up before him and the public is watching to see what he will do with it. I believe he will use his freedom wisely and will demonstrate that he is a useful member of society.

A knowledge of his disease is a great asset to the diabetic. Always I have believed this, but now I know it, and the proof is furnished by the diabetic doctors I have treated. These 300 physicians do far better than my other patients and for those under thirty-nine years of age the mortality is less than one-quarter as great, and, indeed, less at any age. Not a doctor in the group has died of diabetic coma since 1925. Moral: If you have diabetes, learn all you can about it and at least live as long as a diabetic doctor.

To all who assisted me with earlier editions, and especially to H. R. A. for Diet, Exercise and Insulin, to my associates, Drs. Howard F. Root, Priscilla White, Alexander Marble and Allen P. Joslin, to my hard-working secretaries, nurses and technicians, and to all the patients, I extend my warmest thanks. As heretofore, Messrs. Lea & Febiger have aided me with wise counsel and ready coöperation.

E. P. J.

BOSTON, MASS.

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DIABETIC MANUAL.

CHAPTER I.

DIABETES.

"Grow old along with me!
The best is yet to be,
The last of life, for which the first was made:
Our times are in His hand
Who saith 'A whole I planned,
Youth shows but half; trust God: see all nor be afraid!'"

Introduction.—If you have diabetes, remember you are not the only one to have it. There are hundreds, thousands, even hundreds of thousands of others like you and the majority lead useful lives. Like diabetic children, face the facts, accept the situation, study the disease and become the master of your fate. By so doing you are sure to help those less fortunate and may even prevent the onset of diabetes in other members of your own family. Moreover, progress in treatment now rides in an aëroplane and not in an oxcart, and the more rapid the increase in the number of diabetics, the sooner and the surer will treatment improve, because the need of action will arouse greater and greater numbers of workers.

Diabetes is a disease in which part of the food escapes utilization and appears as sugar in the urine. If the patient stops overeating and eats less sugar and starch, most of the symptoms of diabetes will vanish. He may need to make up for the loss of nourishment by taking more fat such as cream, butter, olive oil, and fat meat. Should the urine not become sugar-free with this moderate change in diet, it is wiser to take insulin to bring this about than to make the diet more strict. Insulin was discovered only fifteen years ago and it has altered the entire outlook for diabetics. Protamine

insulin was devised two years ago and although it is only now generally available, I have had the opportunity to use it since July, 1935, through the courtesy of its inventor, Dr. Hagedorn of Copenhagen, and also because of the kindness of Professor Charles H. Best of Toronto and the liberality of the Eli Lilly Company and of the E. R. Squibb and Sons. In fact more than 1200 cases have been treated with this new product. Protamine insulin represents a wonderful advance in the treatment of diabetes and protamine insulin is the reason for the revision of this book.

Not only will the proper use of insulin free the urine of sugar, but it makes possible the return of health to the patient and the prospect of a long life.

The diet of a diabetic need not be severe or conspicuous. He should be able to eat without injury to himself, either with or without the aid of insulin, the equivalent of the food described below.

Breakfast: Fruit, one portion; cereal and cream or a slice of bread and butter, occasionally both; 1 egg or, if he needs more nourishment, either 2 eggs or 1 egg with bacon; coffee.

Lunch: Meat or fish; vegetables, unrestricted in quantity, save the starchy ones such as potato and corn; 1 slice of bread; fruit for dessert.

Dinner: A meal similar to that at noon but rather more abundant and usually containing a salad.

During the day at least a total of $\frac{1}{2}$ pint of milk and $\frac{1}{4}$ pint of cream or *vice versa* and a moderate quantity of butter. Clear broths, coffee, tea, cocoa shells and cracked cocoa can be taken without allowance for food content.

Diabetes is a common disease in middle life, but unusual in the young, and rare in children, although today we hear much more about diabetes in children because they are living—the Metropolitan Life Insurance Company tells me from a study of my cases— fifteen to thirty times as long as formerly. Indeed the younger the diabetic today, the longer he has to live. Twice as many die above the age of seventy with diabetes as under the age of fifty years. For one individual who develops diabetes under forty, there are two who acquire it above forty years. However, diabetes seldom

occurs in persons over forty years of age unless they are fat. In young or old there must be an hereditary element, although one cannot always find it. Heredity alone may not be strong enough to make the disease break out unless the individual helps to bring it on by overeating or his tolerance for carbohydrate is lowered by infections or complicating disease of the thyroid or pituitary gland.

Death from diabetes, pure and simple, is needless, if the patient follows the rules of treatment, and most of the complications of diabetes are avoidable if patients will take the necessary precautions.

Sugar is present in the urine in untreated diabetes and there is also an excess in the blood. This is due to the body having lost the power to use the food which has been eaten. Most of the sugar which leaks through the kidneys into the urine comes from sugar and starch (carbohydrate), but some can be formed out of meat, fish, eggs and cheese (protein) and a little from pure fat. Healthy persons do not have sugar in the urine, because the secretion of special cells of the pancreas, a gland in the abdomen often called the sweetbread, stores the sugar in the body either as animal starch (glycogen), or makes possible its change to body fat or its use for energy as fast as it is formed.

The object of the treatment of diabetes is to prevent the loss of sugar in the urine. This is accomplished: (1) by altering the diet so that the patient will take less than usual of sugar and starch and in general by eating only moderate quantities of all foods; (2) by exercise which favors the burning up of sugar in the muscles; (3) by insulin which is a drug made out of cells of the pancreas of an animal. This manufactured insulin replaces the insulin which the diabetic's pancreas has ceased to produce in sufficient quantity. Treatment with diet alone was formerly unsatisfactory, because the diet was often too strict for comfort or occasionally for life. The patients were sometimes too weak even to benefit from exercise. The discovery of insulin is, therefore, a great boon, because with its help the patient can eat all he needs to enable him to work or play and to become a useful member of society.

The Advantages of Diabetes Over Other Chronic Diseases.—It is perfectly true that diabetes is a chronic disease, but, unlike rheumatism and cancer, it is painless; unlike tuberculosis, it is clean and not contagious, and in contrast to many diseases of the skin, it is not unsightly. Moreover, it is susceptible to treatment, and the downward course of a patient can be promptly checked. Treatment, however, rests in the hands of the patient. It is by diet as well as by insulin and the patients who know the most, conditions being equal, can live the longest. There is no disease in which an understanding by the patient of the methods of treatment avails as much. Brains count. But knowledge alone will not save the diabetic. This is a disease which tests the character of the patient, and for success in withstanding it, in addition to wisdom, he must possess honesty, self-control and courage. These qualities are as essential along with insulin as without insulin. Over 500 of my patients have actually lived longer than would have been expected of them had they been normal, healthy people, and far longer than their similar fat friends whose obesity led to their death by way of heart or kidneys. For the diabetic this is a demonstration and a challenge. (See Frontispiece.)

Definition of Diabetes Mellitus.—Diabetes is an hereditary disease characterized by an increase of sugar in the blood and the excretion of sugar in the urine; it is dependent upon disease of the pancreas, particularly of the islands of Langerhans which are interrelated to several other glands in the body; the secretion of the islands of Langerhans—insulin—not only promotes the normal storage of glycogen (animal starch) in the liver, muscles and skin and the combustion of glucose (sugar) in the tissues, but also exerts a control upon the metabolism of protein and fat.

My rule in the treatment of diabetes is to consider any patient who has sugar in the urine demonstrable by any of the common tests to have diabetes mellitus and to treat him as a diabetic until the contrary is proved. Occasionally an individual has sugar in the urine (glycosuria) and yet the sugar in the blood is not above normal. Such a patient is not considered to have diabetes, but to have renal—kidney—

glycosuria. Rarely a patient shows a reaction for sugar in the urine, which is due to other varieties of sugar—pentose, levulose or lactose. This is harmless. The quantity is always small and in such cases the blood sugar is normal.

The development of diabetes may be gradual or acute and with or without symptoms. It is fortunate that the disease can be so readily discovered, for unlike many diseases whose beginnings can be detected only by specialists or disclosed by the help of elaborate and expensive methods, such as the Roentgen-rays, diabetes can be easily and promptly recognized by any physician who will be on the watch for it and will examine the urine of his patient for sugar. The subsequent behavior of the disease and the effect of treatment are also easily regulated by simple urinary examinations; herein the diabetic has a great advantage over many other patients.

Symptoms.—The symptoms of diabetes are thirst, hunger and the passage of an increased quantity of urine (polydipsia, polyphagia and polyuria) with loss of weight and strength. Itching of the skin, particularly about the genitals, is common. There is no one symptom always present and indeed there are many diabetics who have no symptoms at all. This is the reason it is so desirable for everybody to have routine examinations of the urine at least once a year and always when indisposed, because it is only in this way that many cases will be discovered or at least found out early so that treatment can begin promptly. The eyesight may be affected and occasionally the nerves show trouble by pains or difficulty in moving certain muscles. But these are complications rather than a part of the disease. A properly treated case of diabetes should feel well and have no symptoms. The responsibility for maintaining this favorable state must rest in large measure upon the patient himself. He must learn the diet, the dose of insulin and the amount of exercise which are best for him and must constantly control his condition by the examination of his urine. He is his own nurse, doctor's assistant and chemist. If he tries to be his own doctor, he will come to grief. To acquire the requisite knowledge for his triple vocation requires diligent study, but the prize offered is worth while, for it is nothing less than life itself.

Source of Urinary Sugar.—The sugar in the urine of diabetic patients is derived from their food, and chiefly from that eaten within the preceding twenty-four hours. The effects of a meal begin to show within ten minutes by an increase of sugar in the blood and by the appearance of sugar in the urine. Most of the sugar in the urine comes from carbohydrate (sugar and starch), but in extremely severe cases as much as 58 per cent may come from protein (examples of which are lean of meat and fish, white of egg, and curd of milk) and 10 per cent from the fat in the diet.

Test of Successful Treatment.—Improvement in diabetes takes place when the urine is kept free from sugar. The annoying symptoms of the untreated diabetic then vanish. Under such conditions the power of the pancreas to assimilate carbohydrate is increased. Conversely, if the urine is not free from sugar, the patient is generally only holding his own, or more likely is growing worse. Professor Naunyn of Germany, who for a generation was perhaps the leading specialist in diabetes, observed that even severe cases if treated early did well, whereas mild cases if neglected usually did poorly.

Examination of the blood for sugar gives valuable information in the treatment of diabetes. The total quantity of sugar in the blood of the entire body is surprisingly small. Before meals, it amounts to about 1 teaspoonful (5 grams); and after meals, if the pancreas with its insulin did not prevent its rising above a scant 2 teaspoonfuls, sugar would slip through into the urine and the individual would be a diabetic. The normal percentage of sugar in the blood is 0.10 (100 mg.) per cent but after a meal it may rise to 0.16 (160 mg.) per cent without sugar appearing in the urine. The adjustment of the mechanism by which insulin regulates the quantity of sugar in the blood within these narrow limits is truly wonderful.

The sugar in the blood usually rises above normal before sugar appears in the urine. Consequently, if information can be learned about the blood sugar, one often anticipates the information which an examination of the urine alone would show. The knowledge about the blood sugar is still

fragmentary, and it must be acknowledged that many cases of diabetes have lived comfortably without a single blood sugar estimation. However, analyses of the blood sugar are of much value, particularly in the diagnosis of doubtful cases.

The fat is increased in the blood of the severe and often of the untreated diabetic. It is, indeed, almost as important as the blood sugar. There are various kinds of fat in the blood, but if one kind, cholesterol, is estimated, the value of that will give the clue to the other fats, because they vary closely with the cholesterol which is fortunately comparatively easy to determine.

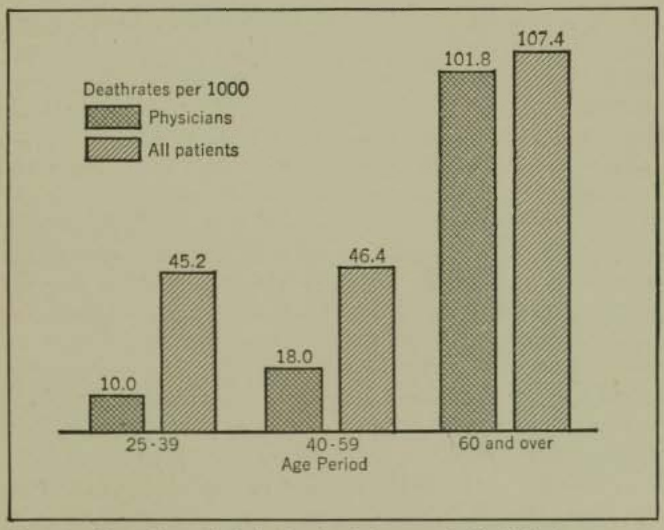

FIG. 1.—Mortality of diabetic physicians and all diabetics compared. Experience of E. P. Joslin, M.D., Boston, Mass. Analyzed by Metropolitan Life Insurance Company. All patients, August 7, 1922–1929. Physicians, August 7, 1922–January 1, 1936.

CHAPTER II.

THE RECENT IMPROVEMENT IN DIABETIC TREATMENT.

One often hears the remark that patients with diabetes live for years with little inconvenience to themselves, even though strict rules of diet are neglected. This may be a consoling thought to some weak-willed patient, but if the average diabetic yields to such seductive advice, the probability is overwhelming that he will later pay the penalty. Furthermore, such statements are not true. Their origin lies in the favorable course of the large number of mild cases of diabetes, but just as it is a serious blunder in war to disparage the strength of the enemy, so it is in diabetes. Certain diabetics improve so much with insulin that they sometimes feel that diet can be broken and insulin omitted. This is wholly wrong and in more than one instance have I known death to result even though their disease was of short duration. With children, when the diabetes is uncontrolled, complications are about ten times as frequent.

Diabetes was serious when I first made its acquaintance. Fortunately I had some wonderful patients in those early days and one of them, my Case No. 8, lived so faithfully that she actually lived longer with her disease than she was expected to live by life expectancy tables without it. Children lived the shortest time, but today they live the longest and it is because of them and the younger patients that diabetes now seems so common. I suspect the average duration of life for all cases has certainly trebled and almost quadrupled in a generation. There are 75 children in the total number who have lived more than fifteen years with their diabetes. It is gratifying that this advance in treatment has come through hard work and not through chance, and that multitudes of scientific men and women have shared in it. All will gladly acknowledge the service of Dr. Frederick M. Allen more than twenty years ago, in helping to bring

this about by his insistence upon the harmfulness of overfeeding the patient and the desirability of the patient learning to test his own urine, but chiefly it is through the discovery of insulin by Banting and Best.

Deaths from diabetes in children in Massachusetts have almost reached the vanishing point. Deaths between the ages of twenty and forty years are now the lowest for this century and the only diabetic death-rate which is increasing is that among those aged fifty years or more. (Fig. 2, p. 20.) Between 1898–1914 the average age at death of my diabetics was 44.5 years, between 1914–1922 it was 46.9 years, but since the discovery of insulin it has risen to 62.8 years. There was no death from diabetes in Boston during 1935 under the age of nineteen years.

The favorable nature of recent hospital statistics demonstrates that the opportunity for further improvement in the treatment of diabetes lies not in the hospital but in the home. To this end a campaign must be aggressively waged. If the mortality can be reduced nearly to zero in the hospital, these same results ought to be attained outside the hospital, for there is no reason why the methods which have made hospital treatment safe should not be employed in making treatment in the home safe. It is unreasonable to expect that the ultimate diabetic mortality in the home will be as low as that in the hospital, because of the shorter duration of stay in the latter, but the time has arrived when the accidental and avoidable deaths, which have now been largely eliminated from the statistics of the best hospitals, should also be eliminated from private practice. The secret of the success of hospital improvement lies in the close and continuous observation of the patient by the doctor. The patient is under the supervision of those who understand the disease. For success in home treatment, close and continuous observation of the patient by himself under the systematic guidance of his family physician is just as essential.

If every diabetic in this country would see his doctor once a month, in my opinion the duration of the diabetic portion of life would be doubled. *No diabetic should let three months go by without a visit to a physician.* Everybody should have

a health examination once a year and after fifty years of age twice a year if he wishes to get all the health which his body affords.

I have always believed in the education of the diabetic patient and now, thanks to the coöperation of Dr. Louis I. Dublin and Mr. Herbert H. Marks of the Statistical Depart-

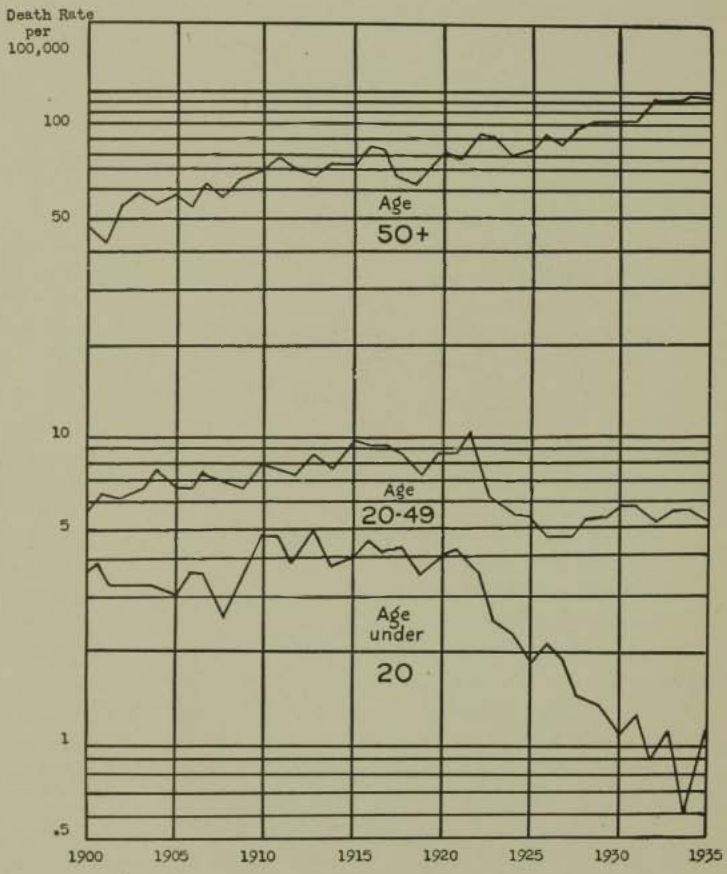

FIG. 2.—Average death-rate from diabetes in Massachusetts by age. Death-rate per 100,000 population. (Logarithmic scale.)

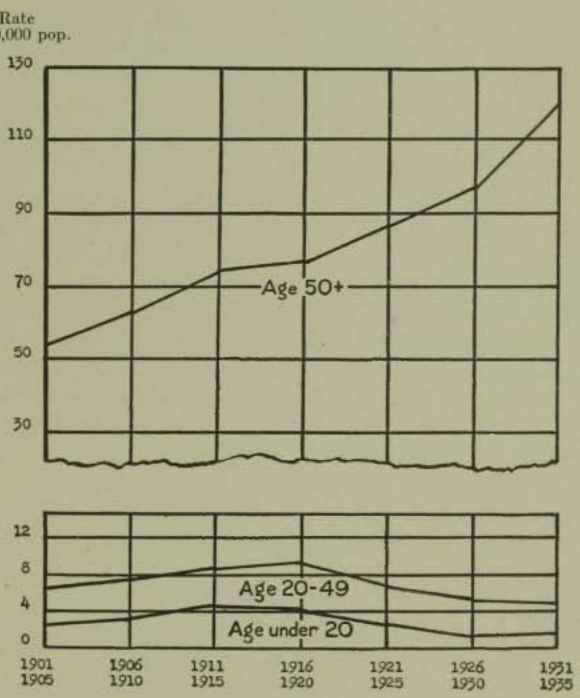

FIG. 3.—Diabetes mellitus average death-rates in 5-year periods Massachusetts. (Arithmetic Scale.)

ment of the Metropolitan Life Insurance Company, I know it is a sound policy. They have prepared tables which show the mortality of the 300 diabetic doctors I have treated compared with all my diabetics in similar age groups. (See Fig. 1.) In the younger group, twenty-five to thirty-nine years, the mortality for doctors is less than one-fourth that of all the patients, and it is definitely less for later age groups. Moreover, my diabetic doctors die at an average age of sixty-eight years as compared with non-diabetic doctors who die at sixty-three years. And as for diabetic coma, none of my doctors have succumbed to it since 1925.

Insulin has wrought this revolution in the lives of severe and moderately severe diabetics. It allows such individuals

to take part in large measure in all that goes on about them, just as diet alone enables most mild diabetics to lead a successful existence. With the help of insulin I have seen children go back to school, enter and graduate from college, young women and men get married and have healthy children, ministers secure a parish, lawyers reënter court, doctors carry on a hospital service, nurses resume work. It is true nearly all of these activities are mental or professional activities; consequently, it is well to record that mechanics have been enabled again to carry on occupations which had been renounced for many months and even to perform strenuous labor, and college students to play on the "Varsity" athletic teams. Insulin, therefore, not only changes the severe and moderately severe diabetic into a milder diabetic, but protects all diabetics in times of emergency. And as for protamine insulin, it promises to do all this and more, and with far less inconvenience for the patient and for these reasons the extension of the use of insulin will be promoted and more who need it will take it.

Insulin has shortened the period of hospital stay from a few weeks to a few days. Not rarely one can concentrate on the treatment of a patient so that only a week-end is necessary, thus greatly lowering hospital expenses.

Insulin is the diabetic's best life insurance policy. It is a gift from Banting and Best and a multitude of workers in quiet laboratories before and since.

Always remember that during an infection a mild diabetes becomes more severe. Therefore during an infection be ready to begin insulin, if your doctor advises it, or alert to the need for increasing the dose if you are already taking it.

CHAPTER III.

THE STORY OF DIABETES AND INSULIN.

"Who eats a crust of bread, tastes all the stars and all the heavens." PARACELSUS.

IN India and Rome there are hints of a knowledge of diabetes, but Paracelsus, who was born two years before Columbus discovered America, was the first to record that if a measure of urine of a diabetic patient was evaporated to a syrupy consistency it yielded 4 ounces of salt. Thomas Willis, born the year after the Pilgrims landed at Plymouth, observed that the urine of a diabetic tasted wonderfully sweet as if imbued with honey and in 1775 Matthew Dobson proved by fermenting the urine that the sweet taste was actually due to sugar. John Rollo, 1796, began to treat diabetics by diet and gave them animal food and vegetables such as our 5 per cent carbohydrate vegetables. Bouchardat in 1845 associated the pancreas with diabetes and Minkowski in 1889 proved diabetes was concerned with this gland, because when he removed it from a dog, severe diabetes occurred. In 1921 Banting and Best found that an extract of special cells in the pancreas, when injected into a diabetic, would control the disease. The work was performed in the laboratory of Professor Macleod of Toronto and subsequently they had the assistance of Professor Collip in refining the active principle of the extract which was named insulin. On account of the discovery of insulin the Nobel Prize in Medicine was bestowed upon Banting and Macleod.

F. G. Banting was a young orthopedic surgeon with zeal for research undampened by four years' service at the front. He received the assistance of his friend, C. H. Best, who, although a second-year medical school student, was trained in physiological research. Thus, just a generation had elapsed since that other epoch-making discovery in diabetes was announced by von Mering and Minkowski, when they

proved that fatal diabetes would follow complete removal of the pancreas. Doctor Charles H. Best is now Professor of Physiology at the University of Toronto, but by helping Banting discover insulin he proved that a medical student was *ipso facto* an investigator and deserved to be regarded as such.

FIG. 4.—Sir Frederick G. Banting, M.D., K.C.B.E.

Realizing that the action of insulin, although wonderful, lasted only a few hours and was also unlike nature in that it caused sudden and often serious falls of the sugar in the blood Hagedorn in Copenhagen sought to remedy these defects. For this purpose he utilized protamine, discovered in 1868 by Miescher in fish sperm and in the nuclei of cells and studied by Kossel in the last years of the nineteenth century. Experimenting with many protamines he found one which would cause a precipitation of insulin and by adjusting with an alkali the reaction of the solution to that of the body, the resulting compound was absorbed so slowly

that it acted twice as long as insulin. Still later several investigators on this side of the ocean found that they could prolong the action for an entire day by the addition of an almost infinitesimal quantity of zinc. By these measures the necessity for injections of insulin in the treatment of diabetes was reduced to once in twenty-four hours.

FIG. 5.—A photograph of Professor C. H. Best taken by Professor A. V. Hill in the Sir William Bayliss Laboratory at University College, London, 1928.

The Pancreas and Its Islands of Langerhans.—The cause of diabetes is usually considered to be due to something wrong with the pancreas. This gland has a double action. It forms a digestive juice which, as a matter of fact, is the most important digestive juice in the body and this it discharges into the intestine; and second, it produces insulin which is discharged into the blood, and this regulates the use of the sugar formed from the food. In animals the pancreas is known as the sweetbread and lies behind the stomach near

the liver. The pancreatic digestive juice is manufactured throughout the gland, but insulin is formed by collections of cells which occur in groups named the islands of Langerhans after the young doctor in Berlin who discovered them in 1869. It is possible experimentally to produce diabetes by removing more than nine-tenths of the pancreas, because then there would be too few islands left to make the insulin which regulates the action of the sugar and starch. In man for some reason, as yet unknown, the islands of Langerhans may become diseased or cease to function and diabetes appears. If the diabetic patient could secure a new pancreatic gland he would be cured. I would not be surprised if sometime we could promise a patient that his old pancreas could be repaired or, if inactive and lazy, could be made to work. (See Figs. 6, 7, 8, p. 27.)

A word about these islands of Langerhans. These consist of groups of cells, varying in number from a quarter of a million to a million or more in a single pancreas. They are scattered throughout the gland, and yet they form but a twentieth part of it. Their total weight is about that of a buffalo nickel. Originally they were described by Paul Langerhans in Berlin in 1869, but it was not until 1901 and 1902 that Opie, in America, and Ssobolew, in Russia, showed that disease of the Langerhans islands and not of the rest of the pancreas was the real cause of diabetes. (Figs. 9, 10, pp. 27, 28.)

Insulin is prepared from the islands of Langerhans of the pancreas of various animals. Protamine insulin is insulin to which protamine is joined. At present protamine insulin is dispensed with the addition of zinc and is sometimes described by its full name—protamine zinc insulin.

Insulin is prepared for general use dissolved in a liquid. The dose is measured in units. One unit of insulin when injected into a diabetic will enable him to utilize 1 or considerably more grams additional carbohydrate. Apparently the power of insulin varies with different patients and under different conditions with the same patient. Therefore, one must always proceed cautiously when administering the first dose. The number of units taken in a day by a patient

Fig. 6

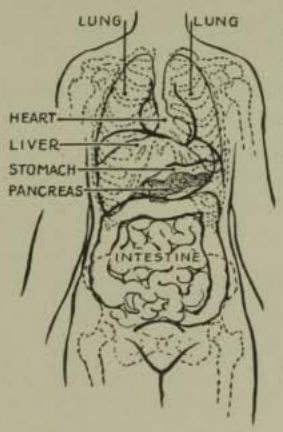

Fig. 7

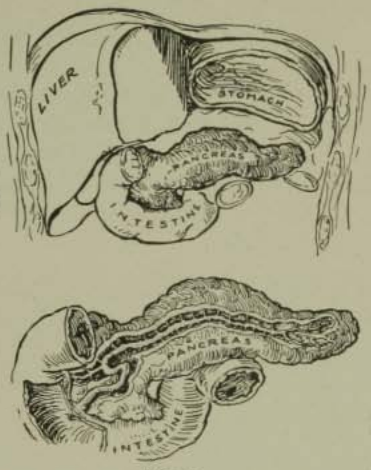

Fig. 8

Fig. 6.—Diagrammatic view of position of the pancreas in the body. The site of the pancreas is shaded to show it is behind the stomach.

Fig. 7.—Liver and stomach cut away to show the pancreas.

Fig. 8.—Pancreas cut to show its duct which carries the pancreatic digestive juice into the intestine.

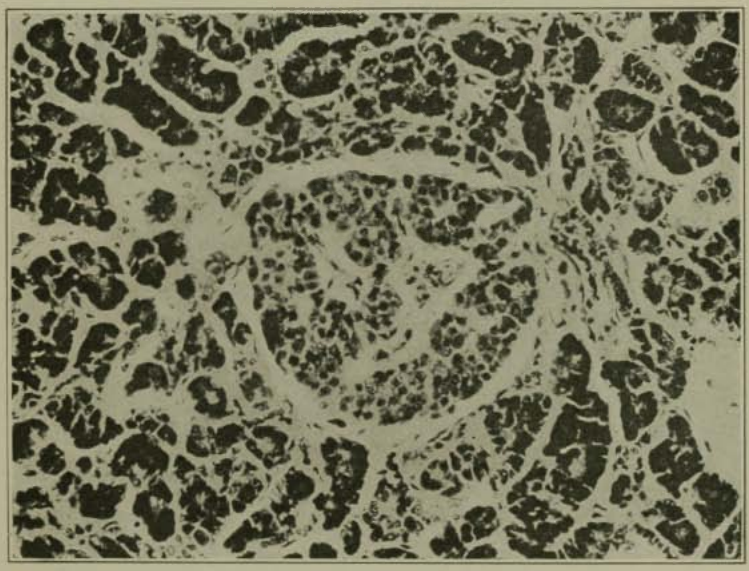

Fig. 9.—Normal island of Langerhans whose cells produce the insulin required by the body. × 250. (Mallory.)

usually lies between 10 and 50 units and if regular insulin is employed is divided between one, two, three, or four injections. Protamine insulin is given in about the same quantity but only once a day because of its prolonged effect. The normal pancreas, I imagine, produces daily 50 to 100 units, perhaps even more.

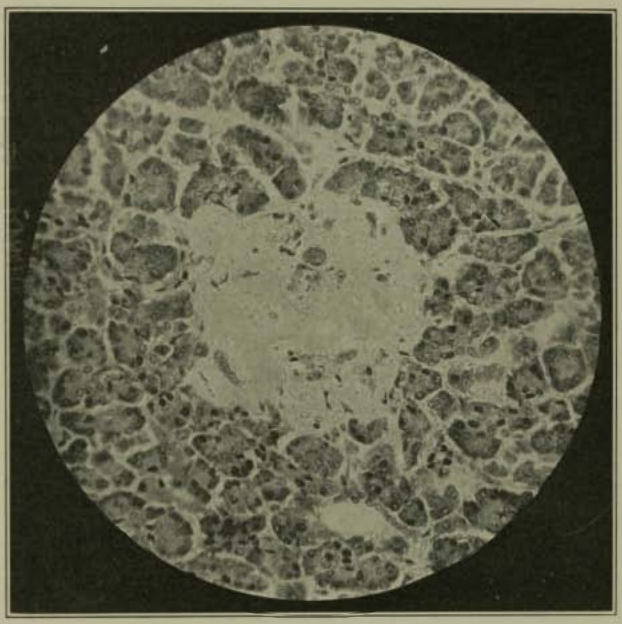

FIG. 10—Marked degeneration of islands of Langerhans with complete disappearance of the functioning cells. ×300. (Warren.)

If an excess of insulin is given, the blood sugar falls below the normal of 0.10 (100 mg.) per cent and symptoms appear which are known as an "insulin reaction." The most striking of these are hunger, sweating, trembling and, unless treatment is instituted, unconsciousness may result. Nausea and headache are not uncommon symptoms with protamine insulin. Fortunately these symptoms quickly subside and disappear if the patient is given a little carbohydrate, such

as the juice of an orange, a few teaspoonfuls of corn syrup or an equal quantity of sugar. Two lumps of sugar should always be carried by the patient.

Similar symptoms to those following an overdose of insulin occur with normal individuals after extreme exertion or when deprived of food. Along with those mentioned are nervousness, weakness, faintness, double vision, dizziness and occasionally the person is irrational. More often than we realize, healthy people four or five hours after meals have a low blood sugar percentage, and in consequence behave as does a diabetic during an insulin reaction. When any individual is hungry and out of sorts before a meal, I often wonder if his blood sugar is low.

Insulin is a remedy which a patient can learn to administer to himself, but it is nevertheless true that it is primarily a remedy for the wise and not for the foolish, be they patients or doctors. Everyone knows it requires brains to live long with diabetes, but to use insulin successfully requires more brains.

Insulin is a comfort to doctor and patient. Insulin has revolutionized diabetic treatment in more ways than one. It has given the diabetic more food, strength and weight,but it has also carried to the doctor and the patient a knowledge and respect for the diabetic diet such as has never before existed. If the diabetic wishes to get his money's worth for the insulin he injects, he realizes that he must know what and how much to eat.

Good health, not tolerable heath, is the right of the diabetic today and this is the real justification for the use of insulin. When I think of what the diabetics were in the days of treatment with undernutrition (1914–1922) and what they are now with insulin, I am reminded of the words of the Prophet Ezekiel about 2500 years ago. No better description of the transformation which has taken place in the life of a diabetic patient can be found than in the account of his vision of the valley of dry bones. (Ezekiel xxxvii, 1–10.)

CHAPTER IV.

QUESTIONS AND ANSWERS FOR DIABETIC PATIENTS.

"dans les champs de l'observation le hasard ne favorise que les esprits préparés." PASTEUR.

Knowledge Essential for a Diabetic.—The diabetic can take no chances; along with a clean body and trained muscles he should have a mind prepared and alert, because he depends upon his brains to make up in part for the loss of his pancreas. The treatment of a patient with diabetes lasts a long time. Treatment therefore should be so arranged that it can be carried on with as little interference with the daily routine as is possible. Consequently, the patient must be taught the nature of his disease and how to combat it and to avoid its complications.

In the following questions and answers an attempt is made to indicate the essential features of the knowledge desirable for a diabetic patient:

1. QUESTION. Why does an untreated diabetic grow thin?

ANS. He fails to get the full value of his food, because a part of it is lost as sugar in the urine. (See Fig. 40, page 166.)

2. QUESTION. Why are untreated diabetics hungry?

ANS. Because they must eat enough to sustain life and in addition enough to make up for the sugar lost in the urine (pages 165 to 168).

3. QUESTION. Why are untreated diabetics thirsty?

ANS. Because they must drink sufficient liquids to produce enough urine to dissolve the sugar which is overflowing through the kidneys.

4. QUESTION. How much sugar is lost in the urine in diabetes?

ANS. From a mere trace to 2 pounds in the twenty-four hours. (Fig. 40, page 166.) The percentage in the urine seldom amounts to as much as 10 per cent, which is the percentage of sugar in orange juice.

5. QUESTION. How can a diabetic gain weight and strength?

ANS. By preventing the loss of sugar in the urine. This is accomplished, (1) through diet by eating those foods which do not readily change to sugar in the body and, (2) if this does not suffice, by the use of insulin which helps the body to assimilate all foods which turn to sugar.

6. QUESTION. What class of foods most easily causes sugar to appear in the urine?

ANS. Carbohydrate foods. These are sugar, starch and others which contain sugar and starch. Cane sugar is the commonest sugar. A pure form of starch is corn starch. Fruits are almost entirely water and sugar, and vegetables are largely water and starch. Bananas, when green, contain nearly 20 per cent starch, but when ripened this changes to sugar. Starchy foods during digestion in the body rapidly change to sugar, and consequently sugar and starch are nearly interchangeable. Potatoes are 20 per cent starch, bread about 60 per cent, and the flour out of which bread is made, being drier than the bread, contains about 70 per cent. Oatmeal is two-thirds starch, but other cereals contain rather more. Milk contains 5 per cent of sugar. An extremely small percentage of animal starch (glycogen) exists in liver. The quantity of carbohydrate in various foods is shown in Table 2, page 50, and also in Table 4, page 51.

7. QUESTION. What other type of food may change to sugar and appear as such in the urine?

ANS. Protein. Theoretically 58 per cent may undergo this change. Protein is the food from which muscles and tissues are made. It is therefore an essential constituent

of the diet and everybody, and every animal, likes it. The cat will catch a mouse, the pony, Jouett, gladly comes for his bridle, and the timid sheep love to feed out of Mary's hand just to get a little protein in the form of meat or even oats. Examples of protein are lean of meat or fish, curd of milk, and white of egg. The yolk contains just as much protein as the white, but it is mixed with fat. Protein is also found in nuts and grains, and there is considerable in beans and peas, but very little in other vegetables, and almost none in fruits.

8. QUESTION. What kind of food is least apt to change to sugar?

ANS. Fat.

Examples of fat in pure form are olive oil and lard. Butter and substitutes for it contain 85 per cent fat. Rich cream contains about 40 per cent fat, whereas milk may contain but 3 per cent. Common cheese is one-third fat. The percentage of fat in meat varies from that in fat bacon, in which the percentage occasionally rises to 80 per cent, to chicken, in which the percentage of fat is 3 per cent or less. In codfish and haddock the amount of fat is negligible, but in salmon it reaches 13 per cent. Nuts are rich in fat. Fat and carbohydrate are to a large extent interchangeable in the diet of the normal person. In northern climates fat forms a large part of the diet, while in the tropics it is replaced by carbohydrate. When I see E. S. O. lick the butter off his bread, it convinces me more than do the schools that the human being needs fat.

9. QUESTION. If fat hardly changes at all to sugar in the body, why does a diabetic not live upon fat alone?

ANS. (*a*) He would tire of it. (*b*) Fat does not contain protein and so would not replace the tissues of the body. (*c*) If fat is taken without some carbohydrate, acid poisoning (acidosis) develops and unless treated this leads to coma and death.

10. QUESTION. What is the proof that a diabetic is not controlling his disease and not making normal use of the food he eats?

ANS. Sugar in the urine. The sugar is glucose (grape sugar).

11. QUESTION. How is the urine tested for sugar?
ANS. By the Benedict test (page 210).

12. QUESTION. What are the sources of sugar in the urine?
ANS. First, the carbohydrate in the diet; second, the protein; third, the fat. From 100 grams of carbohydrate 100 grams of sugar can be formed, from 100 grams of protein 58 grams of sugar, and from 100 grams of fat, 10 grams of sugar. In diabetes sugar may appear in the urine irrespective of the diet because it may be derived from the protein and fat of which the body is composed. Moreover, whenever the total diet is in excess, irrespective of any particular food, the power of the body to assimilate carbohydrate lessens. A diabetic should never overeat.

13. QUESTION. Is sugar present in the blood in health?
ANS. Yes. It amounts to about 0.10 per cent (often expressed as 100 mg. per 100 cc. of blood) normally if the blood is examined before breakfast. After a meal the percentage increases to about 0.14 (140 mg.) per cent, but drops to normal within approximately two hours. If it rises above 0.16 (160 mg.) per cent in the blood, sugar appears in the urine. (See Fig. 19, page 59.)

14. QUESTION. Why is the blood tested for sugar if the urine is known to be sugar-free?
ANS. The results of a faulty diet can be detected earlier in the blood than in the urine. The diet should not be increased, as a rule, unless the blood sugar is normal. In certain rare cases the sugar in the blood is normal and yet sugar is present in the urine. These are not true cases of diabetes, but are known as examples of renal glycosuria. In exceptional cases the sugar in the blood may rise above 0.16 (160 mg.) per cent without any sugar in the urine. Rarely there is an individual who constantly has sugar in the urine which is not glucose (grape sugar). This sugar may be pentose or levulose

and is harmless. I have only recognized 6 such patients among 15,000, but I always look for those sugars. A nursing mother has milk sugar (lactose) in the urine and this is also harmless.

15. QUESTION. How does the diabetic diet differ from the normal diet?

ANS. Very little if the diabetes is mild or if the patient takes insulin, otherwise by a little less carbohydrate and a little more protein and fat. Sugar, sweets and pastry are avoided and overeating forbidden.

16. QUESTION. How much food does a diabetic need?

ANS. Sufficient for health and strength and, if a child, for growth. This amounts in terms of heat units, calories, to about 20 to 30 Calories per kilogram body weight or 10 to 14 Calories per pound, but for a child much more, even twice as much, and for a baby three times as much.

17. QUESTION. What is a Calorie?

ANS. A Calorie is a unit of heat. It represents the amount of heat which is required to raise 1 kilogram of water 1 degree Centigrade, or approximately 1 pound of water 4 degrees Fahrenheit. All of us need food calories to supply us with warmth and energy, just as a steam boiler requires coal calories and burns these to furnish warmth and energy. We differ from the steam boiler, first, in that we burn our calories very slowly and without a flame and, second, we have (food) calories built into and stored in our living bodies and can live on these if we do not have food, although we get pretty hungry and cross doing so and the sugar in our blood may drop as low as it does in an insulin reaction.

18. QUESTION. How many Calories (heat units) are produced in the body when it burns (utilizes or oxidizes) 1 gram of carbohydrate, protein and fat?

ANS. One gram carbohydrate produces 4 Calories; 1 gram protein produces 4 Calories; 1 gram fat produces 9 Calories; 1 gram alcohol produces 7 Calories.

19. QUESTION. How is the treatment of diabetes begun and sugar removed from the urine, or, in other words, how is the patient made sugar-free?

ANS. In mild cases by eating less and exercising more; in moderate and severe cases by still greater reduction in the total diet with especial decrease in carbohydrate, and, if the urine does not become sugar-free, by the use of insulin.

20. QUESTION. When the urine of the patient is sugar-free, what is done next?

ANS. The diet is gradually increased, first, in carbohydrate, next in protein and fat, meanwhile testing the urine daily to determine whether the total quantity of food and the different varieties of it are tolerated without the return of sugar in the urine or excess of sugar in the blood.

21. QUESTION. How does insulin help?

ANS. Insulin allows the patient to eat more food. If he does not manufacture enough in his own pancreas, then he must secure it elsewhere. Insulin enables the patient to get the benefit of the carbohydrate which he eats. One unit of insulin "burns up" 1 to 2 grams and occasionally more of carbohydrate. If a patient keeps his urine sugar-free with diet or with diet and insulin, the danger of acidosis (diabetic coma) largely disappears.

22. QUESTION. What is the dose of insulin?

ANS. It varies with each case. A patient requires as many units as necessary to enable him to secure enough food to maintain vigor and a reasonable body weight. During diabetic coma and in the presence of fever insulin acts less well and more is required, but when given in sufficient quantity it is lifesaving. Exercise reduces the need for insulin.

23. QUESTION. If one begins the use of insulin, must it be continued indefinitely?

ANS. Not in the milder cases. In many instances it may be reduced in quantity, particularly in the old and in those who begin it during complications, because their diabetes has become only temporarily severe.

It is dangerous to omit insulin if sugar is present in the urine. If this rule is not followed, diabetic coma might ensue. Even if the patient ceases to take food, he should continue the insulin in smaller and more frequent doses provided the urine is not sugar-free. If deprived of insulin cut the diet in half. Never be like one of the foolish virgins. Keep a reserve of insulin, needles and syringes on hand.

24. QUESTION. What is an insulin reaction?

ANS. If too much insulin is given, the blood sugar falls below normal and a "reaction" occurs.

(*a*) The symptoms of a reaction are hunger, tremor, sweating, unconsciousness. Other symptoms are weakness, pallor, faintness, nervousness, dizziness, dilated pupils, double vision, emotional upsets. Nausea and headache may also occur if the reaction is due to protamine insulin. The urine is free from sugar. If the urine has not been voided for some hours this old urine which has been collecting in the bladder may contain sugar, but a second specimen would be sugar-free.

(*b*) The cause of an insulin reaction is the lack of sugar in the blood upon which insulin can act. It may occur: (1) if the dose of insulin is not followed soon (*a*) by food, (*b*) or by food containing enough carbohydrate, (*c*) if the digestion is upset and the food not absorbed, vomited or lost by diarrhea; (2) as a result of unusual exercise, because exercise lowers the blood sugar; (3) finally diabetics improve and a reaction may simply signify that they no longer require so much insulin.

(*c*) The prevention of an insulin reaction is accomplished by avoiding sudden changes in diet, insulin and exercise and especially when protamine insulin is used by the insertion of lunches between meals. Regular insulin must always be followed by food, preferably within thirty minutes and in a shorter period if both regular and protamine insulin are taken at the same time. Following regular insulin the interval of time before the onset of a reaction is relatively short, but after protamine insulin is relatively long and may not occur for twenty-four hours.

(*d*) The treatment of an insulin reaction is based upon raising the lowered blood sugar to a normal level. This is done by giving carbohydrate such as a few lumps of sugar, karo syrup, orange juice, ginger ale or any form of carbohydrate. If recovery is not prompt, it may be necessary to give glucose intravenously or under the skin.

25. QUESTION. What can a diabetic patient do for himself besides keeping the urine sugar-free?

ANS. Be cheerful and also be thankful that his disease instead of being of a hopeless character is one which his brains will help him to conquer. He can keep his temper under control and his skin, teeth and feet scrupulously clean. He should avoid people with colds in the head and sore throats; secure a daily action of the bowels; sleep nine hours at night and take one-half hour off for rest of some description during the day and insert exercise into the routine of the forenoon, afternoon and evening.

26. QUESTION. How can you help to prevent the development of diabetes in your children and friends?

ANS. (1) By explaining to them the dangers of obesity and telling them of easy ways by which to escape it, such as:

1. To leave the table a little hungry, avoiding second helpings.
2. To satisfy the stomach with non-nourishing 5 per cent vegetables instead of with bread and butter, which are fattening.
3. To omit lunches and candy and sodas between meals.
4. To use skimmed milk instead of cream.
5. To encourage exercise, abundant sleep, and energetic, yet restful, vacations.

(2) By remembering and explaining the possibility of the transmission of the disease. Two diabetics should not marry one another and have children; the disease may be transmitted if a diabetic marries a non-diabetic in whose family the disease is present. It is wiser for individuals with a familial tendency to the disease not to marry into families with similar tendencies. (See pp. 154, 155, 156 and 157.)

27. QUESTION. What is diabetic coma?

ANS. Acid poisoning. The fat in the body or diet is imperfectly utilized and fatty acids are formed which poison the system and, if neglected, render the patient unconscious and cause death. If sufficient carbohydrate in the body or diet is properly burned, the fat burns normally and no acid poisoning can occur.

28. QUESTION. How can diabetic coma be prevented?

ANS. By keeping the urine sugar-free.

Acid poisoning never occurs unless a patient overeats and fails to burn a sufficient amount of carbohydrate. He may overeat by breaking the diet and overeating food, or he may overeat by eating his own body which is what takes place if he has fever and infections or certain forms of goiter. Never omit insulin if the urine contains sugar. Diabetic coma is so dangerous that whenever a patient feels ill and is in doubt about having acid poisoning it is safer for him to consider it to be present. He should immediately:

1. Call his doctor.
2. Go to bed.
3. Drink slowly a cupful of hot liquid every hour, hot water, tea, coffee, clear thin broth or water-oatmeal gruel.
4. Keep warm.
5. Move the bowels by injection. If nauseated, take liquid by enema in the form of salt solution. A level teaspoonful of salt is to be added to 1 pint of luke-warm water. If this is injected very slowly into the rectum after the cleansing enema, it will be retained and absorbed.
6. Procure a nurse or someone to devote their entire time to you during the emergency.

When the doctor arrives, if he finds diabetic coma present, he will give insulin every half hour or hour, salt solution under your skin or into a vein, protect your heart and wash out your stomach.

29. QUESTION. Can a diabetic be operated upon?

ANS. Yes. Mild diabetics taking little or no insulin and whose regular diet contains 100 or more grams carbohydrate receive no food or insulin before operation. Diabetics of greater severity receive before the operation a somewhat smaller dose of insulin than usual. After the operation insulin is given every three to eight hours if sugar appears in the urine, but one should not expect the sugar to disappear immediately in all cases, particularly those with infections. Some doctors give every four hours 20 units if a red Benedict test, 15 units if orange, 10 units if yellow, 5 units if green, and no insulin if sugar-free.

R	Or	Y	G	B
20	15	10	5	0

The same program can be followed in case of an infection.

If protamine insulin is used one would take one-half the regular dose before the operation and supplement with regular insulin in smaller doses if necessary during the day.

Before discharge from the hospital a patient should know how

1. To test the urine for sugar.
2. To record his diet.
3. To explain the quantity of carbohydrate in it.
4. To describe what he is to do if sugar returns.
5. To describe what he is to do if he feels sick.
6. To describe an insulin reaction—symptoms, cause, prevention and treatment.
7. To measure out his prescribed dose of insulin and to know when and where to inject it.
8. To state the dangers of (*a*) too much insulin, and (*b*) of its total omission (pp. 35 and 36).
9. To care for his feet and the reason why.
10. To fill out his identification card.

QUESTIONS AND ANSWERS PREPARED BY MISS BERNICE MOORE, THE TEACHING DIABETIC NURSE, FOR DIABETIC PATIENTS OF THE GEORGE F. BAKER CLINIC AT THE NEW ENGLAND DEACONESS HOSPITAL.

1. QUESTION. What organ of the body is at fault in diabetes?

ANS. The pancreas.

2. QUESTION. What are the common symptoms?

ANS. Excessive hunger, thirst and urination, loss of weight and strength, and itching, local or general.

3. QUESTION. How is the disease controlled?

ANS. By diet, exercise and insulin.

4. QUESTION. How is the urine tested for sugar?

ANS. Put 4 drops of urine in a test-tube and add a teaspoonful Benedict's solution. Shake tube well and place it in boiling water for five minutes. Colors after boiling. Blue means no sugar, green shows the presence of a small amount of sugar, yellow a moderate amount, and orange and red a large amount of sugar.

5. QUESTION. How often should the urine be tested?

ANS. One to four times a day, preferably before meals or at bedtime.

6. QUESTION. Why is insulin given in the treatment of diabetes?

ANS. Insulin is given in amounts sufficient to make up the patient's own insulin deficiency so that he may have enough food to maintain normal weight and energy.

7. QUESTION. What are the chief differences between regular and protamine insulin?

ANS. Regular insulin lowers the blood sugar rapidly and its effect lasts for a period of six to eight hours.

Protamine insulin lowers the blood sugar slowly and its effect lasts for a period of twenty hours to thirty hours.

8. QUESTION. How long before the meal should insulin be taken?

ANS. About fifteen to thirty minutes before the meal.

9. QUESTION. How are the needles and syringe sterilized before an injection?

ANS. By boiling for five minutes or by keeping them in 70 per cent alcohol constantly.

10. QUESTION. How do you measure your insulin dosage in a 1 cc. syringe which is divided into tenths?

ANS. The strength of insulin equals the number of units in 1 cc. If the syringe is divided into tenths, each space equals one-tenth the strength. For example, each space equals 4 units if using U-40 insulin. Be sure you know the strength of insulin you are injecting!

11. QUESTION. Why is it essential that the site of injection be changed daily?

[illegible]

the needle was pointed, then report to your doctor.

13. QUESTION. What causes an insulin reaction?

ANS. A low blood sugar because of (1) too much insulin, perhaps a mistake in measuring, (2) too little food, (3) strenuous or unusual exercise, (4) too long interval between insulin and meal, (5) food unabsorbed because of stasis, vomiting, or diarrhea, or, finally (6) because you are improving and tolerate your food better.

14. QUESTION. What are the typical symptoms?

ANS. Hunger, perspiration, tremor, pallor, double or blurred vision, weakness, faintness, headache, and tingling sensations of the lips or extremities and, if untreated, unconsciousness and very rarely even convulsions.

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3. QUESTION. How is the disease controlled?

ANS. By diet, exercise and insulin.

4. QUESTION. How is the urine tested for sugar?

ANS. Put 4 drops of urine in a test-tube and add a tea-

ERRATUM.

Page 40, question 4, first line, Answer, should read, Put 4 drops of urine in a test-tube and add a half teaspoonful Benedict's solution.

5. QUESTION. How often should the urine be tested?

ANS. One to four times a day, preferably before meals or at bedtime.

6. QUESTION. Why is insulin given in the treatment of diabetes?

ANS. Insulin is given in amounts sufficient to make up the patient's own insulin deficiency so that he may have enough food to maintain normal weight and energy.

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ANS. The strength of insulin equals the number of units in 1 cc. If the syringe is divided into tenths, each space equals one-tenth the strength. For example, each space equals 4 units if using U-40 insulin. Be sure you know the strength of insulin you are injecting!

11. QUESTION. Why is it essential that the site of injection be changed daily?

ANS. To prevent poor absorption, abscesses, and insulin atrophy.

12. QUESTION. What would you do if a needle breaks during injection?

ANS. Circle the spot where the needle was inserted with ink or mercurochrome, draw an arrow showing which way the needle was pointed, then report to your doctor.

13. QUESTION. What causes an insulin reaction?

ANS. A low blood sugar because of (1) too much insulin, perhaps a mistake in measuring, (2) too little food, (3) strenuous or unusual exercise, (4) too long interval between insulin and meal, (5) food unabsorbed because of stasis, vomiting, or diarrhea, or, finally (6) because you are improving and tolerate your food better.

14. QUESTION. What are the typical symptoms?

ANS. Hunger, perspiration, tremor, pallor, double or blurred vision, weakness, faintness, headache, and tingling sensations of the lips or extremities and, if untreated, unconsciousness and very rarely even convulsions.

15. QUESTION. What would you take to treat a reaction?
ANS. One lump or 1 teaspoonful of sugar, one-half orange or 1 teaspoonful of any kind of syrup.

16. QUESTION. What could you do to avoid a repetition of the reaction the following day?
ANS. Reduce the dose of insulin by 2 units unless the reaction is due to unusual exercise or other obvious cause.

17. QUESTION. How can a reaction due to excessive exercise be prevented?
ANS. By taking 10 grams carbohydrate (small orange or 2 Uneedas) just before strenuous exercise.

18. QUESTION. What time of day are reactions most likely to occur with regular insulin?
ANS. Three to four hours after injection.
With protamine insulin?
ANS. May occur at any time but usually more than twelve hours after the injection.

19. QUESTIONS. What are the six rules for the prevention of coma?
ANS. In case of illness and fever, or if you "feel sick:"

1. Call the doctor
2. Go to bed
3. Keep warm
4. Have a hot drink hourly
5. Take an enema
6. Get some one to nurse you

20. QUESTION. What causes coma?
ANS. The causes of coma are breaking of diet, too little or no insulin and infections.

21. QUESTION. What are the typical symptoms?
ANS. Gradual onset of weakness, fatigue, nausea and vomiting, pain in abdomen, deep and difficult breathing, and increasing drowsiness leading to unconsciousness.

22. QUESTION. How would you regulate the dose of insulin on a day of illness?
ANS. Under your doctor's direction, test a specimen of urine every three or four hours and take graduated doses of regular insulin according to test.

If you are taking protamine insulin, it is usually wise not to take more than one dose of this a day. At times of illness, continue same dose of protamine and for supplementary doses, use regular insulin.

23. QUESTION. What foods served on your diet contain carbohydrate?

ANS. Bread, crackers, potato, rice, macaroni, all kinds of vegetables, cereals, milk, ice cream and fruit.

24. QUESTION. What foods served on your diet contain protein?

ANS. Meat, fish, fowl, eggs, bacon, cheese, and milk.

25. QUESTION. What foods served on your diet contain fat?

ANS. Butter, cream, oil, bacon, cheese, meat, fish, fowl, eggs and milk.

26. QUESTION. What foods are considered to have no food value?

ANS. Tea, coffee, cocoa shells, clear broths, diabetic mayonnaise, mineral oil and distilled vinegar.

27. QUESTION. Why is it important that you do not increase or decrease your diet without permission from the doctor?

ANS. If the diet is increased, the blood sugar will rise and sugar will appear in the urine. If the diet is decreased, the patient will not have enough food to maintain normal weight and strength.

28. QUESTION. What type of diet would you use on a day of illness?

ANS. Soft or liquid diet. For example, one quart milk, three slices of bread, one and a half pats of butter, one egg, one half cup cooked cereal, and two glasses of orange juice.

29. QUESTIONS. What are the important facts to remember about the care of the feet? What antiseptics are safe to use?

ANS. See directions under "Treatment of Feet."

30. QUESTION. How can you avoid the complications of diabetes?

ANS. By controlling the disease with correct diet, adequate exercise and sufficient insulin.

A monthly visit to the physician is advisable.

CASE NO. 5036.

	1928	1933	1937
Age, yrs.	11.7	16.7	20.7
Diabetes, yrs.	3.0	8.0	12.0
Height, in.	57.2	65.2	68
Weight, lbs.	95.5	123.5	148
Carbohydrate, gms.	147	180	200
Protein, gms.	78	105	110
Fat, gms.	101	133	120
Insulin, units	40	48	44

FIG. 11.—Case No. 5036. When Richard began diabetes, his mother worried just as much as the mother in the picture.

CHAPTER V.

DIABETIC ARITHMETIC.

"And I said of medicine, that this is an art which considers the constitution of the patient, and has principles of action and reasons in each case." PLATO: GORGIAS.

A PATIENT can be treated for diabetes successfully even though he does not know what a calorie is, what a gram represents or the meaning of the words carbohydrate, protein and fat. Indeed, many of my patients cannot read or write. But I think if one has a disease it is more fun to know something about it and as that old Grecian philosopher said, to have "principles of action and reasons in each case."

It is far simpler in computations of the diet to use the metric than the avoirdupois system. Unfortunately, the more general employment of scales registering pounds and ounces makes this at times difficult. For this reason it is well to know both the metric and avoirdupois systems and to be able to convert the one into the other. The essential values are given in Table 1.

TABLE 1.—THE METRIC AND AVOIRDUPOIS SYSTEMS COMPARED.

DRY MEASURE.

30 grams	= 1 ounce[1]	: 16 ounces	= 1.0 pound
1000 grams	= 1 kilogram	:	= 2.2 pounds

LIQUID MEASURE.

30 cubic centimeters	= 1 fluidounce[2]	: 32 ounces	= 1 quart
1000 cubic centimeters	= 1 liter		

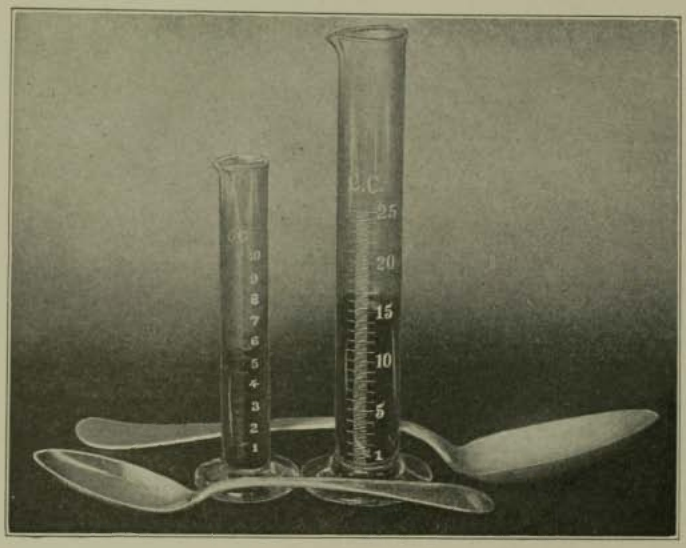
CALORIES.

1 gram carbohydrate	= 4 Calories
1 gram protein	= 4 Calories
1 gram fat	= 9 Calories

The unit of weight in the metric system is a gram. It is easy to visualize the value of a gram when it is known that a

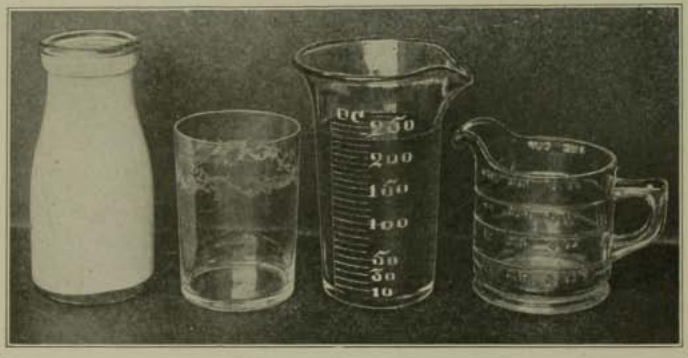
[1] Actually 28.4 grams.

[2] Actually 29.6 grams.



a *b*

FIG. 12.—*a*, teaspoon, capacity 5 cubic centimeters (cc.); *b*, tablespoon, capacity 15 cubic centimeters (cc.) or ½ ounce.



a *b* *c* *d*

FIG. 13.—*a*, cream, ½ pint or 240 cubic centimeters (cc.); *b*, drinking glass, capacity 8 ounces; *c*, 250 cubic centimeters (cc.) graduate; *d*, measuring cup, capacity 8 ounces.

buffalo nickel, five-cent coin, weighs exactly 5 grams. The average egg weighs 60 grams and a banana (peeled) 100 grams. A kilogram (1000 grams) is equivalent to 2.2 pounds.

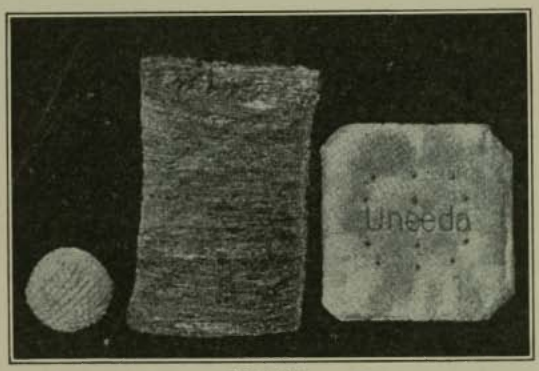


FIG. 14

Butter, 10 grams Fat, 8 grams | Shredded wheat, 30 grams Carbohydrate, 23 grams | Uneeda Biscuit, 6 grams Carbohydrate, 5 grams

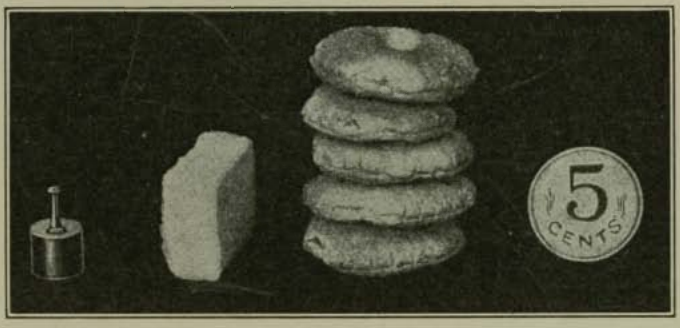


FIG. 15

5-gram weight | Lump sugar, 5 grams | 5 oyster crackers, 5 grams
Buffalo 5-cent piece, 5 grams.

Kilograms become more homelike when one's own weight is changed into kilograms. Thus a weight of 132 pounds avoirdupois is $\left(\frac{132}{2.2}\right)$ 60 kilograms metric.

The unit of volume in liquid measure in the metric system is the cubic centimeter. A cubic centimeter of water weighs 1 gram. Thirty cubic centimeters make a fluidounce, which is approximately equal to 2 tablespoonfuls of water. One thousand cubic centimeters are a little more than a quart.

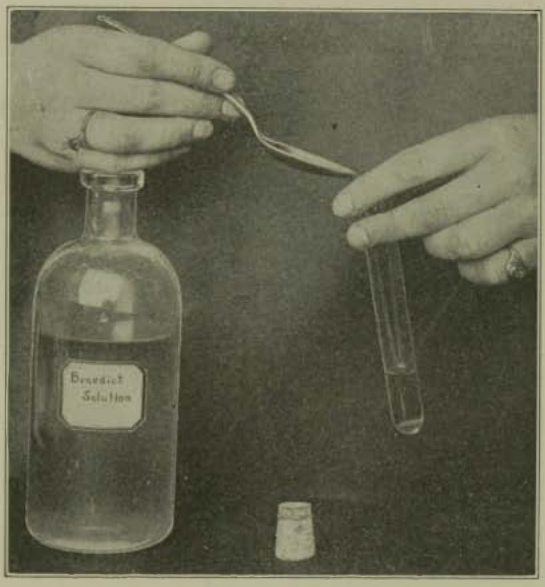


FIG. 16.—One teaspoonful (5 cubic centimeters (cc.)) of Benedict's solution in a test-tube.

In estimating carbohydrate, protein and fat in the diet, or sugar in the urine, enough accuracy is obtained in clinical work by considering that 30 grams (gm.) or 30 cubic centimeters (cc.) equal an ounce, dry or fluid measure.

The foods upon which diabetic patients live are nearly all printed in Tables 2 and 4. Most of the foods in Table 2 come under the head of *5 per cent vegetables*. By this is meant that not over 5 per cent (or 5 grams in each 100 grams) of these vegetables may be counted as carbohydrate. As a matter of fact, lettuce, at the beginning of the first column,

contains 2.2 per cent, and string beans, toward the bottom of the second column, occasionally contain as much as 6 per

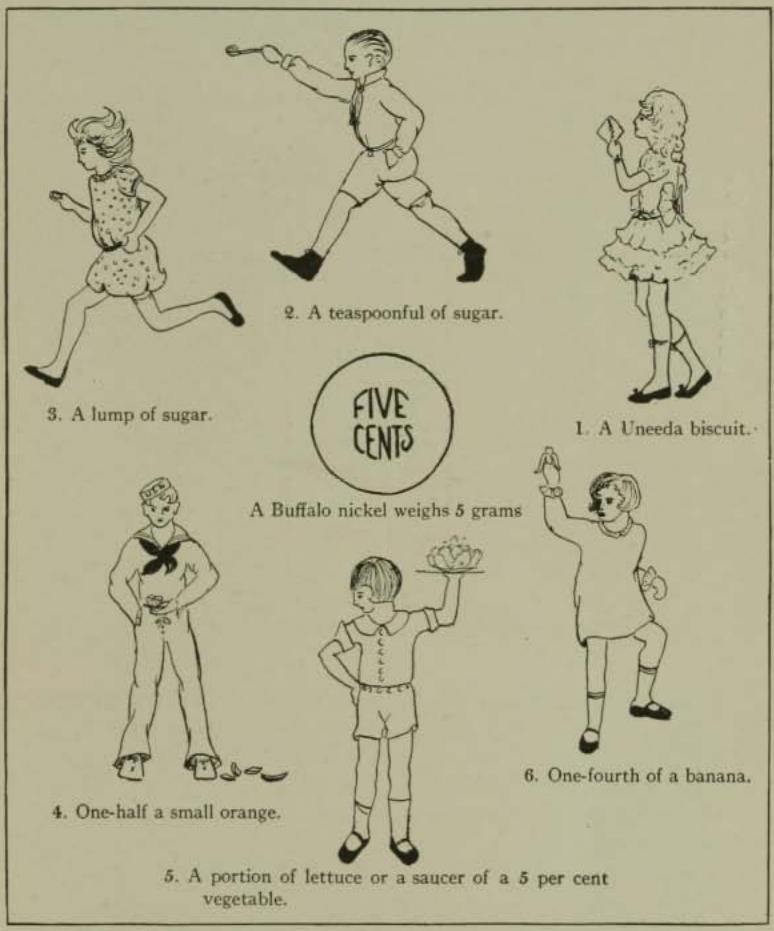


FIG. 17.—A buffalo nickel and its equivalents by weight in carbohydrate.

cent carbohydrate. The average percentage of carbohydrate for the entire group would be about 3 per cent, or 1 gram

carbohydrate for each (1 ounce) 30 grams of vegetables. A large saucerful of a 5 per cent vegetable weighs about 150 grams and contains about 5 grams of carbohydrate. Another reason for reckoning these so-called 5 per cent vegetables at 3 per cent available carbohydrate is that when they are

TABLE 2.—FOODS ARRANGED APPROXIMATELY ACCORDING TO CONTENT OF CARBOHYDRATE.

Vegetables (fresh or canned).

5 per cent.		10 per cent.	15 per cent	20 per cent.
1–3 per cent.	3–5 per cent.			
Lettuce	Tomatoes	String beans	Green peas	Potatoes
Cucumbers	Water cress	Brussels sprouts	Jerusalem artichokes	Shell beans
Spinach	Sea kale	Pumpkin	Parsnips	Baked beans
Asparagus	Cauliflower	Turnip	Lima beans, (young)	Lima beans
Rhubarb	Egg plant	Squash		Green corn
Endive	Cabbage	Okra		Boiled rice
Marrow	Radishes	Beets		Boiled macaroni
Sorrel	Leeks	Carrots		
Sauerkraut	String beans (young)	Onions		
Beet greens	Broccoli	Green peas (very young)		
Dandelions	French artichokes			
Swiss chard	Green peppers			
Celery	Summer squash			
Mushrooms	Kohlrabi			

Reckon average carbohydrate in 5 per cent vegetables as 3 per cent; in 10 per cent vegetables as 6 per cent.

cooked considerable carbohydrate is lost in the water used in the cooking. This also applies to vegetables in the 10 per cent column, and these vegetables are reckoned as containing 6 per cent carbohydrate or 2 grams to the ounce. In the 15 per cent and the 20 per cent vegetables about their full value is available.

Fruits are arranged in Table 3 and the weights of the same which contain 10 or 15 grams carbohydrate are recorded.

TABLE 3.—EQUIVALENTS OF 10 AND 15 GRAMS CARBOHYDRATE IN VARIOUS FRUITS.

Food	Carbohydrate 10 gm.	15 gm.
Grapefruit pulp	150	225
Strawberries	150	225
Watermelon	150	225
Cantaloupe	150	225
Blackberries	120	180
Orange pulp	**100**	**150**
Pears	90	135
Peaches	90	135
Apricots	80	120
Raspberries	80	120
Plums	80	120
Pineapple	70	105
Apple	70	105
Honeydew melon	70	105
Blueberries	70	105
Cherries	60	90
Banana	50	75
Prunes (cooked)	50	75
Ice cream	50	75

Fruits, fresh or canned (water packed)—approximate carbohydrate substitution values.

TABLE 4.—THE QUANTITY OF CARBOHYDRATE, PROTEIN AND FAT AND THE CALORIC VALUE OF 30 GRAMS (1 OUNCE) OF FOODS IN COMMON USE.

30 grams (1 ounce) contain approximately:	Carbohydrate, grams.	Protein, grams.	Fat, grams.	Calories.
Vegetables, 5 per cent	1.0	0.5	0	6
Vegetables, 10 per cent	2.0	0.5	0	10
Potato	6.0	1.0	0	28
Bread	18.0	3.0	0	84
Uneeda Biscuits, 2	10.0	1.0	1	53
Oatmeal, dry weight	20.0	5.0	2	118
Shredded Wheat, 1	23.0	3.0	0	104
Milk	1.5	1.0	1	19
Meat, cooked, lean	0.0	8.0	5	77
Fish, fat-free	0.0	6.0	0	24
Chicken, cooked, lean	0.0	8.0	3	59
Egg, 1	0.0	6.0	6	78
Cheese	0.0	8.0	11	131
Bacon	0.0	5.0	15	155
Cream, 20 per cent	1.0	1.0	6	62
Cream, 40 per cent	1.0	1.0	12	116
Butter	0.0	0.0	25	225
Oil	0.0	0.0	30	270

Patients seldom need to know the food values of more than the 18 foods mentioned in Table 4. I consider this table to be the most important food table in the Manual. Patients are advised to buy gram scales, but since many households already have ounce scales, Table 4 is so arranged that the quantities of carbohydrate, protein, and fat in an ounce (30 grams) of food are placed opposite that food. In Chapter XXVI are given the actual percentage values for carbohydrate, protein, and fat in all foods.

The reason for inserting the food value of dry oatmeal instead of cooked oatmeal is due to the variable quantity of water which it takes up during cooking. There is far less difference in the weights of preparations of dry oatmeal.

TABLE 5.—SUMMARY AND COMPUTATION OF A DAY'S DIET AND CALCULATIONS BASED ON TABLES 2 AND 3.

NAME. DATE.

Food.	Breakfast.	Dinner.	Supper.	Total, grams.	Carbohydrate.	Protein.	Fat.
5% vegetables	...	300	300	600	20	10	0
Orange	150	150	150	450	45	0	0
Oatmeal	30	...	...	30	20	5	2
Bread	30	30	30	90	54	9	0
Egg	1	...	...	1	0	6	6
Cream, 20%	120	...	...	120	4	4	24
Milk	...	60	60	120	6	4	4
Bacon	15	...	...	15	0	3	8
Butter	5	10	15	30	0	0	25
Meat	...	60	60	120	0	32	20
				Total grams	149	73	89
				Multiply for Calories	4	4	9
				Total Calories = 1689	596	292	801

The division of the diet of a patient weighing 121 pounds (121 ÷ 2.2 = 55 kilograms) is given in Table 5, p. 52. In the

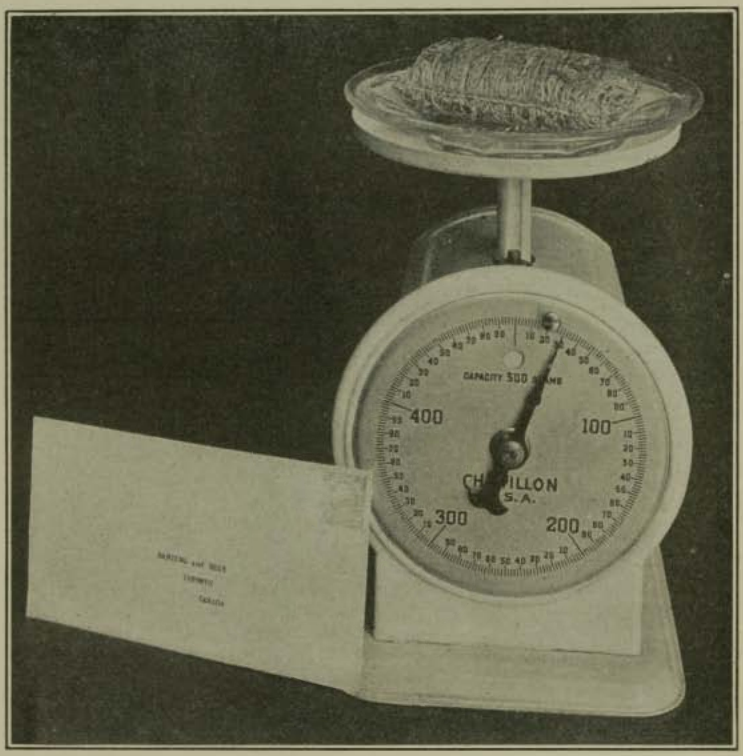


FIG. 18.—Food scales weighing 500 grams.[1] The pointer is at 30 grams which is the equivalent of 1 ounce. This is the weight of the shredded wheat shown on the scale pan or maximum weight of a letter allowed for one stamp. I believe in scales, even if they are used for a short time. Without an occasional recourse to scales a patient gets careless. *Facilis descensus Averno.* (Virgil: Aeneid, Book VI, line 126.)

first column of the table is recorded a list of the different foods taken during the day. Three hundred grams (10 ounces) of 5 per cent vegetables were given for dinner and also for

[1] Convenient food scales of 500 grams' capacity with movable dial are made by John Chatillon & Sons, 89 Cliff Street, New York City.

supper, making a total for the day of 600 grams of 5 per cent vegetables.

A medium-sized orange was given at each meal. Oatmeal, 30 grams (1 ounce) dry weight, 240 grams (8 ounces) cooked, was given at breakfast. Bread 1 slice, 30 grams (1 ounce), was given at breakfast, 1 slice at noon, and 1 slice at night. One egg was given at breakfast. The cream, $\frac{1}{4}$ pint, 120 cc. (4 ounces), might be taken for breakfast, and milk $\frac{1}{4}$ pint could be allowed for the balance of the day. Fifteen grams ($\frac{1}{2}$ ounce) of bacon, 2 strips, were allowed at breakfast. Thirty grams (1 ounce) of butter were divided into 5 grams for breakfast, 10 grams for dinner, and 15 grams for supper. The meat, 120 grams ($\frac{1}{4}$ pound, 4 ounces), was divided between noon and night.

Knowing the total quantity of each variety of food eaten by the patient during the day, by using the table of food values (Table 4) one can determine the amount of carbohydrate, protein and fat for each given food. Thus, 600 grams of 5 per cent vegetables were used. Table 4 shows that for each 30 grams (1 ounce) of 5 per cent vegetables there is 1 gram[1] carbohydrate and 0.5 gram protein, and therefore in 600 grams (10 ounces) there would be 20 grams carbohydrate and half as many grams protein, or 10 grams.

Oranges are not recorded in Table 4 but are to be reckoned as containing 10 per cent carbohydrate and grapefruit as 7 per cent carbohydrate. The 30 grams of oatmeal, dry weight, contained, according to Table 4, carbohydrate, 20 grams; protein, 5 grams and fat, 2 grams. One egg was given. Table 4 shows that an egg contains no carbohydrate, but that each egg contains 6 grams protein and 6 grams fat. In the same way one can reckon the amount of carbohydrate, protein and fat in 120 grams (cubic centimeters) of 20 per cent cream (*i. e.*, cream containing 20 per cent butter fat), 15 grams of bacon, 30 grams of butter, and 120 grams of meat (cooked).

[1] Arithmetically, 1.5 grams, but on account of variations of carbohydrate in vegetables of the 5 per cent group, and on account of losses by cooking, as well as for convenience, reckoned as 1 gram.

The actual percentages of carbohydrate, protein, and fat in various other foods are given in the large tables on pages 186–206. From these it is easy to calculate the quantity of carbo-

Adult weight (naked), 121 pounds, or $\left(\frac{121}{2.2}\right)$ 55 kilograms.

Carbohydrate,	150 grams × 4 =	600 Calories.	
Protein,	73 grams × 4 =	292 "	(1.3 grams protein per kilo-
Fat,	89 grams × 9 =	801 "	gram body weight.)
	Total	1693 "	

1693 Calories ÷ 55 kilograms = 31 Calories per kilogram body weight.

hydrate, protein and fat in any food which a patient takes when the total quantity of food eaten is known. Patients and nurses are repeatedly confused by such tables, forgetting that if the quantity of carbohydrate in milk is 5 per cent (see page 191), 100 grams of milk (or in this case cubic centimeters) would contain 5 grams of carbohydrate, just as 5 per cent interest on $100 for a year would be $5. Lobster (see page 190), for instance, contains 16 per cent protein, and therefore 100 grams of lobster contain (100 × 0.16) 16 grams protein.

The use of percentages, however, is employed far more in determining the quantity of sugar voided in the urine by diabetic patients during the twenty-four hours. If an individual voids 2000 cc. (cubic centimeters) of urine, which can be roughly estimated as 2 quarts, and the percentage of sugar is 6 per cent, it is plain that the quantity of sugar lost in the urine during the twenty-four hours would be 2000 × 0.06 = 120 grams. As a lump of sugar amounts to about 5 grams, this would mean that the equivalent of 24 lumps of sugar was lost in the urine in one day or $\frac{1}{4}$ of a pound.

CHAPTER VI.

EFFICIENCY IN VISITS TO A DOCTOR.

Help the doctor and you help yourself.

A PATIENT frequently fails to gain all he should from a visit to his physician because he does not furnish the facts upon which advice for further treatment should be based. Physical appearance alone is by no means a sufficient guide to the careful doctor. Information ought to be presented concerning the urine, the diet, units of insulin used, insulin reactions or other complications.

1. **Information Obtained by Examination of the Urine.**—The physician should know whether the urine of the patient is free from sugar, or, if present, how much it contains. This is essential in order to prescribe the diet or the insulin. The patient should therefore take with him a specimen of the urine saved from the entire twenty-four-hour amount. To collect such a specimen of urine, discard that voided at 7 A.M. and then save all urine passed up to and including that obtained at 7 the next morning. Take 60 cc. (2 ounces) of the thoroughly mixed twenty-four-hour quantity for examination. Record the twenty-four-hour amount of urine, the date, and the name on the bottle. The large bottle in which the urine is being collected should be kept in a cool place. It is best to procure a bottle[1] for this special purpose sufficiently large to hold the entire twenty-four-hour amount of urine. Select a bottle with a large mouth, that it may be more easily cleansed. The bottle should be scalded out daily. It should have a tight-fitting cork. Urine, so collected, decomposes slowly. On account of the presence of sugar, diabetic urines are prone to ferment, and if fermentation occurs, a portion

[1] Bottles known to the druggists as percolator bottles and graduated in 100 cc. up to 2000 cc. are most convenient, but any bottle can be graduated by making a scale on the outside with graduations of 100 cc. or in ounces.

of the sugar disappears and thus spoils the test. A good preservative is xylol, of which ½ teaspoonful can be placed in a 2-quart bottle before the collection of urine begins.

From the difference between the total quantity of sugar in the urine and the carbohydrate in the diet it is possible to learn how much of the carbohydrate of the diet has been assimilated by the body. More and more patients will desire to know this percentage. Of course 100 per cent utilization is to be desired, but if 90 or better 95 per cent is utilized, worry decreases.

The use of insulin has emphasized the value of the examination of single specimens of urine. The urine voided before a meal may be free from sugar, while that voided one or two hours after eating may show sugar. This indicates that either the carbohydrate should be reduced at that particular meal or insulin increased. If the urine voided upon rising is not sugar-free, it shows that the diabetes is not controlled and that the carbohydrate should have been more evenly divided through the twenty-four hours, lessened in quantity or more insulin should have been taken the previous day. Unless the urine is sugar-free on rising[1] the patient is handicapped all day long. Temporarily it may be desirable to save the day's urine in four portions, forenoon, afternoon, evening and night. The urine voided at about an hour after breakfast may show considerable sugar, but shortly thereafter or more surely later in the morning may become sugar-free. If the rising and forenoon specimens are free from sugar the patient can consider himself about perfect.

A convenient method to report specimens is as follows:

Date.	Forenoon.	Afternoon.	Evening.	Night.
January 1	Red	Orange	Yellow	Green
January 2	R	Or	Y	G
January 3	Y	G	B	B
January 4	B	B	B	B

[1] I must point out that rarely the urine will contain sugar on rising because it appeared at some hour during the night. In this event a second specimen voided a few minutes later and representing freshly secreted urine might be sugar-free.

2. **Information Obtained by Examination of the Diet.**—The quality and quantity of the food eaten during the twenty-four hours should be recorded. If thirty minutes are allowed for a visit to the physician's office, it is no exaggeration to say that unless this summary of the diet is kept, one-third to one-half of the visit is spent by the physician in learning what the patient has eaten. For this reason patients should always bring a diet list arranged according to some such plan as that shown in Table 5 (page 52). If you do not know the weights, record as best you can.

3. **Insulin.**—An accurate record of the amount of insulin taken should be furnished. It is a good plan to show the doctor the syringe and the bottle of insulin used. It is important to know when the insulin has been taken and how much at a time. Has there been an insulin reaction, and what was the cause, and how can another be prevented? Show the doctor where you inject the insulin, and learn his new ideas.

4. **Information Obtained by Examination of the Blood.**—Frequently the course of treatment of a case of diabetes is regulated by the quantity of sugar in the blood. If the sugar in the blood can be kept at the normal figure before a meal, 0.1 (100 mg.) per cent and at not over 0.16 (160 mg.) per cent after a meal, the patient should not show sugar in the urine. It is advantageous to have blood-sugar tests at various times in the day. The blood sugar usually reaches its greatest height in normals about one-half hour after a meal, but in diabetics the peak comes later and the curve falls more slowly to the normal level. The percentage of sugar in the blood usually reaches its lowest limit in the late forenoon. This is the period when the patient taking insulin is most exposed to an insulin reaction and a particularly important hour for a blood-sugar test for patients who are about to leave the hospital, because with extra exercise at home the blood sugar is apt to fall still lower. (See Figs. 19, 20, page 59.)

5. **Body Weight.**—If the patient has scales, the weight before breakfast, and preferably undressed, and for children the height without shoes on the morning of the visit should be taken.

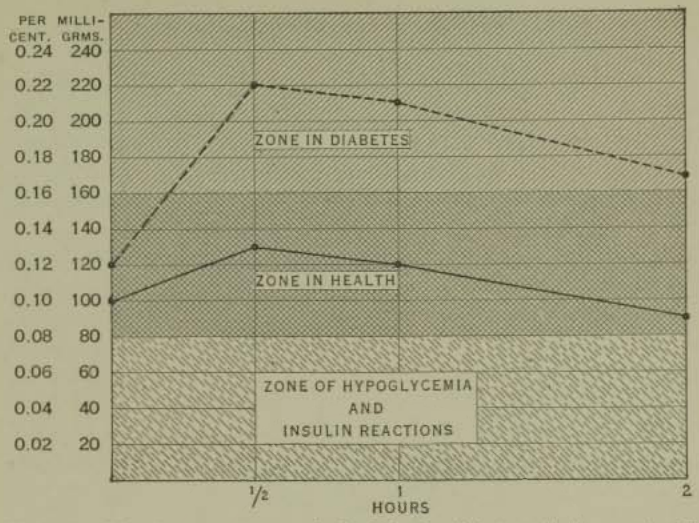


FIG. 19.—Blood sugar zones: in health; in diabetes; during an insulin reaction.

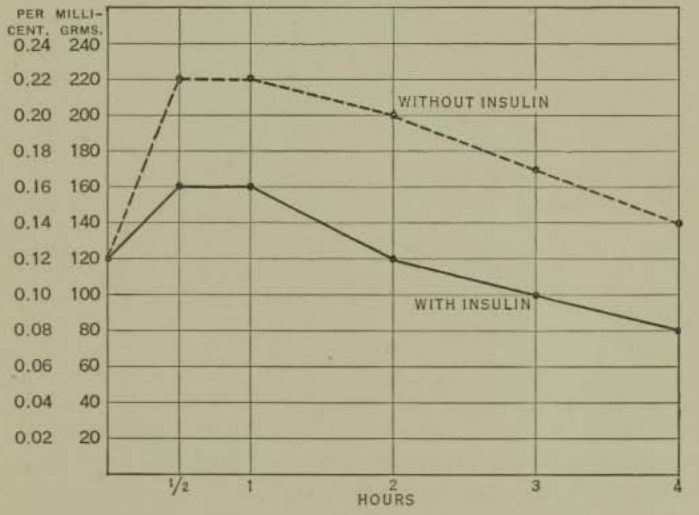


FIG. 20.—The blood sugar in diabetes before and after a meal, with and without insulin. The blood sugar is important, but it can rise to high levels without a fatal issue. Thus, with one patient it rose to 1.62 per cent (1620 milligrams) and even with such a high value Case No. 4099 recovered from coma in 1927.

6. **Heredity.**—Any new details about heredity should be reported. Only by coöperation between patient and physician will new cases of diabetes in the family be detected and others perhaps prevented.

7. **Notebook.**—It is a good plan to start a notebook on the first day of treatment and show it to the physician at each visit. All questions about symptoms and diet which have arisen since the former visit should be set down neatly with space left for an answer to each question. It is a common error for patients to ask the same question many times, whereas if the answer is written down by the physician the question would thus be answered once for all time.

The notebook should contain a statement as to whether sugar has been present or absent in the urine since the last

TABLE 6.—THE DIETETIC TREATMENT OF EIGHT GROUPS OF THIRTY CASES EACH OF DIABETES.

Group.	Date.	Age at onset, yrs.	Carbohydrate.	Protein.	Fat.	Calories per kg.	Insulin.	Weight, kg.
I	1915	40	26	54	76	18	..	57
II	1916	46	43	60	82	21	..	56
III	1917	42	43	60	90	23	..	54
IV	1923	37	71	58	123	34	13	53
V	1927	46	96	60	113	28	21	59
VI	1931	43	144	68	90	29	21	58
VII	1933	40	153	73	91	29	26	60
VIIIA	1936	42	160	80	99	29	18	64
VIIIB	1936	32	167[1]	85	106	34	13 + 30	57

report to the physician. Such data can be gathered on one page. When a patient comes to my office with a single specimen of urine instead of a portion taken from the twenty-four-hour quantity, without any record of the food eaten during the preceding day, and starts in to recount that he

[1] This table gives a wrong impression in that it might imply a preference for higher and higher carbohydrate. As a matter of fact, in recent months, particularly with patients using protamine insulin, there has been a return to an average carbohydrate of 150 grams, with extremes between 100 and 200 grams.

had nothing but eggs, meat, and fish, then later remembers that he had a little cream and various vegetables, then with prompting recalls butter and an orange and a little oatmeal, potato or bread, I always pity him, and on very exceptional occasions am able to recall with satisfaction after the interview Solomon's soliloquy in Proverbs xvi, verse 32.

Changes in the dietetic treatment of groups of diabetic patients between the years 1914 and 1933 are shown in Table 6. Some patients are given 200 grams of carbohydrate and none less than 100 grams.

FIG. 21.—Case No. 6999. Age at onset of diabetes eleven years five months in December, 1926. Reported in good condition, April, 1937, but now she has a husband instead of a lion for a pet.

If a diabetic child can control a lion, she can certainly control diabetes.

CHAPTER VII.

HYGIENE FOR THE DIABETIC.

The diabetic should be the cleanest citizen in the community.

THE diabetic should plan to keep his body strong and his mind alert. He has a disease and it makes him susceptible to complications, particularly to infections, acute and chronic, general or localized in one part or another of the body, but especially in the lower extremities. He should be the cleanest citizen in the community, he should take advantage of sunlight and fresh air because of the resistance to disease which they promote, he should exercise because in his muscles sugar is burned and thus more carbohydrate may be allowed and less insulin required. Case No. 632 said a game of golf is worth 5 units, and any diabetic mountain climber will tell you how much his diet can be increased and his insulin reduced by a long day's hike. The diabetic who does not utilize exercise in the treatment of his disease is handicapped at the very start.

Dr. Sabine, of Brookline, made the remark, based upon the experience of his many years of general practice, that those of his patients who took active camping trips in the woods bore the stress of modern life best. By this means exercise was combined with mental relaxation. That the good effects of each last for months is not hard to believe. It is only natural to conclude that if the muscles, in which is stored one-half of the carbohydrate of the body, are kept in good condition by training, a favorable effect must be produced upon the general metabolism of carbohydrate. The effect of increase of exercise upon the well-being of fat diabetics has been pronounced, and it is striking how many miles a semi-ill or obese diabetic patient can learn to walk in two weeks. The patients are encouraged to take their walks

soon after meals and to go outdoors several times a day. The good effects of exercise are shown not only by the freedom of the urine from sugar and an increased carbohydrate tolerance, but by improved circulation and general well-being. No case should be considered too far advanced for an attempt at muscular redevelopment. Patients themselves realize the value of exercise. More of them upon rising should spend three to five minutes in gymnastic exercises than is apt to be the case.

So important is exercise for the proper assimilation of carbohydrate that even surgical patients are urged to exercise. Occasionally this is accomplished by pulley weights attached to the foot of the bed and by dumb bells, but for others passive exercises or bed gymnastics are recommended. The so-called Buerger exercises may be advantageous almost as much from their effect upon the whole body as upon the lower extremities. This undoubtedly explains in part why diabetic patients today withstand surgical operations better than formerly. A diabetic patient with rheumatism is greatly handicapped. Relieve the rheumatism and much of the insulin may be omitted.

Exercises for the promotion of the circulation in the legs are of great service. They may ward off gangrene. Such exercises are described on page 127.

Case No. 804, a patient whose diabetes changed from severe to moderate and finally from moderate to mild under his own care at home, wrote that he considered exercise of the greatest importance. He said that he had the best garden of anyone in his city.

Case No. 7500, a young farmer, had an insulin reaction when he went out in the woods to chop. His exercise reduced his need for insulin.

Case No. 352 outlived his expectation of life, having had diabetes twenty-three years, and throughout this time he led a most active existence. Moreover this was accomplished many years before insulin was discovered. He was a pioneer and his case was of great value to me in the direction of others. He wrote:

"First, it is very hard to start the exercise, and the less one feels inclined to start it the more one needs it. Second, it is

neither necessary nor desirable that the exercise should be violent. I found a quiet ride of an hour, walking or jogging, after taking something on the stomach started up my old metabolism for the whole day. If I rode hard, I got tired out."

Finally, it is astonishing how much exercise a diabetic in training can take. One of my severe cases, living on a strict diet, several years ago walked between 20 and 30 miles in one day.

To many persons exercise seems a luxury, but a diabetic is fortunate in that he must always consider exercise a necessity.

Athletic contests are allowable for diabetics today, but on account of the danger of a reaction, as a result of the strenuous exercise, every diabetic under such circumstances should have a confederate who will keep a friendly eye upon him. Insulin reactions are very commonly brought on by exercise, but that is no contraindication. Either the diet can be increased or the insulin reduced.

A letter from Case No. 1729. Age at onset eighteen years in 1918. Health excellent 1937.

MARCH 31, 1930.

"DEAR DR. JOSLIN:

"I have just returned from a skii trip in the Rocky Mountains and in view of the fact that I am a diabetic it seems worth while to let you know a few of the details. It might serve as a little encouragement to other fellow patients.

"In our party were seven large and hardy individuals each carrying bedding and personal effects as well as some food, the whole pack varying between 20 to 35 pounds. We covered in all 250 miles over passes, through valleys in temperatures as low as minus 17, sleeping in cabins when possible, otherwise making camp in the snow. At times our food ran very low. One day in particular we travelled from 8 A.M. till 9.15 P.M. through deep snow. Our allowance in food each (estimated, of course) that day was not more than 2000 calories.

"We were the first persons to penetrate the region (Jasper Park) on skiis and the first to reach and ascend in winter the Columbia Icefields, L., who stroked the famous Yale Olympic crew in 1924, S., a Norwegian, and myself.

"It seems like a school boy trick to brag about this sort of thing, but as I took a dose of insulin before a roaring campfire, temperature around zero and snowing, the thought occurred to me that it might be perhaps a unique experience for a diabetic to be in, 100 miles from the nearest railroad. It is from this standpoint that I am writing rather than from the standpoint of a Richard Halliburton.

"Sorry to bore you with this. Also, sorry not to have as yet checked on blood sugar and urine. General health and fitness fine.

Sincerely, "

Exercise, however, is a two-edged sword. For it to be beneficial the individual must have insulin available in his body. A normal man has an abundance of insulin; a mild diabetic has less but yet enough insulin so that he too can benefit by exercise, but a severe diabetic must supplement his supply by injecting insulin, otherwise exercise will do harm. Insulin and especially protamine insulin change a diabetic so nearly to a normal individual that during exercise he utilizes carbohydrate beautifully, but if the carbohydrate is lacking a reaction may develop. The same thing happens with athletes. Therefore when about to take extra and strenuous exercise or during it the diabetic should eat 5 to 30 grams additional carbohydrate.

Rest.—Rest is essential. A tired child is put to bed and wakens refreshed; two of the most noted surgeons in the country are not ashamed to leave their guests at the table and lie down for fifteen minutes after their luncheon; the best treatment for a failing heart is to put its owner in bed for a week. Diabetic patients should rest often, should never allow themselves to get overtired. The diet is designed to give a rest to the pancreas. Sleep nine hours and more if you can. Short periods of complete relaxation yield maximal returns.

Mental Attitude.—Forget that you have diabetes and do not talk about it with others. This is one reason for not using saccharin, and another is to avoid the perpetuation of a sweet taste, thus reviving the thought of the previously unrestricted diet.

Mental diversion is desirable, but anxiety is harmful. Heavy responsibilities should be avoided as well as nervous

upsets and emotional excitements, which are disturbing to anyone. However, the man who has a job is the happy man and as a rule the harder a man works the happier he is and less bother he is to the other members of his family. At one time I feared the effect of emotional upsets upon the diabetic, but the longer I treat diabetics the less importance do I assign to mental perturbations. The Great War taught me worries did not cause diabetes or often make it worse.

The art of learning how to get the most out of life under all circumstances must be cultivated by any patient. It takes time, thought, and practice to accommodate one's methods of living to changed conditions, but it pays to study the problem.

Success in Treatment.—Never forget that if you make a success of your own case, you are aiding some other diabetic and indirectly help-in all diabetics to secure or retain their jobs. And, furthermore, each diabetic who wins a prize protects and advances the reputation of the whole group. Unfortunately the reverse is also true. Therefore, always be alert, and never expose yourself to a reaction in public. Obey all laws and traffic rules.

Case No. 4073.

	1928	1933	1936
Age, yrs.	11.2	16.0	19.1
Diabetes, yrs.	5.2	10.0	13.1
Height, in.	52.0	62.5	63.1
Weight, lbs.	62.8	109	116
Carb., gms.	90	175	150
Protein, gms.	64	75	70
Fat, gms.	107	99	80
Insulin, units	26	58	8 +

Fig. 22.—Case No. 4073. Betty turned a handspring at the Clinic before the American Medical Association in Washington in June, 1927.

CHAPTER VIII.

THE DIET OF NORMAL INDIVIDUALS.

Food and Fuel.—Foods are fuel for the body, just as gasoline is fuel (food) for an automobile. Man and automobile depend upon fuel as a source of energy. In case the gasoline gives out the automobile will stop, but if the food gives out the man will not immediately die, because he carries a good deal of his fuel stored up in his body, first and chiefly as fat, second, a lesser amount in the form of protein in the muscles and various tissues, and third, a little in the form of carbohydrate as animal starch (glycogen) and sugar in the liver, muscles, skin and blood.

A fasting man at the Carnegie Laboratory in Boston went without food for thirty-one days, living upon his reserve supply of food, in other words his own tissues. He used up about all his carbohydrate in five days and then depended upon fat and protein, producing enough carbohydrate out of the latter to prevent acid poisoning from his consumption of his own body fat.

Just as one can measure how much gasoline is required for an automobile to run 100 miles, so one can measure how much food is necessary for a man to live for twenty-four hours and do a given amount of work. Small automobiles require less gasoline than large automobiles, and this is pretty much true of individuals, for the food which they need depends upon their weight. There are exceptions. Children require proportionately more food, because they are growing, and old people require less, because they are quieter. If an adult behaves like a child in that he eats like a child, he will grow fat. How unfortunate it is that there is no one to spank him and thus possibly save him from acquiring diabetes later: however, indigestion occasionally comes to the rescue. Just as the automobile depends upon gasoline, oil, and water, the human automobile depends upon carbohydrate, protein,

and fat, water, and various salts. If the food value of 1 gram of the foods, carbohydrate, protein, and fat is known, and also the quantities of these that are eaten, the total food value of the diet can be determined.

The nutritive value of the diet is readily computed by referring to Table 4, page 51, and by bearing in mind the caloric values of the various foods. (See page 34, Question 18.) Table 5, page 52, will serve as an example.

Another method allows the food required by a given individual to be calculated far more accurately. By this method the total heat which is given off by a man at rest or at work in a closed chamber is measured. This is known as measuring the metabolism of a patient and if it is done twelve hours after food and while he is lying down quietly it is termed the basal metabolism. Patients with certain diseases of the thyroid gland have a high metabolism and others have a low metabolism. Thus they are said to be burning up their body tissues more rapidly or more slowly than normal individuals. Consequently they are apt to be thin or fat. The metabolism of diabetics when properly treated should be normal.

This total heat represents energy which has been derived from the oxidation (burning up or utilization) of the three foodstuffs—carbohydrate, protein, and fat. It is unessential whether the foodstuffs oxidized have been taken within a few moments as food or whether they represent food deposited in the body as fat (fat tissue), protein (muscle tissue) or carbohydrate (glycogen, *i. e.*, animal starch). Knowing the total heat given off it is not a difficult matter to calculate how much carbohydrate, protein and fat were required to produce it. Experiments have shown that the heat which is liberated in the body from the burning of 1 gram of protein or of carbohydrate produces 4 Calories, from 1 gram of fat, 9 Calories and from 1 gram of alcohol, 7 Calories. Fat, as would be expected, is more than twice as nourishing as carbohydrate or protein.

The caloric needs of the body vary not only from day to day and hour to hour, but from moment to moment. The calories required by the average normal adult when at rest are about 25 per kilogram body weight. If the individual

is sitting in a chair instead of lying on a couch 20 per cent more energy is required. Too often in dietetic computations it is assumed that the caloric needs of the body can be accurately estimated. As a matter of fact, the error in such computations is considerable, and it is absurd to expect to compute the needs of the individual when up and about, whether normal or diabetic, more closely than within 10 to 20 per cent of the real value. The reason for this is apparent if one observes the attitudes and motions of individuals in a street car. The one is quiet, the other restless; the one avoids exertion, the other is all activity. In disease these differences of habit and disposition are accentuated. One patient with 40 Calories per kilogram body weight will gain pounds, the other will barely hold her own weight. A diabetic patient, Case No. 1541, a woman, aged fifty-eight years, confined for a year to her bed with paralysis remained sugar-free, held her weight constant and the diet, accurately weighed by a trained nurse for the entire period, averaged 20 Calories per kilogram body weight per twenty-four hours.

As an illustration of the amount of work which can be performed by 1 Calorie of energy, I learn from my friend, Professor Benedict, that the expenditure of 1 Calorie of heat is required to rise from a sitting position in front of a door, turn the key in the door, and sit down. A single 16-candle-power carbon lamp gives off in heat the equivalent of about 45 Calories per hour, which represents a little less than the heat, basal metabolism, of an adult weighing 50 kilograms.

It is desirable for us all to visualize calories and to that end various concrete examples of what calories derived from food will enable an individual to do are given. To walk one hour on a level road at the rate of 2.7 miles an hour requires 160 Calories above that of keeping quiet (Lusk). I suspect one will not err greatly if for each mile of walking one allows 1 Calorie per 1 kilogram body weight. A man of 60 kilograms (132 pounds) walking up one flight of stairs, 10 feet high, expends about 3 Calories.

Sewing and knitting require about 9 Calories, typing at the rate of 50 words a minute 30 Calories, per hour more than that for the same subject sitting quietly in a chair, but

washing, sweeping and scrubbing floors require 50 Calories additional. Ironing and dish-washing each require about 25 Calories additional.

One forgets that an individual doing heavy work does not require additional calories for the entire twenty-four hours. With the cessation of work the metabolism falls abruptly. Furthermore, the actual period of heavy work is short and represented by minutes rather than hours. If of a pessimistic nature one has only to watch street laborers, though a far more enjoyable and as scientific a proof is furnished by the minutes spent in actual play by football teams. In one entire game the minutes in which the ball was actually in play numbered only eleven. As age advances less calories are required and a woman above the age of sixty-six years, whose vigorous physical activities have ceased, will have a twenty-four hour heat production of about 1000 Calories when in a state of complete rest according to my friend, Professor F. G. Benedict. Anyone knows it is cheaper to board an old man than a young boy.

Composition of the Normal Diet.—The ordinary diet for a man at office work contains about 300 grams of carbohydrate, 90 grams of protein and 90 grams of fat. This would amount to 2370 Calories in the twenty-four hours, or about 34 Calories per kilogram for an individual weighing 70 kilograms (154 pounds). These figures would be proportionately reduced both for those of lower body weight and for those with lighter occupations who would require nearer 30 Calories per kilogram.

Usually rather more than one-half of the energy-producing value (calories) of the diet of the normal individual consists of carbohydrate. These figures are only approximate, but they leave no doubt as to how large a place sugar and starch occupy in the daily ration. In fact it is estimated that the average individual in the United States between 1920 and 1930 consumed 100 pounds of sugar yearly or about $\frac{1}{4}$ pound daily.

The quantity of protein in the normal diet of an adult is decidedly less than 100 grams. There is little doubt but that it is safe for an individual to live upon 1 gram protein

per day for each kilogram body weight, and a doctor's worry ends if his patients secure 60 grams protein. Protein is animal food to a large degree; hence its high cost; carbohydrate comes from the vegetable kingdom and is therefore cheap. If an excess of protein is burned the other foods are also consumed more rapidly, and there is more chance for the heat so produced to go to waste.

The quantity of fat in the normal diet varies partly from choice and partly from economic reasons. In general in those cases in which the carbohydrate in the diet is high the fat is low, and *vice versa*.

The more agreeable varieties of fat, such as butter, cream, bacon and oil, are expensive foods. Fat is also a concentrated food, not only because it has twice the caloric value of either carbohydrate or protein, but because it occurs more frequently in pure form. Oil, butter and lard contain little water, whereas except for pure sugar and starch most carbohydrates and proteins are diluted five to ten times with water. The body itself is about three-fourths water.

The chief source of error in calculating the total caloric value of the diet, and especially of the diabetic diet, is in the estimation of fat. I am very skeptical about the accuracy of the so-called high-carbohydrate low-fat diets in which the fat is supposed to be 50 grams or less. Anyone can realize this upon examining a piece of meat with its fringe of fat. The fat in bacon is most variable, and in amount its value can only be approximately estimated. Portions of bacon lose from 43 to 67 per cent of fat in the cooking. For this reason my patients weigh their bacon after it is cooked.

Eggs in some cities by law must weigh 1½ pounds a dozen, an average of 60 grams (2 ounces) apiece. Such eggs contain approximately 6 grams of protein and 6 grams of fat. How gross our caloric reckonings are is obvious if a collection of eggs is weighed and the minimum and maximum weights noted. The weight of the heaviest egg in a collection of 56 eggs was 72 per cent more than that of the lightest. The 6 grams of protein are equally divided between the white and the yolk, but the 6 grams of fat are all in the yolk. When protein without fat is wanted in the diet 1 whole

egg and the white of 2 others can be made into a dish of scrambled eggs. This would contain protein 12 grams and fat 6 grams.

Milk and cream are desirable in the treatment of diabetes, but they must be prescribed and taken with care, because of the large quantity of carbohydrate, protein and fat which they represent. Milk also is valuable because it contains calcium, which is necessary for the bones. A glass of milk, 240 grams or cubic centimeters (8 ounces), is drunk so easily that one is apt to forget that it contains 12 grams carbohydrate, 8 grams protein and 8 grams fat. Thirty cubic centimeters (1 ounce) of whole milk, skimmed milk or buttermilk contain 1.5 grams of carbohydrate and 1 gram of protein. Whey contains 5 per cent carbohydrate, but practically no protein or fat. Cream and koumiss contain about 3 per cent carbohydrate, or 1 gram to the ounce. The Jewish sour cream contains about one-half as much.

Cream, butter and cheese are high in nutritive value because they contain so much fat. They must be greatly restricted or even omitted if a patient desires to live on a low-fat diet or to lose weight. Cheese made from skimmed milk would be practically free from fat. The high-protein value of milk—1 gram to the ounce, 32 grams to the quart—is important to consider, not alone because of the protein itself, but also because from protein sugar is often formed. Cheese contains about one-half again as much protein as fish.

If a physician wishes to prescribe and a patient desires to live upon a definite diet, it is safer to weigh it than to guess at it. Freely granting that there are inaccuracies even in weighed diets, I believe they are most useful. Relatively from day to day a weighed diet will vary less than a guessed diet or grossly estimated diet. One can use a series of model sizes for different kinds of foods, but in the end they will not serve the purpose of the scales. If one guesses at food values, one is apt to be careless in other ways and be tempted to overlook a specimen of urine when it contains a trace of sugar or even a greenish-yellow test. It is a comfort in the treatment of diabetes that one is dealing with facts and that results can be predicted. Idiosyncrasy and chance, as well

as the human equation, largely can be eliminated. If sugar shows in the urine, there is a reason for it.

I recommend to most diabetic patients at the commencement of their training to weigh their food. After a few days of weighing, they can select utensils from their own pantry or china-closet which conform to the size of the portions of their own special diets and use these exclusively. By this means needless weighing is avoided. However, even then from time to time recourse to weighed diets will clear up inconsistencies in treatment in an obscure case.

Patients and physicians often go to the other extreme and think their computations of the diet are extremely accurate. In reality they are only approximate. This applies to grape fruit, oranges and apples and still more so to vegetables and breads.

Errors in computing the carbohydrate in 5 per cent vegetables may be considerable, but their aggregate amounts to little, because few patients can eat enough 5 per cent and 10 per cent vegetables to equal more than 20 grams carbohydrate daily. Particularly is this true if lettuce and other vegetables listed in the first column of Table 2 form a part of the total.

Vitamins.—It is now common knowledge that certain food constituents other than protein, carbohydrate, fat and minerals are essential for proper growth and development of the body and for the maintenance of a proper state of nutrition and health. Advances in our knowledge of these food substances, called vitamins, have been made so rapidly in the last several years that any account is almost certain to be out-of-date within a short time.

Vitamin A is fat-soluble and is found in cream, butter, cheese, egg-yolk, whole milk, green and yellow vegetables, and cod liver oil. Lack of vitamin A in the diet results in a lowering of the ability of the body to withstand infections of various sorts.

Vitamin B is water-soluble and is present in whole cereals, bran, nuts, vegetables, milk, eggs, lean meats and certain fruits. Various specially prepared concentrates of yeast, wheat germ, bran, etc., contain large amounts of vitamin B.

Recent research has shown that this vitamin may be further subdivided. For example, vitamin B in the diet prevents the development of beri-beri, a disease characterized by neuritis and formerly seen a great deal in the Orient, Vitamin G (or B_2) promotes growth; certain investigators have considered that its lack is the cause of pellagra.

Vitamin C is water-soluble and is present in fresh cow's milk and in many fresh fruits and vegetables. Oranges, lemons, grapefruits, tomatoes, and raw cabbage are particularly rich in vitamin C. Lack of vitamin C causes scurvy and insufficient vitamin C may result in a condition of apparent undernutrition. There is some evidence that vitamin C aids in preventing tooth decay.

Vitamin D is found in abundance in the liver of fishes, particularly the cod and halibut. It is present to a lesser extent in egg yolk, whole milk, and butterfat. Sunlight and ultra-violet light are powerful sources of this vitamin as is also irradiated ergosterol (viosterol). Lack of vitamin D produces rickets.

Vitamin E is widely distributed among foods. Since as yet there is recognized no diseased condition in man which can be traced definitely to a lack of this vitamin, its requirement may be assumed to be met in most instances.

Adults require 0.7 gram and children 1 gram calcium in the daily diet. An ordinary hospital diet without milk and eggs or their products contains about 0.4 gram calcium, but milk 100 cc., cream 120 cc., cheese 30 grams, or 2 eggs each contain 0.1 gram, so that it is easy to bring the calcium up to a proper figure. With diabetic patients, who are rather more prone to fractures than normal individuals, we are particular to protect them in this respect.

CHAPTER IX.

THE DIET OF DIABETIC INDIVIDUALS.

THE diet in health is made up chiefly of carbohydrate; the diet in diabetes before the discovery of insulin was made up chiefly of fat. Insulin has changed all this. The task of the modern diabetic is not so much to learn how to live comfortably upon less carbohydrate than that to which he has been accustomed and upon more fat, but rather to balance the carbohydrate in his diet with insulin so that he can utilize it and thus keep his urine sugar-free. The diet of the Eskimo used to be not greatly unlike that of the diabetic, but today the Eskimo, thanks to better transportation facilities, and the diabetic, thanks to insulin, add more carbohydrate to it. However it is just as important now as heretofore to avoid eating too much.

A comparison of the components of the normal and diabetic diets is given in Table 7.

TABLE 7.—NORMAL AND DIABETIC DIETS COMPARED. ADULT WEIGHING 132 POUNDS (60 KILOGRAMS).

Food.	Comparison in grams.		Comparison in calories.	
	Normal.	Diabetic.	Normal.	Diabetic.
Carbohydrate . . .	250	150	1000	600
Protein	60	75	240	300
Fat	60	90	540	810
Total	...	...	1780	1710

The normal individual weighing 60 kilograms, 132 pounds, takes 250 grams carbohydrate, and the average diabetic between 100 and 200 grams. Each takes from 50 to 100 grams of protein according to age. To make up for the slight loss of carbohydrate, the diabetic may increase the fat of the normal diet which is about 60 grams to 100 grams, often less and seldom much more. Remembering that 1 gram of carbohydrate or protein yields 4 Calories and that

1 gram of fat yields 9 Calories, one can arrive at the figures in the right half of Table 7.

Caloric Needs of the Diabetic.—The diet of the diabetic patient should contain the minimum number of calories which the normal individual would require under similar conditions. Many normal individuals, in my opinion, actually live upon less than 30 Calories per kilogram body weight, and repeatedly one sees diabetic patients over fifty years of age who comfortably live upon less for long periods. This is true only for the treated diabetic. If the patient is allowed more than the minimum amount of food there is far more likelihood that a portion will be unassimilated and appear as sugar in the urine. One of the first rules for the diabetic patient to learn is never to overeat. No matter whether upon a diet with low or high carbohydrate, low or high fat, all doctors agree that surplus food must be avoided. He should be a model in food conservation for his household. In pre-insulin days he always returned a clean plate because his appetite was equal to the food allowed.

The Estimation of the Carbohydrate in the Diabetic Diet.—The quantity of carbohydrate in various foods is easily calculated and far more simply than is usually thought. (See Table 4, page 51, with accompanying text.) Most diabetics are given a medium-sized orange, of which the pulp weighs 150 grams, or its equivalent, three times a day. An orange contains 10 per cent carbohydrate and thus the total in this form amounts to 45 grams. A slice of bread should weigh 30 grams (1 ounce), varying more or less according to whether the cook, who cuts it, is fat or thin and contains 18 grams carbohydrate. If allowed at each meal we have (18 by 3) 54 grams carbohydrate. Four portions, 600 grams (20 ounces), of a mixture of 5 per cent vegetables account for 20 grams more. Cream 120 cc. ($\frac{1}{4}$ pint, 4 ounces) would contain 4 grams, and the same quantity of milk 6 grams carbohydrate. If we should add oatmeal, 1 saucerful, 30 grams dry weight (1 ounce), we would have 20 grams more. Thus, altogether, we have carbohydrate 45 + 54 + 20 + 4 + 6 + 20 grams, or a grand total of 149 grams. Fortunately the content of carbohydrate in the 5 and 10 per cent

groups of vegetables is so small that one is justified in the vast majority of cases in accepting an average figure for each group. It is true that there is considerable variation in the vegetables as classified in Table 2 but the average content in carbohydrate for all vegetables under one heading is not far from that represented, the error being in the assignment of too high rather than too low values. This does not hold for string beans, because trouble often occurs from the string beans containing the mature beans thus greatly increasing their content in carbohydrate. Many an unexplained trace of sugar in the urine has undoubtedly occurred in this way. In the same way squash, summer squash, and vegetable marrow, vary in composition according to maturity. Young vegetable marrow and young summer squash are safely included in the 3 per cent column, while mature fruit of any squash may be expected to run between 5 and 10 per cent.

One will not be very wrong if he considers the maximum amount of carbohydrate which a diabetic will secure from 5 per cent vegetables in the twenty-four hours as 20 grams. This is why in mild cases of diabetes it is unnecessary to weigh these vegetables, for it is improbable that a patient will eat too much of these. He is far more likely to eat an insufficient quantity. These vegetables are most desirable because of their content in vitamins, particularly vitamin C. One must never forget that a diabetic likes to eat and that he can seldom eat anything less harmful than 5 per cent vegetables. Tactful wives always provide their diabetic husbands not only with an abundance, but a wide variety, of these vegetables and take infinite pains to get the best and to prepare them with the utmost care.

The Carbohydrate in Various Foods.—1. *Five and 10 per cent vegetables.*—These are of great value. See page 198 and Tables 2 and 4. Lettuce and cabbage are the most useful 5 per cent vegetables. Bulletin No. 28, Office of Experiment Stations, U. S. Department of Agriculture, gives 2.9 as the average percentage of carbohydrate in the former and 5.6 for the latter. By its bulk lettuce satisfies the appetite and the quantity allowed is unlimited. Cabbage is the poor man's 5 per cent vegetable. It can be eaten daily for months, raw

and cooked, without repugnance. Case No. 866 in the pre-insulin era was sugar-free at the hospital with difficulty, but when he went to sea on a lumber schooner and lived almost exclusively on cabbage for his vegetable, he returned after one month not only with a sugar-free urine but with a blood sugar of 0.12 (120 mg.) per cent.

Artichokes are desirable vegetables for diabetics. The French variety with the concentric leaves is to be classed as a 5 per cent vegetable; the Jerusalem artichokes which grow under ground contain 16 per cent carbohydrate.

2. *Fruit.*—Fruit is most desirable for a diabetic patient. The taste is agreeable, it serves instead of a dessert, and so relieves the patient of the embarrassment of sitting idly at the table when others are eating. The best varieties of fruit for diabetic patients are grapefruit and strawberries, each containing 7 per cent of carbohydrate, and oranges (10 per cent). These fruits are safer for the patient than apples (13 per cent), because they contain somewhat less carbohydrate and are more satisfying. Furthermore, it is less easy thoughtlessly to eat an orange than an apple and thus break dietetic restrictions. To a diabetic an apple is devoid of skin, seeds and core. A small apple contains 1 tablespoonful of sugar and a large apple 3 tablespoonfuls. Before insulin was available I never had any success in allowing apples to diabetics and I taught all the children to reply in answer to the question "What should a diabetic do with an apple?" "Give it away."

At present my patients use equivalents in their choice of fruits and certain other foods as representing 10 and 15 grams carbohydrate (See Table 3). The values are approximate. The quantity of carbohydrate in a very small orange 250 to the box, circumference $8\frac{1}{2}$ inches, is about 10 grams. The same statement will apply to one-half a small-sized grapefruit, 96 to the box, circumference 11 inches, one-half a medium-sized apple or banana. One will not be far wrong to consider that one compartment of a very small orange contains 1 gram carbohydrate.

3. *Bread.*—Insulin allows the diabetics bread. Previously few, save the old and mild diabetics, could take it without

sugar appearing in the urine. Today practically all diabetics can have the equivalent of 1 slice at a meal. One slice of bread usually weighs 30 grams (1 ounce) and contains 18 grams carbohydrate. Three slices would therefore contain 54 grams. Bread contains so much carbohydrate that no patient should be careless in its use. Fat people who are dieting to overcome obesity realize this and do not trust themselves to take much of any bread.

An error of 1 ounce in the weight of 5 per cent vegetables amounts to 1 gram carbohydrate, but of bread to 18 grams. If the bread is toasted, enough water is lost to raise the percentage of carbohydrate in the toast to between 60 and 70 per cent. If the bread is made without sugar and with water instead of milk, the carbohydrate content is lowered and may amount only to 45 per cent. Coarse breads if made without sweetening or milk would contain slightly less carbohydrate. Crackers and zwieback contain still less water than toast, and in consequence the percentage of carbohydrate is raised to the neighborhood of 70 per cent. The black Jewish bread contains about 40 per cent carbohydrate (page 193). A slice of white bread weighing 30 grams (1 ounce) is about 3 by $2\frac{1}{2}$ by $\frac{1}{2}$ inches.

Substitutes for Breads. Many of the preparations of bread upon the market contain as great, or even a greater quantity of carbohydrate than ordinary bread; a few contain less; but the percentage of carbohydrate may vary from time to time. Patients, and sometimes physicians, forget that substitutes for bread must be prescribed only in definite amounts. A diabetic bread should never be advised without a knowledge of its content of carbohydrate, protein, and fat.

There are four types of bread substitutes. (1) *Bran Bread.*—Bran washed nearly free of carbohydrate is neither more nor less than the use of cellulose, and this is supposed to have no effect upon the metabolism. Bread made of bran alone is not very palatable, though with the fat of bacon or butter it is liked better. Untreated bran contains about 56 per cent of carbohydrate of which approximately one-half is assimilable. In other words ordinary bran can be reckoned as containing about 28 per cent carbohydrate.

For this reason and because of the molasses which they often contain, bran biscuits bought at a restaurant often prove to be a delusion and a snare. The various preparations of bran, bran breads, and cookies sold under trade names often contain carbohydrate other than bran, hence the reason for their palatable taste; beware of them. They may contain over 60 per cent carbohydrate, of which less than 10 per cent is real bran.

(2) *Gluten Breads.*—These breads are made by removing much of the starch material from the flour. It is surprising how thoroughly this can be done. The large quantity of protein which all gluten breads contain is objectionable. Many gluten breads upon the market contain as much as 30 per cent carbohydrate and the protein may reach 40 per cent. Thus in 30 grams or 1 slice there would be as much protein as in 2 eggs. As nearly 60 per cent of protein can change to sugar the danger of the use of gluten breads is obvious.

(3) *Light Breads.*—French bread cut in thin slices is a possible substitute for bread, because it is bulky and gives the appearance of a large quantity. Its virtue consists solely in its bulk, which allows a surface on which to spread butter.

Various other substitutes have been used for flour in the manufacture of bread. Thus, aleuronat meal, corn cob meal, casein under various trade names, and soy beans have been employed, and the manufacturers have been most ingenious in their preparation.

(4) *Oatmeal.*—Oatmeal is two-thirds carbohydrate. In calculations one should be guided by the dry weight, because the different forms of oatmeal vary greatly in bulk and weight when cooked. It is a simple matter for a few days to weigh out 30 grams (1 ounce) of dry oatmeal, containing 20 grams carbohydrate, have it cooked and note the weight and bulk. Cooked oatmeal contains enough water to make the weight eight times that of the dry variety. A small saucerful of oatmeal contains the equivalent of dry oatmeal 15 grams ($\frac{1}{2}$ ounce) or 10 grams carbohydrate.

In weighing foods with the usual variety of scales one should never attempt to weigh out quantities as small as

5 grams. A more reliable result is obtained by weighing out multiples of 5 grams and then dividing into enough portions to make each portion 5 grams.

A shredded wheat biscuit, weight 30 grams, can be used almost interchangeably with 30 grams of oatmeal because it contains but 23 grams of carbohydrate. Its size and its availability at all times make it an extremely convenient article of food for a diabetic patient. A Uneeda biscuit contains almost exactly 5 grams carbohydrate. Unfortunately now there are various sizes of each of these articles. Whereas oatmeal, dry weight, is approximately two-thirds carbohydrate, most other cereals, especially those partially cooked and crisp and dry are three-quarters or more carbohydrate. Consequently in substituting another cereal for 30 grams oatmeal, lessen the amount to 25 grams.

(5) *Milk.*—The carbohydrate in milk is in the form of lactose and can be reckoned at 5 per cent, or 1.5 grams per 30 cc., or 1 ounce. It is the same in skimmed milk, buttermilk, and whey; but cream and koumiss contain about 3 per cent, or 1 gram carbohydrate to the ounce. Buttermilk and skimmed milk contain essentially the same quantity of carbohydrate and protein as milk, but only a trifling amount of fat. Fermented milk may contain 5 per cent sugar. (See pages 72, 84, 191.)

(6) *Potatoes.*—The variation in the percentage of carbohydrate in potatoes before and after cooking is negligible, save with potato chips, in which on account of the loss of water in their preparation the carbohydrate is more than doubled. In potato chips the fat reaches nearly 40 per cent and if it is desired to keep the fat in the diet low, it would be necessary to allow for this. Similarly the carbohydrate in artichoke chips or flakes is about double (30 to 35 per cent) that in the Jerusalem artichokes themselves, which is 15 per cent. Emphasis should be laid upon the comparatively small amount of carbohydrate in potato in proportion to its bulk in comparison with the large percentage of carbohydrate in bread. Unfortunately it is not so easy to estimate carbohydrate in potatoes as in bread. A considerable number of

my milder cases of diabetes, by giving up bread and bread preparations entirely, have been able to eat potatoes freely.

(7) *Nuts.*—Nuts containing 15 and 20 per cent carbohydrate are probably far less objectionable than most other foods with a similar carbohydrate content. This is due to the fact that in such nuts as almonds and peanuts a larger part of the carbohydrate is in the form of pentosan, galactan or other hemicelluloses, which probably do not readily form sugar. On the other hand, nuts are dangerous for a diabetic unless allowance is made for the considerable quantity of protein and the very large quantity of fat which they contain. Thirty grams (1 ounce) of castanas (Brazil nuts) represent about 6 nuts in which there are carbohydrate 2 grams, protein 5 grams, and *fat 20 grams, or 210 Calories.* Ignorant diabetics often eat nuts as freely as they would 5 per cent vegetables and wonder why they develop sugar in the urine and acid poisoning. Case No. 1930, quite mild when her treatment began, went home, ate nuts about as freely as some 5 per cent vegetables, and escaped diabetic coma, but only with heroic treatment. Thirty peanuts weigh about 30 grams and contain approximately carbohydrate 6 grams, protein 8 grams and fat 12 grams. They closely resemble American cheese plus the carbohydrate.

Protein in the Diabetic Diet.—The quantity of protein required by diabetic patients varies with the age, weight and activity of the case as well as with the condition of the kidneys. It is a safe rule at the beginning of treatment to attempt to increase the protein gradually up to the same quantity as that required by a normal individual. This is approximately 1 to 1.5 grams per kilogram body weight for adults, but for children it may reach 3 grams.

Protein stimulates the metabolism more than any other kind of food, favors acidosis, and can lead to the formation of 58 grams of glucose for every 100 grams protein metabolized.

Meat and Fish.—These two articles constitute the chief sources of protein in the diabetic diet. The study of the chemical composition of these foods is simplified for the dia-

betic patient by the fact that carbohydrate is absent, except in liver and shell-fish. Even in liver the quantity of carbohydrate is almost negligible when we consider the amount and frequency with which this article of food is eaten. The analyses of liver and shell-fish will be found in the tables on pages 188, 190.

The chief difficulty in computing the nutritive value of meat and fish is due to the varying content of fat. Thus, the edible portion of chicken may contain on the average only 2.5 per cent of fat, whereas lean ham may contain 14 per cent of fat, fat ham as much as 50 per cent and smoked bacon 65 per cent, though lean smoked bacon 42 per cent. In general a mixture of cooked lean meats probably contains not far from 10 to 15 per cent of fat.

Fish differs from meat chiefly in the small quantity of fat. Even salmon, which contains more fat than most other fish, showed in its analysis only 12.8 per cent fat, shad 9.5 per cent, and herring and mackerel 7.1 per cent. In general other kinds of fish show 6 per cent or less of fat. Halibut steak, for example, contains 5.2 per cent and cod 0.4 per cent. Preserved fish, however, is quite rich in fat; thus sardines contain 19.7 per cent. In substituting fish for meat, my patients are taught to add from $\frac{1}{2}$ to 1 teaspoonful of olive oil or butter to the diet for each 30 grams of fish. One egg and 30 grams of sardines are convenient equivalents.

The quantity of protein in meat also varies considerably and usually falls as the percentage of fat rises. A value of 20 per cent for protein in uncooked lean meat represents about the average, and this is increased to 25 per cent or more when the meat is cooked. The quantity of protein in fish is very slightly less than that in meat. Shell-fish make agreeable additions to the diet: (1) They are desirable because they are palatable; (2) they are bulky foods and so are satisfying; (3) they furnish a separate course at a meal. Half a dozen oysters or clams are quite sufficient. The edible portion of a medium-sized oyster on the shell weighs on the average $\frac{1}{2}$ ounce, and half a dozen oysters would amount to about 100 grams. The six would contain about 4 grams

carbohydrate, 6 grams protein and 1 gram fat, the equivalent of 50 Calories. Half a dozen clams on the shell (edible portion) weigh 35 grams and contain 0.7 gram carbohydrate, 3 grams protein and a negligible quantity of fat.

Eggs.—Next to meat and fish, eggs are the most frequent source of protein for the diabetic. (These have already been discussed on page 71.)

Cheese.—Cheese is a prolific source of protein and is to be recommended because of its lesser cost. Most varieties of cheese upon the market contain large percentages of fat. Even skimmed-milk cheese may contain as much as 15 per cent. The percentage of protein varies from 18.7 per cent in Neufchâtel cheese to 37.1 per cent in Dutch cheese, while the fat varies from 1 per cent in cottage cheese to 38.3 per cent in red American and to 38.9 per cent in Dutch cheese. Therefore, one must not be oblivious of the variety of cheese when eating an ounce of the same.

Broths.—Broths are so extensively used for diabetic patients that their composition deserves notice. Jelly-like broth contains a large quantity of protein in the form of gelatin, and when it was necessary before the use of insulin to reckon every gram of food a patient ate, its nutritive value could not be neglected, because 58 per cent of the protein may break down into sugar. As a rule, the nutritive value of a broth can be disregarded. That this may be the case the broth should be skimmed free of fat and obviously should be clear so as to be free from particles of meat fiber. Various canned bouillons and bouillon cubes contain very little nourishment. (See page 193.) A danger in broths lies in the amount of salt which they contain.

Fat in the Diabetic Diet.—Fat forms a large portion of the calories of the diabetic patient's diet, amounting to about half the total calories in the diet outlined in Table 7 and to about a fourth or a third of the total calories even in those diets in which the carbohydrate is high and the fat correspondingly low. The discovery of insulin has lowered the fat in the diabetic's diet, because he can take more carbo-

hydrate. Indirectly this is beneficial in that it lessens the danger of acidosis and diabetic coma and very likely it also retards the development of hardening of the arteries. Table 7 gives the proportions which the different foodstuffs hold in the diet and shows the extent to which diabetic patients must depend upon fat to offset the loss of carbohydrate.

How much fat should a diabetic patient eat? This does not depend upon the capacity of the digestion. The safest answer would be: as little as possible above the normal quantity in order to maintain normal body weight.

Fat is most agreeably taken as cream, and cream which contains 20 per cent butter fat is usually easier to bear than a richer cream. The upper 120 cc. (4 ounces) of a quart bottle of milk which has stood for twenty-four hours is 20 per cent cream. Cream bought at the market as medium cream contains about 25 per cent butter fat, and heavy cream contains 38 per cent fat. It is seldom advisable to allow more than $\frac{1}{2}$ pint (240 cc.) of cream, and at present I usually prefer to prescribe $\frac{1}{4}$ of a pint of cream and $\frac{1}{2}$ of a pint of milk. Some patients prefer to increase the quantity of cream at the expense of other forms of fat in the diet. Half a pint of 20 per cent cream contains 48 grams of fat, and yet the quantity of carbohydrate or of protein in cream of this richness is but little over 8 grams and may be estimated in clinical work as 8 grams, or 1 gram to the ounce. Occasionally patients tolerate butter better than cream and, as a rule, fresh, unsalted butter is preferred. Thirty grams of butter contain 25 grams of fat, and this is a welcome addition to the diet. Oleo, butterine and nut margarine contain no sugar and have about the same percentage of fat as butter, and the cost is very much less. Lard is nearly 100 per cent fat. Crisco, also nearly 100 per cent fat, is often more welcome than lard, because of the lack of flavor. Oil is 100 per cent fat. Mineral oil is without nutritive value. One of my patients by error took large doses of olive oil thinking it to be mineral oil and serious symptoms resulted from the surplus food. Mineral oil can be used advantageously in place of olive oil in making salad dressings if one wishes to avoid the fat.

Mayonnaise Dressing.

Yolk of egg	1
Mineral oil	3 cups
Juice of lemon	½
Salt, paprika, mustard to taste,	
Distilled vinegar	1–2 tablespoonfuls

Beat yolk, add lemon juice, mustard, salt, paprika, then oil drop by drop until it is thoroughly worked in, not increasing amount until you are sure it will not separate. Add vinegar to proper consistency. Allow 2 dessertspoonfuls daily.

French Dressing.

Mineral oil	½ cup	Salt
Distilled vinegar	⅔ cup	Pepper
Saccharin	¼ grain	Cayenne
Enough paprika to color.		

Mix in a small bottle which can be kept on on the ice. Shake well before using.

Cod-liver oil is splendid for children and nearly all our children take 10 grams (two teaspoonfuls) daily.

Danger of Fat to the Diabetic.—Fat is the chief source of the dreaded acidosis, though to this in some degree protein contributes as well. Fat, therefore, at one time may preserve the life of the diabetic, because of its high nutritive value, but at another period may destroy it by causing acid poisoning. Fat in the diabetic diet when properly balanced with carbohydrate and protein is harmless.

Alcohol.—Alcohol does not contain carbohydrate, but the oxidation of 1 gram in the body gives rise to 7 Calories. If enough alcohol is taken to make the diet above the caloric needs, sugar appears in the urine as it would after an excess of protein, or fat.

Theoretically alcohol might appear indicated in diabetes, but practically patients do better without it. Furthermore, I think it far easier for a diabetic to exercise self-restraint without the use of alcohol than with it. It is certainly not needed in the diabetic dietary.

The pleasure which comes from the practice of medicine has increased materially since the restriction of the use of alcohol in the community and, despite allegations to the contrary, I believe the amount of alcohol consumed is less than thirty years ago.

I base this upon my experience as a boy with the workmen in my father's factory in a country town, as a student in

college and medical school, as a house officer in various hospitals, as a postgraduate medical student in Europe, as a physician attending medical gatherings and as a practitioner of medicine for more than thirty years. If one partakes of alcoholic beverages I think it unreasonable to expect all railroad employees and all chauffeurs to abstain. I believe modern machinery and the automobile will remove the alcoholic.

A glass of beer contains about as much carbohydrate as the same quantity of milk and as much alcohol as a tablespoonful of whisky. It lacks the protein and fat of milk. A glass of milk contains 163 Calories; a glass of beer costs twice as much and contains 113 Calories.

There are few young men, much less young women or young doctors, who in looking for a job or a practice find it an asset to have it known that they drink. I do not want any such working for me.

Liquids.—It is rarely necessary to restrict the liquids in diabetes. The control of the diabetes which diet, insulin and exercise provide lessens the quantity of the sugar to be excreted and this usually leads to a corresponding diminution in thirst and in the volume of urine.

Case No. 1196 continually voided large quantities of urine, but investigation usually revealed a cause, such as the ingestion of 20 or more grams of salt, bouillon cubes in large number or 21 half-grain saccharin tablets a day Ice water should be discouraged; it may not always upset the digestion, but it does invariably call for the expenditure of calories to warm it to blood heat, and calories for such a purpose a diabetic cannot well spare.

Salt (Sodium Chloride).—Salt is of great service to the diabetic patient. If it is withdrawn from the diet the weight falls, due to the simultaneous excretion of water, and the skin and tissues of the patient become dry. When diabetic treatment began with fasting, patients often lost much weight because water alone was allowed. One case lost 13 pounds in four days in this manner. When broths are freely given during fasting it is not uncommon, particularly in the presence of acidosis, to see a patient gain weight, and invariably such patients feel better than those who lose.

This gain in weight is to be explained by the large quantity of salt in the broths. If a teaspoonful of salt remains in the body it holds back with it approximately 1 pint of water. This frequently causes temporary swelling of the lower extremities and face, a condition which usually is more annoying than dangerous. It may affect the eyesight temporarily due to changes in the lens. Patients should not be fitted for glasses while the diet is being changed. It is relieved by the omission of salt from the food. Salt is very freely used by diabetic patients. I do not remember to have ever seen a diabetic patient who took too little salt. One of my fasting cases was accustomed to shake salt into his hand to eat. Patients will often salt their broths, although these frequently already contain too much.

The fact that it is harmful for a diabetic patient to take large quantities of salt is occasionally shown by the excessive quantities of urine which they are obliged to void, though sugar-free, to get rid of it and by the swelling in legs and ankles which may appear. However, it should be stated that it is most exceptional for a patient with dropsy to develop diabetic coma. The withdrawal of salt from the diet of Case No. 1378 wrought surprising changes in her weight and her dropsy entirely disappeared. From 98 pounds it fell to 70 pounds in twenty-five days, and this was due almost exclusively to the disappearance of the dropsy. If the quantity of the urine in twenty-four hours does not exceed 1500 cc. (3 pints) the amount of salt in the diet is seldom, if ever, too great.

DIETETIC SUGGESTIONS, RECIPES AND MENUS.

The modern diabetic has little need for dietetic recipes, because the diabetic diet today is sufficiently varied and liberal to be both palatable and satisfying. Plain foods well cooked are enjoyed the most, and the taste for such grows rather than wanes. It is both less conspicuous and less troublesome to select the food from the diet served the rest of the family and with intelligence this can be done. The less a diabetic alters the essentials of the standard diet the easier it is for him in the long run to adhere to it.

Cracked Cocoa.—Cracked cocoa (cocoa nibs) makes a most useful drink for diabetic patients. This is not generally appreciated by the profession.

The sample of cracked cocoa (cocoa nibs) used has been purchased by the S. S. Pierce Company, Boston. It was analyzed by Professor Street, with the following result:

Moisture	2.83
Protein	14.69
Fat	51.42
Fiber	4.32
Ash	3.88
Starch	7.48
Reducing sugar, as dextrose direct	None
Reducing sugar, as dextrose after inversion	0.94

The cocoa is prepared for the table by adding 1 cupful of the cracked cocoa to 1 quart of water and letting it simmer on the back of the stove all day, adding water from time to time. The strained infusion alone should be taken and not the nutritious grounds or nibs. Professor Street was good enough to analyze the infusion, and wrote me: "The cocoa prepared according to directions contained 0.032 per cent of reducing sugar as dextrose direct and 0.138 per cent of total reducing sugars."

Cocoa shells are extensively used as a beverage. One cup of cocoa shells to 1 quart of water should be used, allow to simmer at least one-half hour. Drink the strained infusion. Cocoa shells are far cheaper than cocoa nibs.

Desserts can often be made with gelatin and this may be flavored with coffee, lemon, rhubarb, or cracked cocoa. In preparing such desserts if saccharin is used it should be added as late as possible during the cooking for it is apt to become bitter with heat. It is always a safe rule to add too little rather than too much saccharin.

Lunches.—For the following lunches, I am indebted to Miss Somerville in charge of the Diabetic Wards of the New England Deaconess Hospital and Miss Winterbottom, the Wandering Diabetic Nurse for children. The composition of the lunches can be made exact or approximate according to the pains taken in their preparation and selection. The patient will recognize whether portions served at a restaurant exceed his allowance.

	C.	P.	F.
1.			
Lamb chop, 2	0	16	10
Lettuce and tomato salad	5	3	0
Small potato	12	2	0
Bread, 1 slice	18	3	0
Butter, 1 portion	0	0	8
Milk, ½ pint	12	8	8
Orange	15	0	0
	62	32	26
2.			
Clear soup	0	0	0
Steak, medium	0	24	15
Tomato and cucumber salad	5	3	0
Peas, 1 saucerful	10	3	0
Baked potato, 1 medium	18	3	0
Butter, 1½ pats	0	0	13
Ice cream, 1 big scoop	20	0	0
Saltines, 3	10	1	1
	63	34	29
3.			
Milk, ½ pint	12	8	8
Uneedas, 5	25	3	3
Eggs, 2, scrambled	0	12	12
Toast, 1 slice	18	3	0
Butter, 1 pat	0	0	8
Orange, 1	10	0	0
	65	26	31
4.			
Club Sandwich.			
Lettuce, tomato and cucumber	5	3	0
Bacon, 2½ strips	0	3	8
Chicken	0	16	6
Butter, 2 pats	0	0	16
Toast, 2 slices	36	6	0
Melon, ½	20	0	0
	61	28	30
5.			
Oyster Stew.			
Milk, ½ pint	12	8	8
Oysters, 9	6	9	2
Butter, 1 pat	0	0	8
Oyster crackers, 12	15	1	1
Cheese, 1 ounce	0	8	11
Toast, 1 slice	18	3	0
Banana, ½	10	0	0
	61	29	30

6.

	C.	P.	F.
Lobster	0	20	13
Lettuce and tomato salad	5	3	0
French fried potatoes	18	3	0
Butter, 1½ pats	0	0	13
Bread, 1 slice	18	3	0
Berries	20	0	0
	61	29	26

School Lunches.—SUBSTITUTE FOR DINNER.

Approximate value of average diabetic child's dinner C 65, P 35, F 32.

1.

	C.	P.	F.
Bread, 60 grams	36	6	0
Meat, 60 grams	0	16	10
Lettuce,			
Butter, 15 grams	0	0	13
Cottage cheese, 25 grams	0	5	0
Milk, ½ pint (240 grams)	12	8	8
Orange, 150 grams	15	0	0
	63	35	31

2.

Bread, 60 grams	36	6	0
Cheese, 45 grams	0	12	16
Lettuce,			
Egg, 1	0	6	6
Milk, ½ pint (240 grams)	12	8	8
Apple, 100 grams	15	0	0
	63	32	30

3.

Bread, 60 grams	36	6	0
Choice of filling, 75 grams:			
Crabmeat, tuna or salmon	0	20	13
Lettuce,			
Mayonnaise,			
Butter, 15 grams	0	0	13
Milk, ½ pint (240 grams)	12	8	8
Banana, 75 grams	15	0	0
	63	34	34

4.

Bread, 40 grams	24	4	0
Meat, 45 grams	0	12	8
Egg, 1 (hard boiled)	0	6	6
Butter, 15 grams	0	0	13
Milk, ½ pint (240 grams)	12	8	8
Raw carrot, 75 grams	5	2	0
Tomato, 150 grams	5	3	0
Peach, 115 grams	15	0	0
	61	35	35

SCHOOL LUNCH FOR PART OF DINNER.

At school, 11 A.M.			
Milk, ½ pint (240 grams)	12	8	8
Bread, 30 grams	18	3	0
Lettuce,			
Butter, 5 grams	0	0	4
Orange, 150 grams	15	0	0
	45	11	12
At home, 2.30 P.M.			
Meat, 75 grams	0	20	13
5% vegetables, 150 grams	5	3	0
Potato, 90 grams	18	3	0
Butter, 10 grams	0	0	8
	23	26	21

Extracts.—In making agar jelly, gelatin and other desserts, flavoring extracts can be used, 1 teaspoonful to 1 pint.

Sea moss farina and Irish moss are usually allowable for diabetic patients. Most of the carbohydrate in these materials are quite inert in the body. Unfortunately these products are sometimes adulterated.

Seasoning.—The proper seasoning of the food helps the diabetic patient. Horseradish, to be sure, contains 10 per cent of carbohydrate, but it would take at least 2 teaspoonfuls to contain a gram, and probably far more. Sour pickles are allowable, and other pickles made from the group of 5 per cent vegetables, provided one is assured that they have been prepared without sweetening. Mint, capers, curry, tarragon vinegar, distilled vinegar, bay leaf, cloves, ginger, mustard, paprika, anise seed, caraway seed, celery salt and onion extract may all be used as seasoning.

CHAPTER X.

THE TREATMENT OF DIABETES WITH DIET AND INSULIN.

Not every diabetic can lead as useful or strenuous a life as Clemenceau, dying in his eighty-eighth year, who disclosed in an interview that he fought the World War and diabetes at the same time. True, it is a fight, but there is pleasure in the struggle. Victory comes to the courageous; and without courage and common sense, success awaits no one.

I look upon the diabetic as a charioteer and his chariot as drawn by three steeds named (1) Diet, (2) Insulin and (3) Exercise. It takes skill to drive one horse, intelligence to manage a team of two, but a man must be a very good teamster who can get all three to pull together. (See Figs. 45, 46, 47 on page 176.)

1. **Treatment with Diet.**—*Eat Less.*—To get rid of the symptoms of diabetes—weakness, loss of weight, thirst, hunger, frequency of urination—one must prevent the loss of sugar in the urine. If the diabetes is very mild, this is done by eating less of everything, taking more exercise, and reducing body weight to the normal average. By this means instead of the sugar being lost in the urine, it will be used up by the body. This is no more or less than leading a healthier life. But except in very mild forms of the disease such simple measures are not sufficient and hence the quality of the diet as well as its quantity must be altered.

Eat Less Sugar and Starch.—Sugar in the urine comes chiefly from sugar and starch in the food. Therefore, most diabetics must take less sugar and starch (carbohydrate) at their meals. Sugar and starch act almost alike in the body, because the starch of the food changes to sugar soon after it is eaten. If the food is composed of cooked starch, the change goes on very quickly, as one can easily prove for himself by chewing a starchy food for a minute or two, when one

may note the development of a sweet taste. Cereals, rice, macaroni, breads, and potato contain so high a percentage of starch that they change quickly to sugar, whereas the coarser vegetables contain so little starch and this is so closely mixed with the fiber of the vegetables that its transformation goes on much more gradually. A lump of sugar might be said, figuratively, to *run* into the blood; a tablespoonful of cooked oatmeal, which contains the same amount of sugar as the lump, to *walk* into the blood; the starch

FIG. 23.—Sugar enters the blood as fast as a child runs.
Starch enters the blood as fast as a child walks.
The starch in vegetables enters the blood as slowly as a child creeps.

in a large dish of lettuce, which is equivalent to the lump of sugar or to the tablespoonful of oatmeal, would be transformed to sugar so slowly in the course of digestion that it would *creep* into the blood. This is very important, because it explains why diabetics should abhor sugar, measure carefully any bread, cereal, potato, rice or macaroni, but eat vegetables freely. One should select those foods which will not suddenly overload the blood with sugar, because thus there is less chance for it to escape through the kidneys into the urine.

Eat More Vegetables.—The safest vegetables, because they

contain the least carbohydrate, are lettuce, cucumbers, spinach and asparagus. Others follow in order of percentage of carbohydrate such as celery, tomatoes, cabbage and young string beans. These vegetables belong to the group of 5 per cent vegetables. Then come the 10 per cent vegetables—pumpkin, turnip, squash, beets, carrots, onions, very young green peas. The 15 per cent vegetables are peas, which are more mature, Jerusalem artichokes, parsnips, lima beans. Vegetables which contain 20 per cent of carbohydrate are potatoes, shell beans, corn. (See Table 2.)

Test the Effect of Change in Diet by Examination of Urine for Sugar.—If the change in diet makes the urine free from sugar (sugar-free) and body weight and strength are satisfactory the patient is doing well. To know whether the urine is sugar-free the patient should learn to test the urine for sugar. This is easily done and the method is described on page 209.

Not Lower the Carbohydrate too Much.—Reduction in carbohydrate must not be too great, because either too much weight will be lost or, if the carbohydrate is replaced by extra protein and fat to prevent this, danger can result from acid poisoning, because fat burns satisfactorily only when carbohydrate is also burning in the body. Formerly I advised patients to reduce the carbohydrate nine-tenths to become sugar-free and gave them much fat to make up for it; later I reduced it less, because Dr. F. M. Allen proved it was not necessary if patients ate less of everything. But the discovery of insulin proved a diabetic could take at least one-third, usually one-half and often two-thirds of the carbohydrate which would be proper in health. It is still possible to drive the sugar out of the urine of most patients by prescribing very little carbohydrate, but I believe the patient is better off if he does not lower it below 150 grams or about one-half, even if he must take insulin to get the benefit of it. For this reason patients must learn not only what kinds of food to eat, but also how much and the more they know about it, the easier it is for them to live with safety and comfort.

It is not very difficult to learn what kind and how much of

the different varieties of food one should take. The carbohydrate is reduced by one-third or one-half of that taken in health. The protein (meat, fish, eggs, cheese) would be the same or a little more or less than the individual ordinarily eats. The fat would be increased sufficiently to enable the patient to maintain the proper weight. Yet it is not all quite so simple. The diet must be planned so that under all circumstances one important rule shall not be broken, namely, the urine must be free from sugar and, if necessary to accomplish this, rather than reduce the carbohydrate in the diet extremely, the patient should take insulin. (See page 99.)

Division of Carbohydrate between the Three Meals.—The division of the carbohydrate between the three meals is important. The least amount, perhaps one-fifth of the total for the day, should be given at breakfast, leaving two-fifths for each of the other two meals. The reason for this is the fact that at breakfast the diabetes is usually at its worst and becomes milder as the day advances. Why this is so is told in the next paragraph.

Diabetes is most severe early in the morning. The patient shows sugar then in the urine with less food than at any other time of the day. In the morning before breakfast he has very little glycogen (animal starch) stored in the liver. There are two reasons for this. First, during the night the body has been without food from which glycogen could be made, and second, it has little insulin, either its own or regular insulin when regular insulin only was available, because that lasted for only eight hours at the most and therefore its effectiveness in changing the sugar in the blood to animal starch and storing it as glycogen in the liver and muscles ran out during the night. Even with the modern protamine insulin which acts for twenty-four hours one still is handicapped for the first reason above noted. Glycogen in the liver of a diabetic is like gold in the bank for a business man. Without capital in the form of glycogen in the liver a diabetic is as badly off as a business man without gold. One can carry the analogy still further. A diabetic without glycogen is as ill fitted to meet diabetic coma as a business man without gold is to meet a business crisis. Therefore,

never try to do a big business in carbohydrate at that time of the day when your glycogen capital is small.

Theoretically the form in which the patient takes his carbohydrate makes no difference, but it makes a great deal of difference practically. Already we have commented upon the rapidity with which sugar leaves the stomach and enters the blood and the more gradual passage of starch in the form of bread and potatoes and the slowness in which the carbohydrate in vegetables is absorbed. But there is another reason. The diabetic is human when he eats. Oatmeal although it contains much carbohydrate is served but once a day and a patient is not so easily tempted to break his diet with it as with bread. The same holds true of grapefruit as compared with apples.

The development of the full power of the patient to utilize carbohydrate is favored by diets somewhat low in protein and fat. Often one is gratified to see the patients do far better than was at first anticipated. Overeating of any kind of food lowers the power of the diabetic to assimilate carbohydrate. This is one of Allen's great contributions. Elderly diabetics are frequently discharged after a brief hospital stay without the urine becoming quite sugar-free. This is done with the expectation, which experience has justified, that persistence in a diet of slight undernutrition will lead to the disappearance of the slight quantity of sugar in the urine. Time accomplishes what heroic treatment often fails to secure. In reality these patients demonstrate the recuperative power of the insulin-secreting cells of the pancreas, such as one observes after the abatement of an infection or of an injudicious diet which has needlessly brought on acid poisoning.

Standard Diabetic Diets.—To save time for doctors and nurses certain standard diets are frequently used at the New England Deaconess Hospital. There are five of them and they look complicated, but in reality they are very simple and already upon page 12 the principles of the diet have been described. The patient receives a portion of fruit and bread or cereal at each of his three meals. In addition an egg and sometimes bacon for breakfast; at noon and night meat

TABLE 8.—STANDARD DIABETIC DIETS.

DIETS.	TOTAL DIET.				CARBOHYDRATE (C).						PROTEIN and FAT (PF).				
	Carbohydrate.	Protein.	Fat.	Calories.	5% vegetables.	Orange.	Oatmeal.	Potato.	Bread.	Milk.	Egg.	Meat.	Bacon.	20% cream.	Butter.
C1 PF1	100	47	61	1137	300	400	15	60	30	120	1	75	..	120	15
C2 PF2	127	59	79	1455	300	400	15	120	45	240	1	90	..	120	30
C3 PF3	151	74	92	1728	300	400	15	150	75	240	1	120	15	120	30
C4 PF4	175	88	104	1988	300	400	15	180	105	240	1	150	30	120	30
C5 PF5	200	100	123	2307	300	400	30	210	120	240	1	180	30	120	45
Acute illness . .	152	50	52	1276	...	400	15	...	90	960	1	...	..	...	15

Approximate equivalents: 1 small orange, 100 grams = ½ banana, 50 grams = ½ saucer oatmeal, 15 grams dry or 120 grams cooked = 2 large saucers 5 per cent vegetables, 300 grams = 1 large saucer 10 per cent vegetables, 150 grams = potato size of egg = ½ slice bread, 15 grams.

or fish and 5 and 10 per cent vegetables and during the day a limited quantity of butter, cream, milk and perhaps potato.

The letter C in Table 8 represents the carbohydrate in the diet and the articles which go to make it up are mostly grouped under the heading Carbohydrate at the top of the table. The letters PF are for protein, fat and the foods rich in these are likewise under a heading Protein and Fat. These tables are quite convenient for hospital use, but of course they must be modified to meet all cases.

Fasting is a very efficient way in which to banish the sugar from the urine, but I do not like to use it. During fasting the patient is almost devoid of carbohydrate, because there is so little stored in the body of a diabetic. Actually he is living almost wholly upon his own body fat. He is thus on a very low carbohydrate but very high fat diet and nearly all agree that is bad for him.

Should it be desired to give a diet low in fat and high in carbohydrate, cream is omitted, bacon and cheese omitted and butter reduced to 15 grams or none. Naturally fat meats, fish and oil would be debarred. The carbohydrate could be increased by the addition of bread or substitutes for it. Sometimes I think it is forgotten that every person in the world began life and continued it for many months upon a diet which contained relatively large proportions of protein and fat to carbohydrate. Thus, the composition of 1 quart of human milk is approximately carbohydrate 65 grams, protein 10 grams, and fat 30 grams, and of cow's milk carbohydrate 45 grams, protein 30 grams, and fat 35 grams.

Treatment with Insulin.—*Who Should Use It.*—If a diabetic is not happy, energetic and a joy to himself and to his family, and his urine sugar-free, he had better take insulin. The chances are overwhelming that it will do him good. Even if he does not actually require it or only needs it temporarily, it is a good plan to learn how to use it, because then he will be ready for emergencies, such as infections and operations which later he may face. Insulin allows a diabetic to eat more, to work more, to sleep undisturbed, to ward off complications of diabetes, to postpone the coming on of old age and by living long, either largely to outlive the symptoms of

diabetes and perhaps to give up insulin or at least to approach more nearly to the Golden Age when diabetes will be more easily treated or perhaps cured.

I wrote the preceding paragraph several years ago and it holds true in 1937, but I must add to it. I am convinced that a diabetic whose disease is controlled with carbohydrate 150 grams in his diet plus insulin is less likely to grow old prematurely than when controlled with carbohydrate 100 grams and no insulin. And as for the Golden Age, I cannot say protamine insulin has brought it, but it certainly has made it less remote.

Insulin, the second horse of the diabetic's chariot, is a clever steed, practically never fails to do what is asked, but unless understood, may run away with the driver. One needs a good many lessons and much practice to ride a prancing horse, and this Insulin horse is no exception. Protamine insulin, likewise, is a powerful creature, but totally unlike insulin in that he is slow and strong, but once get him started and it is hard to stop him. Insulin can run away with a diabetic, but protamine insulin might run over him.

Insulin begins to act quickly, reaches its peak of power in an hour and the effect is over in eight hours. Insulin is ideal in the treatment of diabetic coma. To control a patient whose disease is so severe as to produce almost no insulin it would be required three times a day. In fact most diabetic patients took it two times daily, many three times and a few take a small dose upon retiring to last for the greater part of the night. Some even inject insulin at 4 A.M. so as to be able to keep their urine free from sugar and their blood sugar normal when they awaken.

Protamine insulin acts slowly, but steadily, and its effect lasts for a full twenty-four hours or even more. It is not so suddenly active and so suddenly strong as regular insulin and therefore will not protect one as well against the peak load of carbohydrate in a meal. If a diabetic taking regular insulin divided his carbohydrate between three meals as follows, 30—60—60 grams, he should change with protamine insulin to three meals and three lunches, perhaps as follows, 30—(10)—45—(10)—45—(10) in which the grams in paren-

theses represent lunches in the forenoon, afternoon and evening. By an arrangement such as the above the carbohydrate of the meals would be spread out over a longer period. It is likewise advantageous for a protamine insulin diabetic to have his meals far apart—an early breakfast and a late evening meal.

Period of Action of Regular Insulin.—Since regular insulin acts most powerfully about one hour after it is injected, it is therefore given one-half hour before a meal in order to meet the high tide of sugar in the blood which occurs at one-half hour after a meal. In this way its greatest effect is exerted when the products of the meal are collecting in the blood. Occasionally one gives insulin three-quarters of an hour or one hour before eating, because even before the meal the blood sugar might be much above normal and insulin's task is to keep the blood sugar between 0.10 (100 mg.) per cent and 0.16 (160 mg.) per cent. Some patients who have found that their blood sugar rises to a high level during the night, as their evening dose of insulin wears off, are forehanded and take a few (2 to 8) units of insulin just before they go to bed. In this way they avoid rising early and injecting insulin more than one-half hour before breakfast.

The effect of insulin is over in about eight hours. Frequently it is not required before each meal, because after the early forenoon, when the diabetes is at its worst, the cells of the patient's pancreas may begin to produce enough insulin to take care of all the food prescribed in the diet. I suspect the normal pancreas manufactures at leat 50 to 100 units of insulin in twenty-four hours, varying with the body weight and the diet.

Times of Administration.—When regular insulin is required twice in the twenty-four hours, it is usually given before breakfast and before the evening meal. The second dose in the day is almost invariably less than the first. Sometimes a small dose is necessary before the noon meal to keep the urine sugar-free. More and more often I am advising patients to take their insulin before breakfast and the evening meal and then if a third dose is necessary to inject that upon retiring. As said above this dose at bedtime need be only 2 to 8 units,

because it is not followed by food or by minimal quantities of food such as 100 grams of milk or a small biscuit. Occasionally one sees a patient who takes a single dose of insulin a day and that before the evening meal and with results which justify this procedure. Doctor and patient sometimes forget that insulin, like the Sabbath, was made for man and not man for insulin.

Protamine insulin, unlike regular insulin, acts a long time —for twenty-four hours or more—and therefore is required but once a day. Patients who have never taken insulin readily learn how to get the full benefit of it. They usually begin with 10 units before breakfast and then increase daily or every few days by 5 or 10 units up to even 60 units if necessary. If the diabetes is not thus controlled it is usually wiser, at least temporarily, to take an injection of regular insulin, too, at the same time of the day but in another part of the body.

Protamine insulin acts so slowly that it may require a week to show its real effect. Consequently one must not expect quick results. Unlike regular insulin it acts for every hour of the twenty-four and therefore one must see to it that there is not a long interval without food. On the other hand, by acting less quickly it may not be able to offset the heavy load of carbohydrate at a meal and this makes another reason for a lunch of 5, 10 or 15 grams carbohydrate between meals. Such a lunch would be an Uneeda or similar biscuit, a half glass of milk, an orange, or their equivalents. A small portion of protein, as cheese or nuts, may act well, because of the slow release of carbohydrate.

Rule for Giving Insulin When Food is Not Retained.—Insulin lowers the sugar in the blood and theoretically should always be followed soon by food in order to prevent the sugar in the blood from dropping too low and so producing an insulin reaction. However, if the individual cannot take food and the urine contains sugar, insulin is also indicated. Under such circumstances insulin should be given every four, six or eight hours testing the urine before each dose to be sure it is needed. Never stop insulin because the patient does not

eat. Adjust the dose according to the condition of the urine. At the hospital at such times we sometimes write orders as follows: Test urine with Benedict's solution every four hours. If test is red, give 15 units; if yellow, give 10 units; if green, give 5 units; if no sugar, omit insulin, but repeat the Benedict test every four hours until the patient is able to resume his usual diet and insulin.

Insulin and an Infection.—At such times the dose must be increased and, as meals are irregular when one is ill, it is often best to double the number of times insulin has previously been given, so as to take care of all the meals and lunches.

During an infection the effect of insulin wears off more quickly. If a patient has been taking 10 units of insulin twice a day (10–0–10), he might change to 5 units four times a day (5–5–5–5), or he might increase the dose and alternate between 10 and 5 units every six hours (10–5–10–5). In pneumonia I have given as much as 100 units a day to a patient with subsequent recovery. He was Case No. 6762, a street cleaner with chronic asthma. Usually he injected 20–0–18–2 units of insulin, but when he developed pneumonia it rose to 30–30–30–10 units. Three months after discharge from the hospital it fell to 24–0–16 units.

With another patient, a lady aged seventy-one years, the insulin rose from 10 units before the pneumonia to 84 units during it and then fell to 10 units upon recovery. After two trips to Europe she changed to protamine insulin 12 units once a day, flew to New York and sailed for the Coronation.

Treatment with Exercise.—Exercise is the third horse hitched to the diabetic's wagon and is a great aid to Diet and Insulin. When Exercise works, Diet and Insulin have less to do. Exercise will lower the blood sugar and so permits more food and lessens the demand for insulin. A diabetic requires exercise to do well. A patient confined to bed is given bed gymnastics. But one must watch Exercise, because unless one allows for what he does, the blood sugar falls so much below normal that symptoms appear akin to those from an overdose of insulin. The boy who plays hockey, basketball

or indulges in any strenuous sport always allows for this and lowers his insulin or raises his carbohydrate—in other words adjusts the load for Diet and Insulin. (See p. 62-66.)

Exercise lessens the requirement for insulin because it lowers the blood sugar. We know this is so because athletes are so much better off if they take a little carbohydrate during prolonged exercise to prevent their blood sugar becoming too low. The same holds true of a mild diabetic; exercise lowers his blood sugar, too. But it is entirely different with a severe diabetic. He is made worse with exercise unless he makes himself like a normal individual by taking insulin which they both have. If he does this, exercise helps him, too.

Anyone using insulin, regular or protamine, should have an extra 5 to 20 grams of carbohydrate if he undertakes unusual exercise. Of course if he knows about this in advance he might lessen his insulin, but I think it safer for him to take the additional food; particularly true is this for those using protamine insulin. With protamine insulin he may need still more food, because protamine insulin acts longer. In fact, the diabetic is almost normal so far as insulin goes when taking protamine insulin and yet he may be lacking in a store of carbohydrate (glycogen) in his body and therefore, just like the athlete, requires food.

The Dosage of Regular Insulin.—The individual dose of insulin varies. Quite a number of my patients take as little as 2 units at a time, particularly at bedtime, when they do not follow insulin with food. They do this in order that they may wake up the next morning sugar-free and as mild diabetics. One patient lived most successfully when he had 50 units before breakfast and 50 units before his evening dinner. He lived to be ninety-one years old and strange to say he never had a reaction from insulin. (Might this have been due to an urticarial condition of the skin which annoyed him for several years?) Most of my patients used to take 10 to 15 units before breakfast and 10 units before the evening meal. Few take as little as 5 before breakfast and few less than 5 before supper. Many take 20 units before breakfast, some even 30. It is exceptional for an intelligent and faith-

ful patient to require more than 50 units in twenty-four hours. Remember that the preceding statements apply to the old regular insulin.

The small doses of insulin do the most good per unit. For example, the first 5 units may enable one to add 1, 2 or more grams carbohydrate per unit, but when one is taking 30 units, an added 5 units would have much less effect. Repeatedly one sees patients who waste insulin. Case No. 11893, supported by the State of Massachusetts, entered the hospital while regularly taking insulin 80–80–80 units, with 5 per cent sugar in the urine. After eight days her weight rose 5 pounds, the sugar in the urine was 0.1 per cent, and the total insulin in twenty-four hours instead of 240 units was 50 units.

Insulin should never be omitted when sugar remains in the urine. If vomiting prevents the taking of food, continue the insulin, testing the urine every four hours, and only omit a dose when the urine is sugar-free. I know these two sentences are repetitions, but if they are heeded, there will be no deaths from diabetic coma.

The Dosage of Protamine Insulin.—This is much more simply arranged, because it is almost never given but once a day. As a rule I begin with 10 units before breakfast and increase daily by 10 units until the urine is sugar-free. Thus far I have seldom been obliged to go above 60 units. Rarely it is necessary to give regular insulin 5, 10, 15, 20 units also before breakfast. In such instances give the regular insulin first and follow it with the protamine insulin.

In general with protamine insulin one adjusts the diet to the insulin, shifting it from one meal to another or giving it between meals so as to lessen the load for the protamine insulin to carry.

Problems in Treatment.—The illustration on page 107 shows various problems which may occur in the treatment of diabetes with diet and insulin. In the upper row of test tubes the Benedict test is positive in the morning, afternoon, evening and night specimens of urine. The conclusion is plain. Either the patient is taking too much food, too little insulin or both diet and insulin are at fault. As a matter

of fact the patient was not receiving sufficient calories per kilogram body weight and consequently both diet and insulin were increased. With another case, showing a similar Benedict test, it happened that the patient had been sugar-free previously with a little insulin, but it had been given up. The result of the tests convinced the patient that insulin was necessary.

In other instances the patients have simply overeaten, broken diet, developed infections such as a cold in the head, measles, mumps or a carbuncle and in still others had reduced their exercise and as a result sugar appeared in all specimens of urine.

In the second row of tubes in the illustration on page 107 the Benedict test was positive in the forenoon specimen of urine but clear in the afternoon, evening, and night specimens. The patient had enough calories and the questions to decide were: (1) Whether the carbohydrate was divided properly between the three meals; (2) whether the patient was receiving too little insulin before breakfast, because it was after breakfast that the sugar showed; (3) whether the insulin should have been injected one hour instead of one-half hour before breakfast or whether perhaps a very small dose should have been given the previous night; (4) whether he might have been taking too little exercise after breakfast, or should have had ten minutes of gymnastics before breakfast. A study of the chart showed at breakfast he received less carbohydrate than at any other meal. Consequently, it was quite plain that the trouble was not with the carbohydrate at breakfast, and there remained the alternatives: too little insulin before breakfast or not long enough before breakfast; the need for it the previous night or too little exercise before or after the meal. Before changing the insulin, he was advised to take more exercise, and it was found that the sugar disappeared.

The above paragraph shows the difficulties of the diabetic before Dr. Hagedorn discovered protamine insulin. Today the problem would be solved either with a dose of protamine insulin alone before breakfast or combined with a separate injection of a few units of regular insulin.

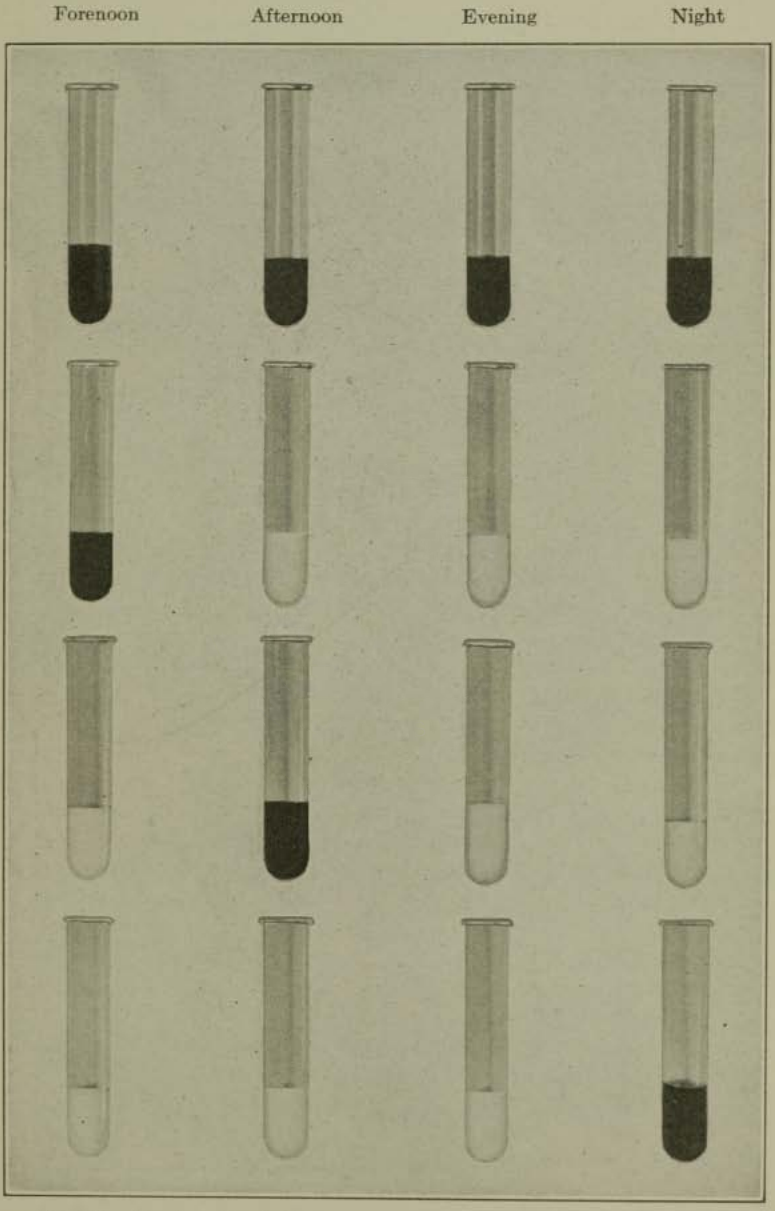


FIG. 24.—The heavily shaded area represents the presence of sugar in the urine at the time of the day indicated.

Looking at the test-tubes in the third row shown on page 107, it will be seen that sugar was present in the afternoon specimen but absent from all the others. Examination of the chart disclosed that the patient had no insulin before his noon meal and further that he had as much carbohydrate at noon as at the other meals. Consequently, the first change to get the urine sugar-free for the afternoon was to decrease the carbohydrate at noon and give a little more at breakfast and distinctly more at night.

In the fourth row of the illustration the specimens representing morning, afternoon, and evening showed no sugar, but the night specimen of urine gave a positive test, despite the fact that a good dose of insulin was given before supper. Here the cause for the presence of sugar was found to be different. It is true the patient was taking insulin before breakfast and before supper and that the carbohydrate was satisfactorily divided between the meals, but it happened that the patient had supper at 5.30 P.M. and did not have breakfast until 8 A.M. in the morning. Consequently, he was left without insulin from 5 o'clock at night, when he took his last dose, until 7.30 o'clock the next morning, which was too long an interval. This patient cleared promptly as soon as he had his breakfast a little earlier and supper a little later. This will not always solve the difficulty and at such times it is a good plan to give 2 to 4 units upon retiring or instead to change to protamine insulin.

The most important specimen of urine to examine to control one's diabetes is that voided on rising, and next to that I would place that upon retiring. From the discussion above it is evident that at times it is quite worth while to examine four specimens in the twenty-four hours, but I do not advocate this daily. Likewise a specimen taken from the twenty-four hour quantity is of much aid and if sugar-free is most reassuring.

Protamine insulin acts for the day and therefore often it is desirable to examine the entire output of urine for the day. The exact amount of sugar lost in the urine can be determined easily by the patient with the use of the Sheftel apparatus.

A test of the urine voided upon rising may give a false

picture, because it may represent urine made during the night and retained in the bladder. It is often desirable to test a second specimen voided one-half hour later to get the exact condition of the patient before adjusting insulin for the day.

INSTRUCTIONS FOR GIVING INSULIN SUBCUTANEOUSLY.

Insulin will keep unless overheated, but it is wiser to place all of it in the ice-chest save the actual vial daily in use.

1. **Sterilizing.**—Wash the hands thoroughly with soap and water.

Wrap the cylinder and the piston of the syringe separately in a piece of cloth and cover them and the wired needle with cold water in a dish, heat to boiling, and let boil for three minutes. Pour off the water, being careful not to touch anything in the dish, and allow to cool by standing.

Paint the top of the insulin bottle with medicated alcohol.

Certain patients, it is true, do not sterilize their syringes and needles by boiling, but by alcohol. I still hesitate to advocate indiscriminately such a method. The hands of the patients who adopt this plan should be exceptionally clean and deft in the handling of syringe and needle.

To sterilize with alcohol pour the alcohol, either pure 70 per cent alcohol or a standard medicated alcohol into a teaspoon into which the needle has been placed. Wait three minutes. Without inserting fingers into the teaspoon work the syringe into the butt of the needle so that it can be raised from the spoon, and then it can be made fast. Expel the alcohol. Dip the cap of the insulin bottle for sterilization into the spoon containing the alcohol and proceed as usual. After injecting the insulin, draw up alcohol from the teaspoon into the syringe and expel it back and forth into the spoon, through the needle and then draw air in and out.

2. **Loading.**—Take barrel and insert in it the piston being careful not to touch the surface of the piston which enters the barrel and thus contaminate it. After removing wire from needle fasten the latter onto the barrel. Draw

FIG. 25.—Injection of air into insulin bottle. (Bowen.)

FIG. 26.—Drawing insulin into the syringe. (Bowen.)

FIG. 27.—The withdrawal of the needle from the rubber cap. (Bowen.)

FIG. 28.—The insertion of the needle and injection. (Bowen.)

out the piston so that the syringe contains a little more air than the amount of insulin needed.

Push the needle cautiously but firmly through the rubber cap until the point is just seen, invert the bottle; force the air from the syringe into the bottle and then withdraw as

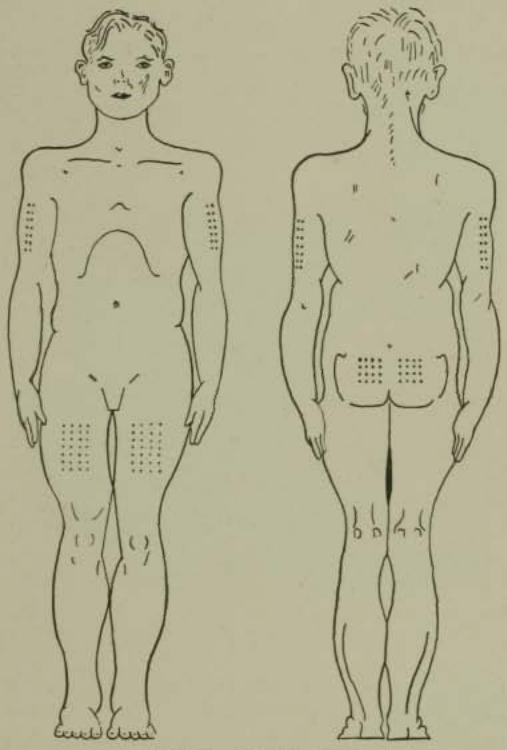


FIG. 29.—Insulin maps.

much insulin as is desired. By holding the syringe and needle point upward air is easily expelled from the syringe before withdrawing it from the bottle.

3. **Injecting.**—The desirable site for injecting insulin is one where the skin is loose. It is advisable to change the place with every dose. All my diabetics learn to give insulin

on the right side of the body in the morning and the left side at night, and in four longitudinal and parallel lines down the extremities. The Sunday dose begins at the upper end of each line and the Saturday dose is at the lower end. Never give insulin many times in one place. Necrosis of tissue occurs, an abscess may form, failure of absorption is bound to ensue, the dosage in consequence is increased and if by chance the same quantity is given in another part of the body a reaction follows. Furthermore, atrophies of the subcutaneous fat may develop and these are quite disfiguring. Nearly all of these troubles are obviated with the use of protamine insulin.

FIG. 30.—Case 9443, aged two years and eleven months, injecting her insulin. Alive in 1937, five years later, and doing well.

Having decided on the site for injection, rub gently an area an inch in diameter with alcohol.

Pick up a fold of the skin between the thumb and forefinger of the left hand, and with the syringe held parallel to the skin, push the needle quickly and firmly into the fold nearly up to the butt. The tip of the needle should then feel loose in the soft tissue between the skin and the muscle.

Force the insulin gradually out of the syringe, while withdrawing the needle slowly, so that all of the insulin may not be left in one spot.

Touch the spot lightly with clean cotton until the insulin has been absorbed.

If the insulin has been given too close to the upper layers of the skin a white blister-like elevation will appear.

Protamine insulin is injected once a day and regular insulin several times a day. Consequently an error of technic with protamine insulin does more harm than with regular insulin because the effect lasts for twenty-four hours.

Protamine insulin is a solid. All the virtue of it is in the precipitate. Therefore, be sure this is uniformly distributed. There is no use to inject foam or indeed the clear liquid in a protamine insulin vial.

4. **Cleaning Up.**—Rinse the syringe and needle with cold water immediately. Dry the syringe and needle with a cloth and blow air with the syringe repeatedly through the needle. Rub off any irregularities on the point on a fine stone such as a razor hone. A fine wire should always be kept in the needle.

Diabetes Associated with Disease of Kidney, High Blood Pressure or Disease of Liver.—Diabetic patients with involvement of the kidney or high blood pressure should be given low quantities of protein and salt. For these patients one can substitute cream for bacon and give the required amount of protein in salt-free meat, because bacon contains too much salt for damaged kidneys to excrete. Fresh butter would be substituted for salted butter and no salt would be added to the food at the table. The extra carbohydrate allowed because of insulin is a great boon.

Still more valuable is the extra carbohydrate in diseases of the liver. Here it is almost life-saving and now-a-days both for non-diabetics and diabetics great pains are taken to fill the liver with glycogen by means of large quantities of carbohydrate whenever it is thought to be diseased or injured as in the course of operations upon the gall bladder.

CHAPTER XI.

ACID INTOXICATION—ACIDOSIS—DIABETIC COMA.

Acid intoxication used to be the bugbear of doctor and patient. Before we had insulin two-thirds of the diabetic patients and all the diabetic children succumbed to it, but now among carefully treated diabetics it can be completely avoided. The reduction in mortality from diabetic coma in my own practice was compiled for me by the Metropolitan Life Insurance Company and is shown in Fig. 31.

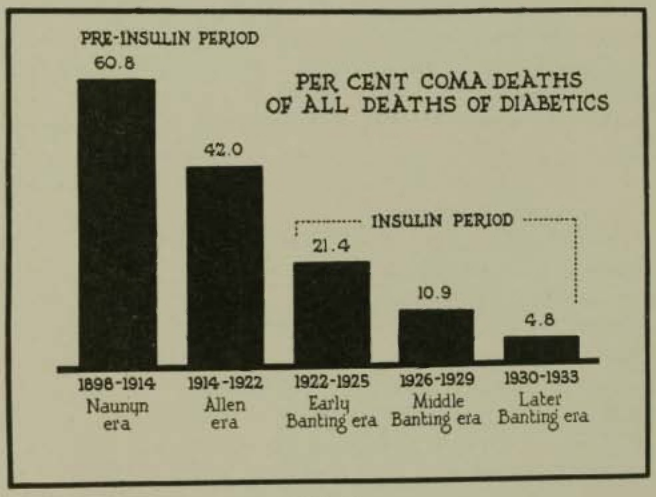


Fig. 31.

This is due first to the prevention of the causes which lead up to it and second to insulin. Above all else remember that diabetic coma comes on like a thief in the night. Whenever a diabetic feels sick, he should call it coma and follow the rules given on page 117.

The acid intoxication which develops in a diabetic resembles that which develops in a normal individual when he stops eating carbohydrate. Under such circumstances when there is no carbohydrate to burn in the body or what amounts to the same thing as in diabetes when the body cannot burn it, the fat burns only to the stage of fatty acids, or to adopt Woodyatt's picturesque phrase, the fat does not burn but smokes. These fatty acids are poisonous, cause acid poisoning (acidosis) and, unless removed from the body or completely burned up in it, lead to diabetic coma and death.

The invariable cause of acid poisoning is well understood. Overeating brings it on and can lead to death by coma. It makes no difference whether the overeating comes from food (breaking the diet) or whether it comes from an infection which makes the diabetes more severe and at the same time, because of the accompanying fever, burns up the tissues more rapidly. Indeed the latter condition is the more serious. Overeating of food is easily corrected, but overeating of one's own body as in pneumonia and similar infections is controlled with difficulty, and for most diabetics only with insulin. Inflammatory conditions and certain types of goiter likewise lead to an increased metabolism, *i. e.*, overeating of the body, but most of these may be relieved by surgery.

There is always a reason for diabetic coma and the reason is overeating of food or overeating of the body and diabetics should never forget this fact. For the overeating of fat of the body, which accompanies an infection or an overactive thyroid, hyperthyroidism, the patient is blameless, but for the overeating of food he is responsible. Since an infection always makes the diabetes more severe, the patient should be prepared to meet it by increasing insulin, or, if not taking it regularly, be ready to employ it. Never omit insulin so long as the urine contains sugar.

A sugar-free urine spells safety for a diabetic. A sugar-free urine implies that he is not overeating, and it is from overeating, from taking more fat than can be burned by the carbohydrate utilized, that acid intoxication results. Danger from acid poisoning vanishes in 999 cases out of 1000 if a diabetic is sugar-free because that shows he is

burning enough carbohydrate to oxidize the fatty acids. A given amount of fat may be utilized or burned up, but if too much is given either from the food or from the body it cannot be used up and consequently appears in the urine as acid bodies—the acetone bodies. In other words, if we feed fuel to a fire too rapidly and in too great a quantity it smothers it and it smokes, but if we feed it more gradually, it is totally consumed and burned.

Deaths from acid poisoning before the discovery of insulin decreased with the advent of undernutrition, the reverse of overeating. In my practice this was accomplished by the restriction of fat, which is so rich in calories.

In years gone by when doctors saw diabetics growing thin, it was very natural for them to decrease the carbohydrate to get rid of the sugar, and to allow an unlimited supply of fat to increase the weight. Temporarily this advice would occasionally succeed, but eventually it would end in acidosis and a fatal issue.

Insulin and undernutrition both help carbohydrate to burn, and with the burning of carbohydrate in the body, acidosis vanishes like dew before the sun. No wonder therefore that there are less cases of diabetic coma today. There need be none if care is taken in the diet and insulin is used in season. On the other hand if the patient has been taking a diet more than would be possible for him to take and keep sugar free without the use of insulin and then suddenly omits his insulin and continues to eat the same amount of food, diabetic coma can occur with surprising swiftness. A diabetic is walking on insulin stilts. Take away the stilts and he falls. Never omit insulin when sugar is present in the urine even if you are not eating or retaining food.

A diabetic boy overeats at Thanksgiving on Thursday. If he breaks his diet that day it is fairly good evidence he has broken it before. Upon Friday and Saturday he may have indigestion and vomiting. Not caring for food perhaps he neglects insulin and feels "sick." He is irritable, thirsty, but does not keep down the food he takes, his bowels are neglected. He feels weak and loses interest, becomes sleepy and stuporous and breathes heavily with air hunger. Before anyone

realizes the fact unconsciousness develops and only the miracle working action of insulin will save him.

Signs of the onset of acid poisoning are most indefinite. Consequently, it is a good rule for any diabetic patient if he feels ill, and always if he has fever, to take for granted that he may have acid poisoning and adopt those measures which will prevent its becoming serious. These are very simple, and are as follows:

Treatment of Acid Intoxication. Rules for the Patient.

1. Send for the doctor.
2. Go to bed.
3. Liquids. A cupful an hour. Hot water, tea, coffee, broths, water-oatmeal gruel, orange juice.
4. Take an enema. The enema clears the lower intestine so that salt solution, a teaspoonful of salt to each pint of water, can be given later by the rectum in case liquids are not retained by mouth.
5. Keep warm: flannel nightclothes. Heaters, but put a blanket about the heater to avoid burns.
6. Secure a nurse or someone in the family who will spend her entire time caring for you until the doctor arrives.

Treatment of Acid Intoxication. Questions for the Doctor.

1. Has this patient acidosis and is it severe enough to account for his present symptoms?
2. If so, how much and how frequently is insulin to be given? Ten, 20, 30, 40, 50, 100 or more units? Every half hour or every hour? What does the urine or blood indicate?
3. Is the patient dry? Does he not need immediately 1 or 2 quarts of salt solution injected under the skin and later 1, 2 or more quarts subcutaneously or perhaps intravenously?
4. Is the stomach dilated? Does it demand lavage?
5. Does the heart need caffeine sodio benzoate, $7\frac{1}{2}$ grains in repeated doses, or other stimulation?

In the convalescence, patient, and physician too, will do well to make haste slowly. Carbohydrate up to 50 grams however should be given and retained and absorbed by the patient during the first twelve hours of active treatment and during the next twelve hours at least as much more. This will suffice for temporary nutrition with the gradual addition of protein and fat as rapidly as the stomach will bear food. If carbohydrate is not retained, when given by mouth, 25 to 50 grams of glucose must be given intravenously or subcutaneously.

It is a shame for a diabetic patient to die of diabetic coma, because coma is practically always preventable. Patients must keep their diabetes under control to avoid coma and this means that no day should go by without at least one or more of the specimens voided being sugar-free. I will admit that with the diets higher in carbohydrate than formerly and with greater activity upon the part of the patients this is more difficult, but it can be done.

When approaching or in diabetic coma the safest place for the patient is in a hospital. Diabetics should think in advance to which hospital they wish to go in case of an accident, diabetic coma or an insulin reaction.

Not one of my diabetic doctors has died of coma since 1925. They know enough to avoid it. Do you?

> Recently my colleague, Dr. Howard F. Root, has followed up the after-history of my patients who have had diabetic coma and recovered. To the surprise of us all he found that within three years after the discharge of these patients from the hospital, 8 per cent developed pulmonary tuberculosis. Therefore it behooves both patient and doctor to keep in contact with each other for years, yes, even for life.

CHAPTER XII.

THE DIFFERENCES BETWEEN DIABETIC COMA AND INSULIN REACTIONS.

DIABETIC coma is due to acid poisoning, is serious, and if untreated leads to death. It is caused by overeating, often by breaking the diet, by omitting the insulin which has allowed the regular meals, or may occur when the patient overeats of himself as in the course of fever and infections or in some kinds of goiter. Coma is preventable. (See page 114.)

TABLE 9.—DIABETIC COMA AND INSULIN SHOCK. DIFFERENTIAL DIAGNOSIS.

	Diabetic coma.	Insulin shock.
1. Onset	Slow—days	Sudden—minutes.
2. Food	Too much	Too little.
3. Insulin	Too little	Too much.
4. Presence of infection	Frequent	None.
5. Thirst	Extreme	Absent.
6. Hunger	Absent	Frequent.
7. Vomiting	Common	Seldom.
8. Pain in abdomen	Frequent	Absent.
9. Fever	Absent except with infection	Absent.
10. Skin	Dry	Moist.
11. Tremor	Absent	Frequent.
12. Vision	Dim	Double.
13. Eyeballs	Soft	Normal.
14. Appearance	Florid—extremely ill	Pale—weak—faint.
15. Respiration	Air-hunger	Normal.
16. Blood-pressure	Tends to fall	Tends to rise.
17. Mental state	Restless—distressed	Apathetic—irritable—hysterical.
18. Unconsciousness	Gradually approaches	May intervene suddenly.
19. Urine: sugar	Present	Absent (always in 2d specimen).
20. Urine: diacetic acid and acetone	Present	Absent.
21. Blood: sugar	High	Low.
22. Specific treatment	Insulin—fluid—salt	Carbohydrate.
23. Response to treatment	Gradual—hours	Quick—minutes.

Insulin reactions are explained by the blood sugar falling too low. This may be due to too much insulin, to the taking of too little food after the injection of insulin or its poor absorption due to vomiting and diarrhea, or to so much exercise that the food eaten has been used up. Insulin reactions almost never cause death but can be serious, because they may occur in places where they are embarrassing or dangerous to the patient. They can be prevented by taking a little carbohydrate when the first warning signal appears. (See page 36.)

Diabetic coma is always avoidable by following the rules of treatment. An insulin reaction may occur accidentally, but is usually preventable.

One of the reasons I cannot advise the use of alcohol by diabetics is the danger of an insulin reaction being unrecognized if the breath shows a trace of an alcoholic odor. I have a high estimation of policemen; they make reliable patients, but it is unreasonable to expect that there will always be a diabetic sergeant in every station-house ready to diagnose an insulin reaction or diabetic coma.

Protamine insulin causes reactions, but they are usually less severe and, unlike those due to regular insulin, are frequently accompanied by nausea and headache. Reactions from regular insulin most commonly occur in the late morning or early afternoon, but from protamine insulin they appear in the late afternoon, evening or night. A reaction due to regular insulin is usually relieved by taking a little carbohydrate once, but when due to protamine insulin, it may be necessary to repeat it in an hour.

Identification Card.—It is desirable for a diabetic to carry in his pocket an identification card. One of my patients wears a bracelet upon the inside of which is inscribed, in addition to his name and address, the words—Coma or insulin shock. Which?

CHAPTER XIII.

CARE OF THE TEETH.

Revised by Harold R. Kent, D.M.D.

The teeth of diabetic children are better than those of other children. We believe that the reason for this is because their diet consists of the correct amount of fruits and vegetables and eliminates soft foods and candy. Even now, when the carbohydrate content has been increased, the teeth have not suffered because it is done in proportion to the needs of the individual and the proper balance has been kept. These children know how to guard against infection and they are taught precautions regarding suspicious irregularities and how to take care of themselves physically. They know that their bodies must be cared for as a unit, each part running smoothly in order to maintain the proper balance of the whole. They are under the detailed attention of a physician and have check-ups frequently. Every day care of the mouth and constant supervision at frequent intervals by the dentist are impressed upon them. Thus the combined value of physical well-being and proper diet with supervision results in good oral health and good teeth. This is a contribution to our knowledge of diabetes because, unlike diabetic children, diabetic adults generally have poor oral health. We realize that this is not due to the diabetes, but to factors previous to the onset of diabetes. An outstanding example is explained by a series of 300 patients, nearly one-half of whom had poor teeth or no teeth at all.

Adult patients usually have a history of dental trouble in early life and previous to the onset of diabetes the general balance may have been upset, thus affecting the teeth and tissues. Soft tissues around the teeth incline to gingivitis and pyorrhea with heavy deposits of tartar around the teeth. Tartar collects rapidly upon the teeth of diabetics even in childhood. Unless carefully treated and removed frequently, tartar may be a factor that will lead to the destruction of the bone around the teeth and the loss of the teeth. Definite

tissue changes accompany acidosis and the mouth should be carefully watched during this time as these changes respond less easily to treatment in a diabetic.

Prevention of infection is, therefore, a vital factor in the régime of diabetics. To this end we are endeavoring to impress upon diabetics the necessity of constant care of the teeth and mouth. Good teeth are an aid to a diabetic, so that he may properly chew the green vegetables and other coarse foods in his diet. These must be masticated thoroughly.

Bad teeth are worse than no teeth and are a handicap to a diabetic because the infection which accompanies them makes the diabetes worse. A diabetic cannot afford to tolerate anything which makes his disease worse, consequently he should get rid of all the poor teeth which proper treatment cannot save. So important do we believe this to be at the Deaconess Hospital that a Dental Hygienist examines the teeth of all diabetic patients and makes a preliminary report to the Dentist who later advises as to extractions if necessary.

Extraction of teeth in a diabetic is a simple affair if performed by a competent dentist and by one who is acquainted with diabetes. Such a dentist knows that injury to the gums of a diabetic should be reduced to a minimum, thereby averting the opportunity for a fresh infection. Usually, it is wiser to extract a few badly infected teeth at one appointment.

Extractions are performed with novocaine, care being taken to avoid extensive infiltration of the tissues, or with gas-oxygen, which is very satisfactory, but ether is contra-indicated unless the patient is protected with insulin.

Time spent in a hospital by a diabetic to get sugar-free and learn the diet should be utilized to have the teeth put into perfect condition. In the Deaconess Hospital those patients who are under dental treatment while there receive individual instructions in the method of home care and any diabetic may consult the dentist or dental hygienist about his dental problems.

Suggestions to diabetics in the care of the mouth at home are as follows:

1. The teeth should be cleaned by a dentist or hygienist every three months, examined for cavities and filled if necessary.

2. Roentgen-ray examination should be made every year.
3. Teeth should be brushed with a small tooth-brush, with tufts well separated, at least twice daily, morning and night, spending two minutes each time. Be sure to do this properly. Ask your dentist or hygienist to show you if you are not sure. Replace your tooth-brush when the bristles become soft, and have two brushes and alternate each time you brush your teeth.
4. A mixture of equal quantities of bicarbonate of soda and table salt is a satisfactory tooth powder.
5. After brushing your teeth, massage the gums with your fingers working the fingers down on the upper gums and up on the lower gums always toward the teeth, using a rotary motion. This is particularly important for diabetics.

One of the advantages to the patient in having a chronic disease like diabetes is the detailed attention that his body receives from his physician. The neuritis and pains in various parts of the body which used to be attributed to diabetes were probably often independent of the disease and brought on by other causes, such as the deficient and improperly balanced diets which were the rule. The health examinations which a diabetic should receive at each visit should protect him against many ills which non-diabetics thoughtlessly acquire.

We have found that when an adult diabetic has his teeth and gums examined every three months, when he takes the proper home care of the mouth, when his diabetes is under control and is checked by a physician frequently, he has a good chance to retain his teeth as long as a non-diabetic.

> No matter how much one enjoys good food, bear in mind that the simplest diet is the best and that the first big advance in the treatment of diabetes in this century followed Dr. F. M. Allen's insistence that no diabetic should overeat. The diabetic should not become fat or suddenly become thin.

CHAPTER XIV.

GANGRENE AND INFECTIONS OF THE SKIN.

GANGRENE.

No diabetic expects to get gangrene or having gangrene to die of it. Yet unless improvement in the prevention and treatment of gangrene is made, 1 diabetic of every 15 will succumb to this painful and sorrowful and long drawn out complication of diabetes. Think of it! There are upward of 500,000 diabetics now living in the United States and of this number more than 33,000 are destined to die of gangrene unless our methods are improved! They have improved, because ten years ago 1 diabetic in 10 died of gangrene. The overwhelming majority of all such deaths are needless and could be prevented by cleanliness, proper care of the feet, and early treatment of all wounds, insignificant though they are in the beginning. Exceptionally gangrene will develop because of the closure of a blood-vessel and without any previous injury. Cleanliness is here not a factor. Each patient treated at the Deaconess Hospital is told to protect the reputation of the institution and its doctors and his own reputation as well by avoiding death by gangrene.

Gangrene is common in the old, rare in the young, just the opposite to what holds in coma; indeed it has replaced coma as a menace to diabetics. It comes because the circulation in the legs is poor. The legs are far from the heart, and the blood must return to the heart up hill; the legs are used much, their blood-vessels wear out, especially when they are compelled to carry 200 pounds day after day, and gangrene occurs particularly in those who have been fat. Recently on one day in the hospital there were 53 diabetics and each of 19 of these had weighed over 200 pounds. Gangrene is rare under the age of forty years. It becomes more frequent as age advances and most of the cases are between sixty and seventy

years of age. One patient, aged eighty-nine years, had an amputation, recovered and left the hospital twenty days later.

Gangrene becomes more frequent the longer the diabetic lives. Each added year of diabetes exposes him more to gangrene. This is easily explained. Gangrene results from poor circulation, and one's circulation is more and more impaired as age advances. This applies to non-diabetics as well as to diabetics and here we are up against a stone wall. The second reason in a measure is being overcome. Hitherto diabetics grew old faster than non-diabetics, but with the introduction of insulin, which has allowed more carbohydrate and less fat in the diet, diabetics age less rapidly and there is no question in my mind but that the carefully treated diabetic is thus helped to retain his youth. For this I also have proof, thanks again to the Statistical Department of the Metropolitan Life Insurance Company.

A Beauty Parlor for Diabetic Feet.—The prevalence of complications in the feet of diabetics with the prolonged hospital stay which they involved led to the establishment of the Beauty Parlor for Diabetic Feet at the New England Deaconess Hospital. Here every diabetic patient who enters the institution is taught the care of his feet so that he can avoid gangrene. The Beauty Parlor has amply repaid the generosity of the original donors, Mr. and Mrs. William L. Shearer, and the extension of the work through the assistance of Mr. and Mrs. Albert C. Burrage. One of our chiropodist friends joined us in 1928 and has spread the knowledge of the vulnerability of the feet of diabetics among his associates and their diabetic clients. The chiropodists are our greatest allies in the prevention of gangrene. Many hospitals today have a chiropodist attached to their staffs.

Coma and gangrene are a good deal like pneumonia and rheumatism. From coma or pneumonia you recover or die soon; in the case of gangrene or rheumatism you suffer long and are exposed to all the complications which attack the body when its vitality is reduced. There is another analogy between coma and pneumonia on the one hand and gangrene and rheumatism on the other, namely, that of the cost of medical care. It is true a coma case or a case of pneumonia

is temporarily expensive, because extra nursing and medical attention are demanded, but this is nothing compared to the cost of caring for a patient with gangrene or chronic rheumatism. I do not hesitate to say that the latter diseases cost five times as much as the former. A sore toe costs on the average fully three hundred dollars ($300.00) without any allowance for compensation of the doctor or surgeon. And there is also a third analogy. After coma or pneumonia the recovery is usually complete, but after gangrene or rheumatism one is left impaired and often handicapped for life.

TREATMENT OF FEET.

Hygiene of the Feet.—1. Wash feet daily with soap and water. Dry thoroughly, especially between toes, using pressure rather than vigorous rubbing.

2. When thoroughly dry, rub with lanolin as often as necessary to keep skin soft and free from scales and dryness, but never render the feet tender. If the feet become too soft, rub once a day with alcohol.

3. If nails are brittle and dry, soften by soaking in warm water one-half hour each night and apply lanolin generously under and about nails and bandage loosely. Clean nails with orange-wood sticks. Cut the nails only in a good light and after a bath, when the feet are very clean. Cut the nails straight across to avoid injury to the toes. If you go to a chiropodist, tell him you have diabetes.

4. All patients with overlapping toes or toes that are close together should separate them by lamb's wool. Patients with large joints or cramped-up toes should wear shoes without toe boxes and only vici kid leather.

5. All patients over sixty should have daily rest periods, at which time they should remove their shoes.

6. Do not wear bed-room slippers when you ought to wear shoes. Slippers do not give proper support. Do not step on floor with bare feet.

7. Wear shoes of soft leather which fit and are not tight (neither narrow nor short). Wear new shoes one-half hour only on the first day and increase one hour daily.

8. Use bed socks instead of hot-water bottles, bags or electric heaters.

9. After fifty years one hears less well, sees less well, and the sense of feeling is diminished. Remember this and be cautious. Every Sunday morning ask someone to examine your feet.

Treatment of Corns and Callosities.—1. Wear shoes which fit and cause no pressure.

2. Soak foot in warm, not hot, soapy water. Rub off with gauze or file off dead skin on or about callus or corn. Do not tear it off. Do not cut corns or callosities. Do not try to remove corns or calluses with patent or other medicines.

3. Prevent calluses under ball of foot. (*a*) By exercising, such as curling and stretching toes twenty times a day. (*b*) By finishing each step on the toes and not on the ball of the foot.

Aids in Treatment of Imperfect Circulation.—*Cold Feet.*—1. Exercises. Bend the foot down and up as far as it will go six times. Describe a circle to the left with the foot six times and then to the right. Repeat morning, noon, and night.

Buerger exercises are excellent. They consist of elevation of one or both legs at an angle of 45 degrees for one, two or three minutes followed by hanging them out of bed for the balance of the five minutes and then keeping them horizontal for the next five minutes. The cycle is repeated six times an hour and two to four times in the day.

2. Massage with lanolin or cocoa butter.

3. Do not wear circular garters or sit with knees crossed.

4. If you have had gangrene or been threatened with it, keep off your feet five or more minutes each hour of the day and fifteen or more minutes if you have already had an amputation.

Treatment of Abrasions of the Skin.—1. Proper first-aid treatment is of the utmost importance even in apparently minor injuries. Consult your physician immediately.

2. Avoid strong irritating antiseptics, such as sulphonaphthol and iodine.

3. As soon as possible after injury certain surgeons recommend the application of sterile gauze saturated with medi-

cated alcohol or hexylresorcinol (S.T. 37). Keep wet for not more than thirty minutes by adding more of the antiseptic solution. Sterile gauze in sealed packets may be purchased at drug stores.

4. Elevate, and as much as possible until recovery, avoid using the foot.

5. Consult your doctor for any pain, redness, swelling or other evidence of inflammation.

To my patients with diabetic gangrene I feel much indebted. They are the ones upon whom the observations were made which Dr. Root incorporated into a table which showed that persistent, faithful treatment of diabetes yields good results. Thus 7 patients with gangrene before surgical intervention showed an average blood-sugar test of 0.27 (270 mg.) per cent; during the first week after operation 0.26 (260 mg.) per cent; in the second week 0.19 (190 mg.) per cent; the same in the third week, but at discharge 0.13 (130 mg.) per cent. And these results were obtained in the days before the discovery of insulin when treatment was supported chiefly by hope. With the use of protamine insulin our patients with gangrene have done better than ever before and have been most useful to us in our studies of its action.

"They also serve who only stand and wait."

INFECTIONS OF THE SKIN.

The skin of a diabetic should be kept exquisitely clean. A diabetic should be recognized for his clean skin and clean clothes. If his feet are kept as clean as his face, gangrene and infections will seldom occur. With patients over fifty years of age it is usually more important to look at their feet than their faces.

An infection makes the diabetes worse. When Case No. 3589 had a septic arm, 90 units of insulin failed to keep the urine sugar-free; when the infection was removed, sugar disappeared though the insulin was reduced to 30 units and carbohydrate and calories were increased. It makes little

difference whether the infection is general, as in pneumonia, or local, as in the case of a boil, a carbuncle, an abscessed tooth, an infected finger or toe, an inflamed tonsil, appendix or gall bladder. Therefore, all infections should be promptly and energetically treated.

In the presence of an infection the diet is simplified and the substitutions employed as given on page 138, Table 10. Regular meals are replaced by more frequent feedings and therefore the dosage of insulin must be changed. If regular insulin heretofore has been employed one can give it as indicated every three, four, or six hours according to the results of the Benedict test.

Red	Orange	Yellow	Green	Blue
20	15	10	5	0

If the patient has been taking protamine insulin, reduce the dose one-half or one-third and then add regular insulin according to the above schedule in approximately one-half the quantities, 10, 8, 5, 3, 0 until the need for more is demonstrated. A similar rule is often followed during surgical procedures and with surgical convalescents.

Itching.—Pruritus pudendi (itching of the genitals) frequently occurs in diabetes and will usually vanish within a few days, but occasionally not until two weeks after the disappearance of sugar from the urine. General pruritus, on the other hand, is exceptional, may be annoying and persist for weeks. It does not occur in young diabetics. If local pruritus does not clear up promptly, as the urine becomes sugar-free, an examination will probably disclose a prolapse, leukorrhea or urinary incontinence. Rest in bed, absolute cleanliness, simple douches and the simplest of ointments are indicated. The free use of oil to prevent irritation during micturition is helpful. There may be cases where $\frac{1}{4}$ skin unit doses of Roentgen-ray become necessary to allay the itching.

Epidermophytosis (Athlete's Foot).—Many people are affected with itching, scaling, cracking or blisters on the

feet, especially between the toes. This condition is often a ringworm infection or epidermophytosis, as it is called, and is caused by a vegetable parasite which grows in the skin. It is a very common infection and the majority of all people have it at some time. It is particularly dangerous in diabetics, because it leads to scratching and by softening of the skin between the toes allows more dangerous infections to get started. The disease is usually acquired by walking barefoot on the floors of common shower baths, dressing and locker rooms, infected bath mats or any floor or floor covering where others who have it have walked in their bare feet.

The disease most commonly shows itself as a slight cracking or scaling, giving the appearance of dead, white skin between the fourth and fifth toes. The so-called soft corn is one form of this infection. The skin may look parboiled. In more severe cases groups of small deep blisters come on the soles of the feet and the palms of the hands. This form usually itches intensely. Most cases are worse during hot weather or when wearing shoes and stockings which heat the feet.

Here are some rules for the care of the feet if you have the disease or if you would avoid it:

1. Wash the feet with soap and water daily.
2. Dry the feet with a paper towel or with a towel which will not be used on the rest of the body.
3. Stand on a clean mat, a newspaper or paper towel when you get out of the bath.
4. Never walk on any floors barefoot.
5. Do not wear wool stockings next to the skin—wear inside the outer socks thin socks which can be boiled.
6. Do not wear shoes which heat the feet.
7. Use this dusting powder on your feet, in your shoes and in your bath slippers.

	Grams.
Salicylic acid	1
Benzoic acid	1
Talc	100

Mix.

8. If you have signs of the disease rub a little of this ointment every day on the affected parts.

	Grams.
Salicylic acid	2
Precipitated sulphur	2
Vaseline	30

Mix.

9. Wash your hands after touching your feet.

10. Don't scratch if your feet itch—put on some ointment.

11. If the feet get worse in spite of your treatment consult your doctor about it.

Certain of the angry eruptions seen about the genitals, buttocks, in the groins, armpits or under the breasts are likewise due to a similar infection. These usually yield promptly to treatment when the urine becomes sugar-free and the sugar in the blood falls. If they do not and scrupulous cleanliness, careful drying after bathing, dusting with a small quantity of a simple dusting powder fail, see a doctor.

Boils.—If there is the slightest tendency to boils, furunculosis, at once adopt simple measures like those described by Bowen.[1] Wash the whole body twice a day with soap and water, using a fresh piece of sterilized gauze and powdered or liquefied soap; dry the skin with a freshly boiled towel without rubbing or blot it with a paper towel, so as to avoid breaking open any pustule; the whole body is then bathed with a saturated solution of boracic acid in water, with the addition of a small proportion of camphor water and glycerin. I have often advised a solution of 2 parts medicated alcohol No. 1 and 1 part water to advantage, but I notice that Bowen, in his second paper, still prefers the boracic acid. Individual furuncles may be treated with the following ointment, according to Bowen:

	Grams.
Boracic acid	4
Precipitated sulphur	4
Carbolated petrolatum	30

[1] Bowen: Jour. Am. Med., 1910, **55**, 209; Boston Med. and Surg. Jour., 1917, **176**, 96.

One should be careful, however, not to overtreat the skin. Harm may result from frequent dressings. The simplest lotions should always be employed. In severe cases the patient should be put to bed, all linen changed twice daily, and the patient treated in as aseptic a way as possible. In a few cases vaccines have appeared to be of marked benefit. "This procedure—thorough bathing and soaping, the application of the borated solution and the dressing of the individual furuncles—is repeated, as has been said, morning and night. A further point of vital importance relates to the clothing that is worn next to the skin. Every stitch of linen worn next to the skin should be changed daily, and in the case of extensive furunculosis all the bedclothing that touches the individual, as well as the nightclothing, should be subjected to a daily change. Naturally, this treatment must be continued for several weeks after the last evidence of pyogenic infection has disappeared, and this fact must be emphasized to the patient at the outset." (Bowen.)

Exposure to sunlight or to Ultra-violet Ray Lamp is a distinct aid.

"The washed neck, like the watched pot, never boils." (Brigham.)

Carbuncles.—Carbuncles are similar to boils, but more serious. They should be treated invariably by a surgeon from the start. A very, very few may heal by Roentgen-ray treatments without operation. Carbuncles are dreadfully dangerous of themselves and also because they make the diabetes so much worse. Fortunately they are comparatively rare.

Dr. Arthur Greenwood, who has been so helpful to my patients, has again made me his debtor by writing out for me the treatment of poisoning with poison ivy. I insert it here particularly for the sake of the children.

Poison Ivy.—The best way to prevent poisoning from ivy is to know the appearance of the plant and keep strictly away from it. If you have touched it, however, washing over the skin exposed to the poison with a 5 per cent alcoholic solution of ferric chloride will entirely prevent an attack. If you

cannot get this, use alcohol and follow it by a thorough scrubbing with laundry soap and water.

When the eruption has appeared it is too late to use these measures as preventives. Then you should apply white wash (zinc oxide and calamine lotion)

Phenol		0.65
Zinc oxide,		
Calamine	āā	8.00
Lime water	ad	250.00

or Burrow's solution diluted 1 to 20 with water. Daily washing with soap and water is also of benefit. Do not use any ointments or greasy substances until the eruption is completely dry. Then you may use zinc ointment or cold cream if necessary.

I think the most common cause of gangrene in my patients is the use of a hot-water bag or electric heater. Don't use such! Sleep in blankets or wear bed socks. My surgical friends think blisters caused by shoes a close rival or even a more serious cause of gangrene.

Case No. 4702.

	1928	1933	1937
Age, yrs.	11.5	16.4	20.4
Diabetes, yrs.	3.6	8.4	12.4
Height, in.	52.8	58.5	60.0
Weight, lbs.	74	115	118
Carbohydrate, gms.	75	135	182
Protein, gms.	70	73	99
Fat, gms.	110	81	74
Insulin, units	40	55	46

Fig. 32.—How Barbara felt after taking insulin in 1929.

CHAPTER XV.

SURGERY IN DIABETES.

I CALL the surgeon the diabetic's friend. It is the surgeon who cures the infections which make his disease worse, extracts his bad teeth and poor tonsils, takes out his gall stones or thyroid, thereby in some cases almost causing the diabetes to disappear, removes his appendix, and finally it is the surgeon who often can relieve the diabetic from the suffering of gangrene by the amputation of his leg or better still save it by the removal of a toe. Without a surgeon's aid one-third of my hospital patients would needlessly die.

Every other diabetic is operated upon during the course of his disease. Diabetics are just as liable to diseases requiring the surgeon's help as non-diabetics and, indeed, rather more so, because infections make a diabetic worse and it is imperative to get rid of them. Gall stones are common in diabetics and probably 25 per cent of those above thirty years of age have them. Gall stones precede rather than follow diabetes. Appendicitis occasionally occurs and is easily confused with diabetic coma, and more rarely with a reaction due to protamine insulin. Diseased tonsils and abscessed teeth require removal. Carbuncles are serious, but if treated early the mortality is much lessened. The most common surgical ailments are those of the lower extremities due to gangrene or chronic infections involving the bone. Such conditions begin unobtrusively in elderly people, because old people's feet are not sensitive and so injuries, whether from shoes or from burns, cause little pain. If neglected, these abrasions, cuts, cracks or burns of the skin become infected and the infection burrows deeply into the tissues and joints because the resistance is low, due to poor circulation. As a result amputation of a toe, foot or leg may be necessary. Picking, cutting, or tearing a callus or a corn, or pricking a blister may lead to such an infection. Corns on the upper side of

the toes are especially dangerous, because so often these become infected and the joint in turn is involved.

If a diabetic washes his feet every night, he will discover trouble with the feet early, should it occur. Corns and calluses will be softened and can be rubbed off with gauze or pumice stone. Do not prick a blister. Put that responsibility upon the surgeon. The majority of the surgical diabetic beds at the hospital are still filled with patients who have gangrene or infections of the feet, and these are really to a very large extent needless. Do not join this brave but pathetic, old army.

Modern surgery makes the surgery upon diabetics safe and insulin allows any type of anesthesia which is necessary. Should ether be employed, the liver is protected by the patient being operated upon early in the morning so that carbohydrate from the preceding evening meal will still be present in it. Ginger ale, water gruels and, except in the case of abdominal operations, orange juice can be employed. Doctor and surgeon, however, must work hand in hand to get the most successful results. It is wiser to operate when the urine is sugar-free, but it is wrong to put off an operation, even if not sugar-free, should the surgical condition be getting worse. Insulin is given according to the need and, as meals are irregular, more by the hour than by the day, depending upon the state of the patient and as described. (See page 39.) One tries to keep the urine sugar-free, but this is not usually possible for a day or two following operation.

If a needle breaks and is left under the skin while injecting insulin, do not be alarmed. The needle will not wander. Mark the site by drawing a circle about the point of injection. Draw an arrow in the direction the needle was inserted. Then when a convenient time arrives ask a surgeon and not a doctor like myself to take it out. He will probably desire a Roentgen-ray picture. The removal is not painful, but it is not so easy to find a needle as one might think.

CHAPTER XVI.

CONSTIPATION AND DIARRHEA.

CONSTIPATION.

The bowels should move daily. To this end nothing compares in effectiveness with the cultivation of regular habits and hours for this purpose. Time is required, and one-half hour, or even more, assigned to the toilet at the same time of the day for three successive days will often bring relief from constipation and this will persist for months. The coarse vegetables and fruits of the diet may prove quite sufficient, but it is essential to impress upon the patient the necessity of preparing coarse vegetables in a simple manner. It is perfectly possible to prepare cabbage, cauliflower, turnips, parsnips, radishes, cucumbers and onions so as to be unirritating to the digestive tract and yet preserve their laxative qualities. And this is important because the prolonged and careless use of coarse vegetables may bring on the spastic type of constipation which renders their abandonment for a period almost necessary. Caution should be exercised in the use of bran because temporary intestinal obstruction may result from its collection as a dry mass in the rectum and this necessitates its removal by hand. Mineral oil used in place of olive oil as an ingredient of mayonnaise salad dressing is excellent, but it is not a good plan to use mineral oil month in and out. It is said to remove vitamins. Never purge the bowels, but depend upon an enema or upon simple laxatives, such as milk of magnesia; aloin, grain $\frac{1}{5}$; fluidextract of cascara sagrada, 10 to 30 drops; extract cascara sagrada, 5 grains. The ordinary compound rhubarb pill, obtainable in any drug store, is the cathartic most in use at the Deaconess Hospital. These are very satisfactory. In certain rhubarb pills the presence of pepper-

mint or salicylate may lead to the excretion in the urine of an acid which may be confused with the diacetic acid of acid poisoning and thus lead to unwarranted alarm. (See page 214.)

Citrate of magnesia in liquid form is contraindicated. In one preparation examined there was found 11 per cent of sugar. The amount of sugar in one bottle was more than 2 tablespoonfuls.

If the patient has not had a movement for several days, at the beginning of treatment give an enema and follow by some simple cathartic or mild aperient, and then give another enema twelve to twenty-four hours later; but do not purge the patient. Gain enough is obtained if a movement is produced once in twenty-four hours when it has only been taking place once in seventy-two. In other words, do not upset any patient who is in a tolerable state.

The following exercises for constipation were recommended to me by Mr. Gustaf Sundelius:

1. **Abdominal Kneading and Stroking.**— *Kneading.*—Lying down, with knees slightly drawn up, place hands one on top of the other on the abdomen at the right groin; with small circular movements and deep pressure work upward until the ribs are met, then across toward left, following the boundary line of the chest, then downward to the left groin. Repeat 20 to 50 times. *Stroking.* With hands similarly placed, make long, steady and deep strokes, following the same route. Repeat 25 to 100 times.

2. **Leg-rolling.**—Lying down, take hold of both legs just below the knees, press the knees up close to the abdomen, then carry them apart, then down and inward until they meet again, thus letting the knees describe two circles. Repeat 10 to 20 times.

3. **Abdominal Compression.**—Standing against the wall with hands clasped behind neck, draw the abdomen forcibly in, using the abdominal muscles, hold a second, then let go. Repeat 10 to 40 times. This exercise flattens a protuberant abdomen.

4. **Trunk-rolling.**—Standing with hands on hips, feet apart and legs well stretched, roll the upper body in a circle on the

hips by bending forward, to the left, backward and to the right. Then reverse, and repeat 6 to 12 times each way.

Case No. 559 warded off constipation by sawing wood, and Case No. 265 regulated his bowels by eating a slice of raw cabbage for breakfast. This is one of the reasons why cabbage next to lettuce is the most useful diabetic vegetable.

DIARRHEA.

The reverse of constipation, diarrhea, is rare in diabetes. It is a serious complication. When it occurs the patient should go to bed immediately, keep warm and live upon hot water, hot weak tea and strained oatmeal gruel which is thoroughly cooked and made with water. The half ounce, 15 grams, of dry oatmeal used for breakfast will make one-half pint of gruel. Temporarily being without food for a few hours is allowable, but this should not go on for long. The carbohydrate of the diet should be continued in the simplest form, such as gruels, crackers, toast, rice, macaroni, or even grape juice or ginger ale. For their carbohydrate content see food tables, page 193. See also Table 10 for the equivalent of the standard diet in simple and unirritating form.

TABLE 10.—A SUBSTITUTE FOR STANDARD DIET.

Useful in the Treatment of Patients with Infections or Digestive Disturbances.

Food.	Carbohydrate, grams.	Protein, grams.	Fat, grams.
Milk, 960 cc. (1 quart)	48	32	32
20 per cent cream, 120 cc. (½ pint)	4	4	24
Bread, 90 grams (3 slices)	54	9	0
Oatmeal, 30 grams (1 large saucerful)	20	5	2
Egg, 1	0	6	6
Butter, 30 grams	0	0	25
	126	56	89
	4	4	9
Total Calories	504	224	801

For a child cream could be omitted and butter reduced.

The return to the diabetic diet is rendered easy by the use of cottage cheese, soft cream cheese, lean meats, oatmeal,

milk, cream, biscuits, eggs, purée vegetables. The carefully prepared, tender vegetables are frequently better borne than a diet containing considerable quantities of albuminous and fatty food.

If diarrhea exists, lime water could be employed or a portion of the allowed bread could be crumbed into the milk. It is also satisfactorily diluted with Vichy Célestin or Kalak Water. During infections orange juice (10 per cent carbohydrate) is desirable, but following abdominal operations ginger ale, which is about the same strength, is preferable, because it is less likely to cause cramps.

If liquid is not retained by mouth it may be necessary to give salt solution and even 5 per cent glucose solution subcutaneously. If there is any suggestion of undigested food remaining in the stomach this should be removed by lavage or induction of vomiting. The lower bowels should be cleared with an enema. A Seidlitz powder may be given to clear the intestines. The physician may administer an opiate or he may give a teaspoonful of bismuth subcarbonate before each meal and after each loose movement. Rest in bed is the essential and the best sort of treatment.

Diarrhea may necessitate the decrease or the increase of insulin. As a result of the loose movements, the carbohydrate of the food is less well absorbed, and in consequence the insulin has less carbohydrate upon which to act and an insulin reaction may take place. On the other hand, with vomiting and diarrhea the body is forced to depend upon its own protein and fat for nourishment and may consume so much of these without any carbohydrate at the same time that acid poisoning takes place, and this can easily go on to coma. In the presence of acidosis insulin acts less efficiently and hence the demand for an increase in the dosage of insulin.

Upon all such occasions it is safer to give the insulin more frequently, but in smaller doses. The same general rule can be followed as in the case of infections. (See page 103.)

Diarrhea and fasting were the weapons used by Guelpa to get his patients sugar-free, and they were most efficacious. Perhaps we might use them as advantageously as a food faddist. Consequently, when these conditions occur by

chance in a patient caution is demanded or else a little insulin will produce an unexpectedly great effect.

Diarrhea in any diabetic is dangerous. Call the doctor.

Caution.—Pain in the abdomen should never be neglected nor should delay in seeking medical advice for it be permitted. Even in health it may be difficult and require time to determine exactly the cause of abdominal pain. If a serious cause for the pain is present in a diabetic within a few hours the development of acidosis may obscure the signs and symptoms upon which the doctor must depend in making a diagnosis. The result may be confusion resulting in death. Beware of castor oil and strong cathartics at such a time. They may cause an inflamed appendix to rupture. Let the doctor decide!

Case No. 2560.

	1928	1933
Age, yrs.	13.5	18.3
Diabetes, yrs.	7.5	12.3
Height, in.	57.8	68.8
Weight, lbs.	75	140
Carb., gms.	124	156
Protein, gms.	62	99
Fat, gms.	125	125
Insulin, units.	22	54

	1937
Age, yrs.	21.6
Diabetes, yrs.	15.6
Height, in.	71
Weight, lbs.	154
Carb., gms.	235
Protein, gms.	100
Fat, gms.	99
Insulin, units	9 + 57

Fig. 33.—Case No. 2560 in August, 1924.

CHAPTER XVII.

EXPECTATION OF LIFE. PROGNOSIS.

A NATURAL measure of longevity is the average length of life, or, as it is also often called, the expectation of life at birth. It tells us the age in years to which, on an average, a newborn baby will survive. Similarly, the expectation of life at any other age, as for example, age thirty, tells us how many more years, on an average, a person of thirty years of age will survive.

About the middle of the last century the expectation of life at birth was in the neighborhood of forty years. Today it is nearly sixty years for white males and well over sixty for white females in the United States.

As the individual grows older his expectation of life naturally diminishes (except in very early infancy, where it at first increases on account of the rapid weeding out of the unfit). This will be seen in Table 11, which exhibits the expectation of life at successive ages of the white male and white female population of the United States in 1930, as prepared by Drs. Louis I. Dublin and Alfred J. Lotka, in the Statistical Bureau of the Metropolitan Life Insurance Company.*

How long can a diabetic live? That depends largely on his common sense. He may live to a ripe age, but will he do so? The question cannot be answered for many many years, because the discovery and use of insulin did not begin until 1922, and insulin was not generally employed until 1924. The course of the disease in children more than anything else throws light on the question. Before the introduction of insulin the duration of life of the diabetic child was 2.4 years, whereas in the fourteen years since insulin was discovered the mortality has been about 1 child per 100

* This table is here reproduced by courtesy of the authors. It forms part of a paper, The History of Longevity in the United States, which appeared in Human Biology.

TABLE 11.—UNITED STATES LIFE TABLE, 1930. (Dublin and Lotka.)
Registration States of 1930.

Age.	Males, white,	Females, white,	Age.	Males, white,	Females, white,
0	59.49	63.07	52	20.17	21.97
1	62.33	65.26	53	19.46	21.20
2	61.92	64.79	54	18.76	20.45
3	61.24	64.09			
4	60.46	63.29	55	18.07	19.70
			56	17.39	18.97
5	59.64	62.44	57	16.73	18.24
6	58.79	61.56	58	16.07	17.53
7	57.92	60.67	59	15.43	16.34
8	57.03	59.76			
9	56.13	58.84	60	14.80	16.15
10	55.21	57.90	61	14.19	15.48
11	54.29	56.96	62	13.59	14.82
12	53.37	56.02	63	13.00	14.18
13	52.45	55.09	64	12.43	13.54
14	51.54	54.15	65	11.88	12.93
15	50.63	53.23	66	11.33	12.33
16	49.73	52.32	67	10.80	11.74
17	48.85	51.41	68	10.29	11.17
18	47.97	50.51	69	9.79	10.61
19	47.10	49.63	70	9.30	10.08
20	46.24	48.75	71	8.83	9.56
21	45.38	47.88	72	8.38	9.06
22	44.53	47.02	73	7.94	8.58
23	43.68	46.16	74	7.52	8.11
24	42.83	45.30	75	7.12	7.67
25	41.99	44.45	76	6.74	7.25
26	41.14	43.60	77	6.37	6.84
27	40.29	42.74	78	6.02	6.46
28	39.44	41.88	79	5.69	6.09
29	38.59	41.03	80	5.37	5.75
30	37.74	40.17	81	5.08	5.43
31	36.89	39.32	82	4.81	5.13
32	36.04	38.46	83	4.53	4.84
33	35.20	37.60	84	4.28	4.57
34	34.35	36.75	85	4.05	4.32
35	33.51	35.90	86	3.82	4.08
36	32.68	35.05	87	3.59	3.86
37	31.84	34.20	88	3.36	3.62
38	31.02	33.35	89	3.15	3.41
39	30.19	32.50	90	2.94	3.22
40	29.38	31.66	91	2.74	3.02
41	28.57	30.83	92	2.52	2.83
42	27.77	30.00	93	2.37	2.67
43	26.98	29.17	94	2.13	2.49
44	26.19	28.35	95	1.92	2.30
45	25.41	27.53	96	1.67	2.10
46	24.63	26.72	97	1.39	1.87
47	23.87	25.91	98		
48	23.11	25.11	99		
49	22.36	24.31	100		
50	21.62	23.52	101		
51	20.89	22.74	102		

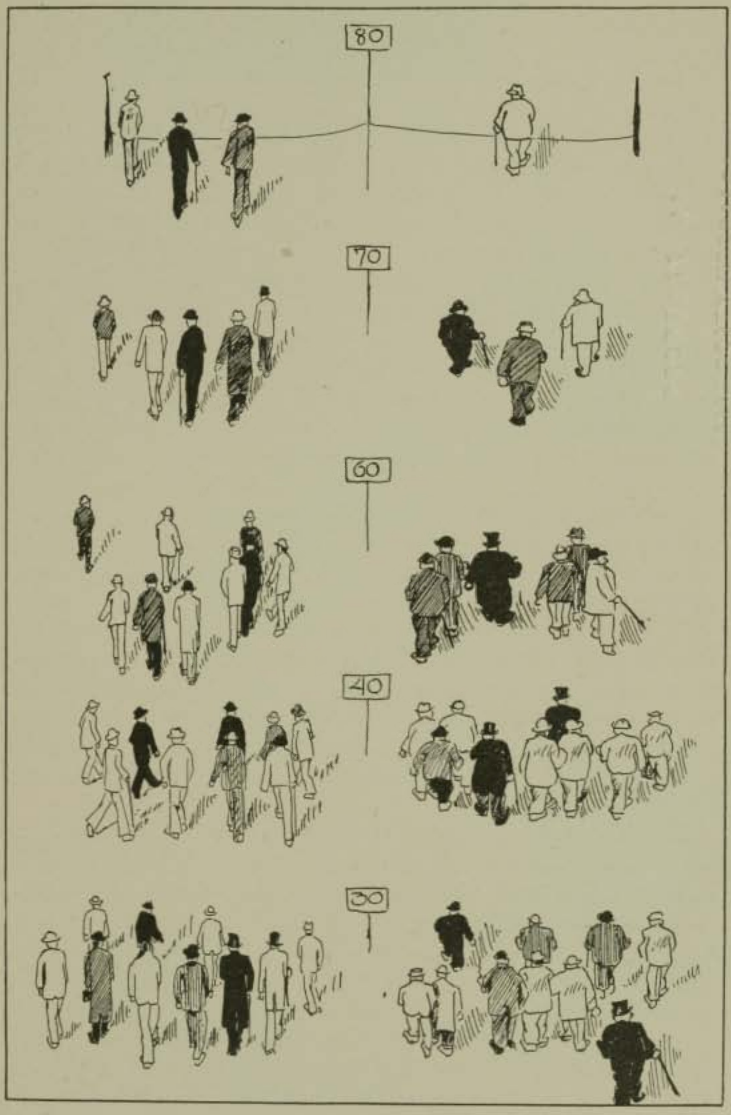


FIG. 34.—How 10 fat and 10 lean men fare as they walk through life.

diabetic children annually. Furthermore, about 2 out of 3 deaths in my series of diabetic children since the discovery of insulin I consider needless and avoidable, because due to coma.

One in 100 of the diabetics I had seen up to July 1, 1926, had lived twenty-five years or more. Not until 1947 will twenty-five years have elapsed since my patients began to use insulin and really not until then can one form a very accurate idea of its effect. To show how rapidly the number of long duration cases is growing particularly with children, I find that in 1934 I had 15 diabetics with onset in childhood of fifteen years' duration, but in 1937 there were seventy-five. The year 1947 is a long way off, consequently I am made happy whenever I see any of my diabetics who have outlived their expectation of life at the onset of their disease and appear in good health and spirits.

Many of my diabetics live longer with their disease than the average individual would be expected to live at the same age at which they acquired it. The number is well above 400. And to such through the kindness of a friend I am able to give the medal, designed by Amelia Peabody, shown on page 3 of this book. The inscriptions upon it speak for themselves. The medal is made of bronze, but if the patient should live one-half again as long as his expectancy, then he would receive a medal of silver, and if he were so fortunate as to live twice as long as his expectancy, he would be given a medal of gold and twice I have had the privilege to officiate on such an occasion.

The wonderful change in the expectancy of life of the diabetic today, particularly of the diabetic child, is shown in a table, the first of its kind, prepared by the Statistical Department of the Metropolitan Life Insurance Company and based upon my patients. It speaks for itself but I cannot help call attention to the fact that in 1936 a diabetic child of ten years irrespective of the duration of his disease had a life expectancy by insurance standards of 31.7 years. This table makes no allowance for improvements which may take place in the treatment of diabetes in the coming generation

and therefore understates rather than overstates the life expectancy of the diabetic. See Table 12.

TABLE 12.—EXPECTATION OF LIFE FOR THE GENERAL POPULATION AND FOR DIABETICS.[1]

Age.	White persons, U. S.[2]	Diabetics, Joslin.[3]
10	57	32
20	47	26
30	39	23
40	31	19
50	23	13
60	15	9
65	12	8

[1] Prepared with the coöperation of the statistical bureau of the Metropolitan Life Insurance Company.

[2] Registration states of 1930.

[3] Based upon death-rates of each age, subsequent to first observation regardless of duration of diabetes.

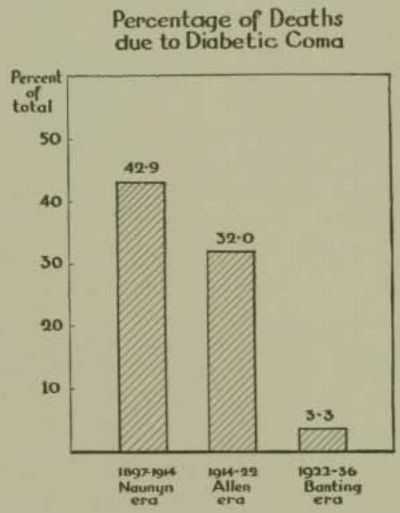


FIG. 35.—Prepared by the Statistical Bureau of the Metropolitan Life Insurance Company. 92 diabetic doctors-fatal cases.

CHAPTER XVIII.

THE PREVENTION OF DIABETES.

Obesity and the Diabetic.—Since you cannot pick your parents and grandparents and thus avoid diabetes, do the next best thing and not get fat. To be a few pounds overweight is all right until you are thirty-five years of age, but after that it is absolutely not allowable if there is any tendency to diabetes in your family, and indeed it is contrary to future good health under any circumstances. To inherit diabetes is blameless, but to acquire it through obesity plus heredity is blamable.

Diabetics in middle life are proverbially fat before the disease begins. Nearly always in a diabetic class of 30 persons it is possible to pick out 10 whose combined weights made a ton before the onset of the disease. The average weight of 1326 married diabetic women above the age of forty-five years recently coming to me for treatment was 181 pounds and of 111 single women 161 pounds. In a group of 1000 diabetics arranged by decade of onset in Table 13 one can see the small number (77) who were underweight and the large number (772) who were overweight. It is most exceptional for a thin individual over forty years of age to get diabetes.

TABLE 13.—VARIATION FROM NORMAL OF MAXIMUM WEIGHTS AT OR PRIOR TO ONSET OF 1000 CASES OF TRUE DIABETES, CALCULATED FOR HEIGHT, AGE AND SEX. SECOND SERIES, 1926.

Age, years.	Number of cases.	Number underweight.	Number overweight.	Number of normal weight.
0–10	43	19	8	16
11–20	84	24	27	33
21–30	112	11	80	21
31–40	172	8	153	11
41–50	244	7	207	30
51–60	252	2	220	30
61–70	79	5	66	8
71–80	14	1	11	2
1–80	1000	77	772	151

In middle life diabetes is overwhelmingly more common in women than in men and obesity is an important factor. I suspect it accounts in large measure for the predominance of diabetes in Jewish adults. Consequently efforts for prevention should be concentrated upon women, and especially Jewish women. One must insist that these susceptible individuals do not get fat, particularly if there is also present an hereditary tendency to diabetes.

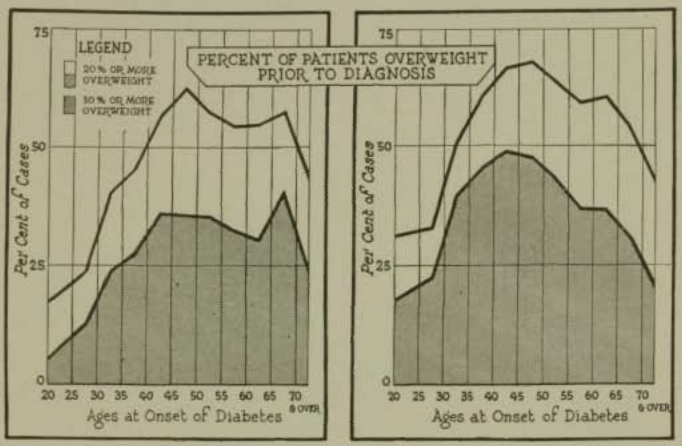


FIG. 36.—Influence of obesity in the etiology of diabetes as compiled from the Author's cases by the Metropolitan Life Insurance Company.

If one regards diabetes as a penalty of obesity, the greater the obesity the more likely is Nature to enforce it. A fat man generally has a fat wife, so it is not uncommon to encounter the disease in both heads of the family. Fat parents bring up fat children, so it is no wonder that diabetes is found in fat families. A fat nurse cuts a fat slice of bread and a thin nurse automatically cuts a thin slice. Obesity is so common in the Hebrew race that it is easy to understand why diabetes is two and a half times more frequent in the Jewish population of Boston than among the rest of the inhabitants. I have had only one adult Jewish male and only one adult Jewish female who were underweight.

Lack of exercise is, of course, a factor in producing the condition of overweight and thus is an indirect cause of diabetes. Disuse of the muscles, however, is also a direct

FIG. 37.—Case No. 3030. Age at onset, twenty-four years. Two years later Richard was born, December, 1924. In the illustration he is three and a half years of age but wearing seven-year-old clothes. The second boy, Gordon, is three weeks of age and was born in June, 1928. In March, 1937, the condition of the mother is excellent; diet: carbohydrate, 159 grams; protein, 65 grams; fat, 79 grams. Insulin, 24 to 28 units. Weight, 145 pounds. Richard is now twelve years three months of age; height, 62 inches; weight, 110 pounds. Gordon is eight years nine months of age, 51½ inches tall and weighs 62 pounds.

factor, for it is largely in the muscles that the sugar formed from the food is consumed. The man who gives up an active outdoor life and is promoted to an office chair by this change becomes a promising candidate for diabetes. Very likely this is the reason diabetes is more often met in those living

in the city than in the country, because in the city there is less physical work. So, too, in a larger sense this may account to some degree for the increase in diabetes in recent years,

FIG. 38.—It took the combined weights of these three nurses to equal the weight—315 pounds—of one of my diabetic patients.

because now we depend so much upon mechanical devices instead of our own muscles. Electricity and the automobile in the hereditarily predisposed are undoubtedly responsible for many cases of diabetes. Exercise is important in treatment of diabetes, but just as important in prevention.

An existing diabetes grows worse in the presence of any infectious disease, whether general like pneumonia, or local like tonsillitis or a boil; but it is yet to be demonstrated that an infection causes diabetes, save when it occurs in the region of the pancreas and gall bladder and there is doubt about that.

Pregnancy.—During pregnancy sugar is apt to occur in the urine. Mild cases of glycosuria which go untreated in pregnancy may later in the same or in subsequent pregnancies become aggravated cases of diabetes. The gain in weight which so often follows cessation of nursing should be avoided. Mothers should not continue to eat for two persons when they stop feeding one.

Gall Stones.—Gall stones are about twice as common among diabetics over twenty-five years of age than among a similar group in the community at large. As gall stones are proverbially more frequent among women, it is of especial interest that females are now showing a higher incidence of diabetes than men. Gall stones often precede diabetes and may precipitate it by direct extension of infection to the head of the pancreas. This seems likely, because there the islands of Langerhans are few and the gall stone type of diabetes is mild.

My advice to non-diabetic patients with gall stones is to be operated upon not only because of the danger of repeated attacks of gall stones and of the danger of a subsequent cancer, but also because of the danger of the development of diabetes. To diabetic patients my advice is to have the gall stones removed when the conditions of time, place, surgeon, and physician are all propitious.

Overweight predisposes to diabetes and I certainly know it. For the prevention of more than one-half of the cases of diabetes in this country no radical undernutrition is necessary; the individual is simply asked to maintain the weight of his average fellow man. It is desirable to spread the informa-

tion that those live longest who, above the age of thirty-five years, are 5 to 10 per cent below the average normal weight. Patients should be cautioned against gaining weight particularly after infectious diseases, pregnancy, after operations for gall stones, and when changing from an active to a sedentary mode of life. Although emphasis is usually laid upon the appearance of sugar in the urine with a patient losing weight, it cannot be too strongly emphasized that it is a common occurrence for sugar to appear in the urine when a patient is gaining weight. The first hint of diabetes occurred in Case No. 1207 when she weighed 142 pounds in 1895, but the disease did not become established in full force until 1912, when her weight was 248 pounds.

The slow onset of diabetes is favorable for the prevention of the disease. There is good reason to believe that the outbreak can be postponed or even prevented. In children diabetes comes on more rapidly, but among children this halting onset is occasionally seen and a considerable interval occurs before the disease becomes permanent. Case No. 129 showed sugar in the urine in 1901, at the age of three years, her father writes, "at a time when she appeared out of condition. Examining her frequently after that I failed to find it and did not look for it again until in February, 1905, when she appeared like a full-fledged case of diabetes."

Who would say that the onset of diabetes in George M., Case No. 2151, aged twenty years, could not have been prevented? His grandfather and father had diabetes. His weight was 29 per cent above standard for his age, and he reports eating two whole pies a day and a whole bottle of cream on his pudding on Sunday. Now he has a cataract, though the diabetes is mild.

March 30, 1920, there came to my office a woman with diabetes. She was given the usual examination with suggestions for treatment, and as it was impracticable for her to enter the hospital she was taught on the spot to examine her urine. She went home and shortly after contracted pneumonia and died. But in the intervening days amid her household cares she found time and took enough interest to examine the urines of 10 others in her boarding-house, and

in so doing discovered the presence of diabetes in a boy. She gave him sound advice and sent him to his own physician, who also subsequently died, and later the boy came to me with this story. On the day she learned the Benedict test and made these 10 urinary examinations for her friends Louisa Drumm was aged seventy-nine years and four months. Can one not appropriately say to younger diabetic patients, "Go thou and do likewise?"

CHAPTER XIX.

HEREDITY.

DIABETES is hereditary. Suppose two diabetics should marry and have 100 children, all these children theoretically would be expected to develop diabetes. But this is not quite so bad as it sounds. At birth the chances are overwhelming that none of the children would have diabetes. Among 12,000 diabetics I have not seen 1 congenital case, and in fact, there are only 8 such cases known in medical history. Moreover, until these 100 children reached their tenth year only 5 even theoretically would come down with the disease and but one-third before they became forty years of age, and the last 3 of the 100 would not develop diabetes until they were over seventy years of age.

TABLE 14.—AGE AT ONSET OF DIABETES. PERCENTAGE DISTRIBUTION OF 6357 CASES IN EACH DECADE OF ONSET. BY SEX.

Decade of onset.	Total persons.	Males.	Females.
Total	100.0	100.0	100.0
First	4.7	5.0	4.4
Second	6.6	7.5	6.1
Third	7.9	9.3	6.5
Fourth	12.9	14.7	11.2
Fifth	23.6	23.1	24.1
Sixth	27.2	25.1	29.2
Seventh	13.8	12.5	15.1
Eighth	3.1	3.0	3.2
Ninth	0.2	0.2	0.2

It is the tendency to diabetes and not the actual disease which is inherited. Dr. Umber of Berlin tells the story of a child who entered the hospital with diabetes; ten years later the mother was admitted for the same cause; and again in ten years the grandmother came for treatment also with diabetes. Before the discovery of insulin diabetic children lived so short a time that we heard little about heredity, but in 1937 Dr. Priscilla White tells me among 75 of our

cases who developed diabetes in childhood and had survived fifteen or more years, there were 52 per cent who had relatives with the disease (brothers or sisters 7, 8 who had parents, and 15 who had grandparents with the disease, and enough others with uncles and aunts or cousins to bring the total with a diabetic relative up to 52 per cent). Of course we are constantly finding new cases among the group and if we knew all the facts it would be shown that every diabetic had a diabetic relative.

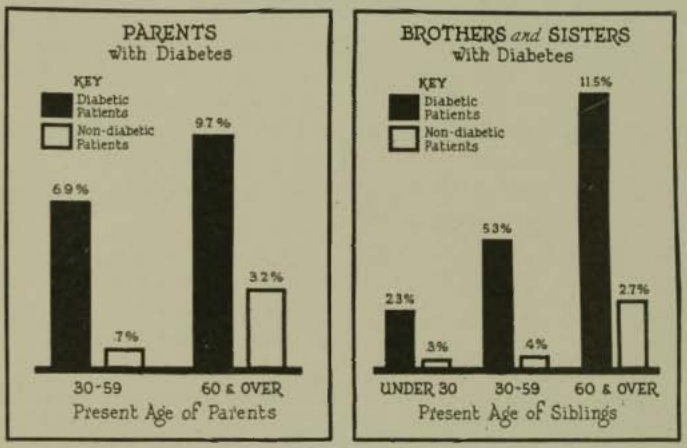


FIG. 39

Fig. 39 illustrates the difference in the frequency of diabetes between brothers and sisters and between parents of diabetics and non-diabetics at different ages, as compiled from my cases by the Metropolitan Life Insurance Company, but originally studied by Professor Pincus of the Department of Physiology at Harvard University from data submitted by Dr. White.

The following table also illustrates forcibly the influence of heredity as a cause of diabetes.

TABLE 15.—A COMPARISON OF THE INCIDENCE OF DIABETES IN THE SIBLINGS (BROTHERS AND SISTERS) OF NON-DIABETICS, DIABETICS, DISSIMILAR AND SIMILAR TWINS, AND OF DIABETES IN THEIR PARENTS.

Type of population.	Siblings, number.	Per cent diabetic.	Per cent parents diabetic.
Control	862	0.6	2
Diabetic	2835	5.0	9
Dissimilar twin	19	10.0	10
Similar twin	16	69.0	6

When a diabetic marries a non-diabetic but whose father or mother and sometimes brother or sister has diabetes, one-half of the children should develop the disease. If two non-diabetics, but each of a diabetic family and thus carriers of the disease, marry, the ratio of the offspring destined to diabetes would be 1 in 4. But if a diabetic will choose a non-diabetic of a non-diabetic family for a partner, none of the children should come down with the disease. Be careful then, diabetics, with whom you fall in love.

Diabetes unquestionably is a disease of the family. One must focus on the family to prevent it. Diabetic parents and grandparents should strive not only to care for themselves, but should endeavor to protect their posterity. Further I think they should contribute to the study and care of other diabetics, so that if their descendants do develop the disease, treatment will be better than at present. Diabetics are bright and there are enough of them to care for one another. Diabetes for the Diabetics is a good slogan and I believe so much in my diabetics that I expect eventually they will solve their own problems.

How can diabetes be prevented if there is a family tendency to it? Above all things do not become forty and fat, and if you are a diabetic put this same rule in force among your relatives and teach your descendants to avoid obesity. By this means much of the element of heredity can probably be overcome.

CHAPTER XX.

THE MARRIAGE OF DIABETICS.

SHALL a diabetic marry?

No diabetic girl or boy should get married (1) unless the parents of the non-diabetic have been told that the other has diabetes; (2) unless sufficient capital is available to provide for a "sick fund" in case of emergency or pregnancy; (3) unless there is proved good health apart from diabetes; (4) unless the two contracting parties have known each other long enough to realize what the treatment of diabetes by diet and insulin involves; (5) unless the two have such strength of character that they are prepared to sustain the shocks of life with a smile; (6) unless the diabetic is sensible and follows the general rules of treatment.

Two diabetics should not marry and have children. (See pages 154 and 155.)

Marriage involves no danger for the man, but parturition does involve danger for the woman although far less than formerly. To reduce this danger to the minimum the pregnant diabetic should be under close observation and should enter a hospital for the last two or three weeks of the pregnancy, certainly for the first child, and it is wiser under all circumstances. The condition of a diabetic woman during pregnancy may change suddenly and arrangements should be perfected early in its course so that she can enter a hospital at a moment's notice. With close observation of this type, neither she nor the doctor need have many worries.

The babies of diabetics are apt to be big. They are long and heavy. Often in the past a mother has lost her child simply from the mechanical difficulty of its birth. This can be avoided by Cesarean section, and my associates and I unanimously advise such a procedure for the first pregnancies of diabetics. In general this should be done two weeks or more before term, because during these last two weeks toxemia is so apt to cause the death of the child.

The diet of a diabetic mother should contain at least 150

grams of carbohydrate and often more. The quantity of protein and fat should be regulated according to the weight of the patient, but the total calories should not lead to undue gains in weight, because large babies should be avoided. This is not easily accomplished. A minimum of 1 pint and often 1½ pints or 1 quart of milk should form a part of the mother's diet.

The hours immediately following delivery are critical both for mother and child. Access to a laboratory in which tests for non-protein nitrogen, blood sugar, carbon dioxide combining power, and the blood chlorides can be performed either by day or by night removes nearly all risks. Sudden alterations in the insulin requirements of the mother often follow delivery and the infant, too, must be watched, because its pancreas may have been unusually active prior to birth, and if this continues, even for a few hours after birth, without nourishment from the mother or other food, a low blood sugar could develop. The question of nursing the baby depends upon the ability of the mother to control her diabetes and maintain her strength and proper weight.

The importance of intimate coöperation between the physician and obstetrician led to the inclusion of a delivery room in the George F. Baker Clinic at the New England Deaconess Hospital—a practice which I hope already exists or will be adopted at other similar institutions. Few diabetic women have babies and therefore they require unusual care. Moreover, this is doubly necessary because so many pregnancies end unsuccessfully.

CHAPTER XXI.

WEIGHT PECULIARITIES.

Most diabetic patients are obese prior to the onset of diabetes. However, as soon as sugar begins to be lost in the urine, the weight usually falls because the body is losing nourishment, being unable to utilize the food eaten even though the quantity be excessive. It is not uncommon for a patient to lose 50 pounds before diabetes is discovered and treatment begins, and occasionally a patient will lose as much as 100 pounds during the course of years. A diabetic patient, whose urine is free from sugar, in reality is probably in safer condition if he is 10 to 20 per cent below weight, because thus he can be assured that he is not overeating. In this respect it is better to emulate the Indian and Uncle Sam than the Eskimo and John Bull. The individual 10 per cent and even 20 per cent below weight may not be a delight to our eyes, but if over thirty-five years of age and in this condition, he is much more acceptable to the insurance company. It is often desirable for a patient to lose weight, but this should be undertaken only under the doctor's direction. Frequently it is only by losing weight that a patient regains the power to tolerate carbohydrate. As a guide to the proper weight for a diabetic the average weights of individuals for given heights and ages are given in Tables 16 to 20.

Height and weight tables should not be considered law and gospel. The Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association definitely advises teachers weighing and measuring children to interpret heights and weights in terms of growth over a period of time rather than by comparison with an average and has omitted all tables from its report.

TABLE 16.—HEIGHTS AND WEIGHTS OF CHILDREN BETWEEN ONE AND FOUR YEARS OF AGE (WITHOUT CLOTHES).[1]

5602 boys			4821 girls	
Height, inches.	Weight, pounds.	Age, months.	Height, inches.	Weight, pounds.
26.5	18.0	6	25.9	16.8
27.3	19.1	7	26.5	17.4
27.6	19.8	8	27.0	18.3
28.1	20.4	9	27.6	19.1
28.5	20.9	10	27.9	19.5
29.0	21.4	11	28.4	20.1
29.4	21.9	12	28.9	20.8
29.9	22.9	13	29.4	21.0
30.3	23.0	14	29.5	21.6
30.8	23.6	15	30.1	21.9
31.1	24.1	16	30.5	22.6
31.4	24.5	17	30.8	22.9
31.8	24.6	18	31.1	23.4
32.3	25.5	19	31.5	23.8
32.6	25.8	20	32.0	24.1
32.9	25.8	21	32.3	24.8
33.3	26.9	22	32.6	25.3
33.6	27.0	23	32.9	25.6
33.8	27.1	24	33.4	26.4
34.0	27.9	25	33.8	26.9
34.1	28.3	26	33.9	27.3
34.8	29.0	27	33.9	27.3
35.1	29.1	28	34.6	27.8
35.4	29.3	29	34.8	27.8
35.4	29.5	30	34.9	28.3
35.5	30.5	31	35.1	28.8
36.0	30.6	32	35.4	29.0
36.1	30.6	33	35.6	29.1
36.5	31.1	34	36.5	30.1
36.8	31.9	35	36.5	30.3
37.1	32.3	36	36.8	30.5
37.4	32.3	37	36.8	30.8
37.5	32.4	38	37.0	31.0
37.9	33.1	39	37.3	31.6
38.5	33.5	40	37.5	32.0
38.6	33.6	41	37.8	32.3
38.6	33.8	42	38.0	32.5
38.8	33.8	43	38.3	32.8
38.9	34.3	44	38.5	33.0
39.0	34.5	45	38.5	33.5
39.0	34.8	46	38.8	33.5
39.3	35.8	47	38.9	33.5
39.5	35.9	48	39.0	33.8

[1] Crum, F. S.: Quarterly Publication of the American Statistical Association, Boston, September, 1916, N. S., No. 115, **15**, 332.

TABLE 17.—HEIGHTS AND WEIGHTS OF BOYS BETWEEN FIVE TO FOURTEEN YEARS (WITHOUT CLOTHES).[1]

BOYS

Weight in Pounds Without Clothes

Height in Feet and Inches Without Shoes

AGE	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	4	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	5	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	6	6-1
5	35	38	39	41	42	46																													
6		36	39	41	42	44	45	48																											
7					42	43	46	45	49	54																									
8							45	48	50	53	54	57	59																						
9									50	53	55	58	60	62	62	65																			
10										53	55	58	60	62	65	66	69	71																	
11													61	61	63	66	71	77	77	78															
12														63	67	70	75	76	79	84	84	85													
13															67	71	75	78	80	85	86	91	95	99	100										
14															67	71	76	79	82	88	90	94	97	103	107	114	122								
15																		79	82	87	91	95	99	106	112	118	119	121	128	133					
16																						90	96	104	115	120	122	125	129	132	134	136			
17																								104	110	117	122	125	128	130	136	140	140		
18																									120	120	126	131	136	139	143	146			
19																									130	126	129	134	136	139	144	146	149		
20																										125	130	132	136	139	145	146	154	165	

TABLE 18.—HEIGHTS AND WEIGHTS OF GIRLS BETWEEN FIVE TO FOURTEEN YEARS (WITHOUT CLOTHES).[1]

GIRLS

Weight in Pounds Without Clothes

Height in Feet and Inches Without Shoes

AGE	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	4	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	5-0	5-1	5-2	5-3	5-4	5-5
5		34	37	38	41	41	45																				
6			35	37	39	41	43	45	48																		
7					39	42	44	45	47	50																	
8						42	45	47	49	51	53	56															
9									49	51	53	56	59	63													
10											54	57	59	62	64	69											
11													60	62	63	68	70	75									
12														63	66	69	71	75	78	83	88	94					
13															65	69	73	76	80	86	89	94	99	104			
14																		78	82	88	93	98	100	104	107	112	114
15																				89	97	100	102	106	109	118	118
16																					100	104	109	111	116	116	121
17																						109	108	110	110	117	125
18																						103	106	107	112	114	120
19																						99	105	111	113	119	123
20																						99	111	114	114	115	125

[1] Wood, T. D.: The ninth yearbook of the National Society for the Study of Education, Part I, Health and Education, Chicago, 1910, p. 34.

TABLE 19.—HEIGHTS AND WEIGHTS OF 221,819 MEN OF FIFTEEN OR MORE YEARS OF AGE (WITH CLOTHES).[1]

Age.	Graded average weight in pounds with clothes.																	
	Feet and inches with shoes.																	
	5–0	5–1	5–2	5–3	5–4	5–5	5–6	5–7	5–8	5–9	5–10	5–11	6–0	6–1	6–2	6–3	6–4	6–5
15	107	109	112	115	118	122	126	130	134	138	142	147	152	157	162	167	172	177
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
17	111	113	116	119	122	126	130	134	138	142	146	151	156	161	166	171	176	181
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
19	115	117	120	123	126	130	134	138	142	146	150	155	160	165	170	175	180	185
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
21	118	120	123	126	130	134	138	141	145	149	153	157	162	167	172	177	182	187
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
23	120	122	125	128	132	136	140	143	147	151	155	159	164	169	175	180	185	190
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
25	122	124	126	129	133	137	141	145	149	153	157	162	167	173	179	184	189	194
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
27	124	126	128	131	134	138	142	146	150	154	158	163	169	175	181	187	192	197
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
29	126	128	130	133	136	140	144	148	152	156	160	165	171	177	183	189	194	199
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
31	127	129	131	134	137	141	145	149	153	157	162	167	173	179	185	191	197	202
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
33	127	129	131	134	137	141	145	149	154	159	164	169	175	181	187	193	199	204
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
35	128	130	132	135	138	142	146	150	155	160	165	170	176	182	189	195	201	207
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
37	129	131	133	136	140	144	148	152	157	162	167	172	178	184	191	197	203	209
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	104	210
39	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	199	205	211
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
41	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	207	213
42	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
43	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
44	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
45	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
46	134	136	138	141	144	148	152	156	161	166	171	177	183	189	196	203	210	216
47	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
48	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
49	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
50	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
51	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
53	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219
55	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

[1] Association of Life Insurance Directors and Actuarial Society of America, New York, 1912, p. 38. Published by a committee. Allow 1 inch for shoes and 10 pounds for clothes.

TABLE 20.—HEIGHTS AND WEIGHTS OF 136,504 WOMEN OF FIFTEEN OR MORE YEARS OF AGE (WITH CLOTHES).[1]

Age.	Graded average weight in pounds with clothes.																
	Feet and inches with shoes.																
	4–8	4–9	4–10	4–11	5–0	5–1	5–2	5–3	5–4	5–5	5–6	5–7	5–8	5–9	5–10	5–11	6–0
15	101	103	105	106	107	109	112	115	118	122	126	130	134	138	142	147	152
16	102	104	106	108	109	111	114	117	120	124	128	132	136	139	143	148	153
17	103	105	107	109	111	113	116	119	122	125	129	133	137	140	144	149	154
18	104	106	108	110	112	114	117	120	123	126	130	134	138	141	145	150	155
19	105	107	109	111	113	115	118	121	124	127	131	135	139	142	146	151	155
20	106	108	110	112	114	116	119	122	125	128	132	136	140	143	147	151	156
21	107	109	111	113	115	117	120	123	126	129	133	137	141	144	148	152	156
22	107	109	111	113	115	117	120	123	126	129	133	137	141	145	149	153	157
23	108	110	112	114	116	118	121	124	127	130	134	138	142	146	150	153	157
24	109	111	113	115	117	119	121	124	127	130	134	138	142	146	150	154	158
25	109	111	113	115	117	119	121	124	128	131	135	139	143	147	151	154	158
26	110	112	114	116	118	120	122	125	128	131	135	139	143	147	151	155	159
27	110	112	114	116	118	120	122	125	129	132	136	140	144	148	152	155	159
28	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
29	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
30	112	114	116	118	120	122	124	127	131	134	138	142	146	150	154	157	161
31	113	115	117	119	121	123	125	128	132	135	139	143	147	151	154	157	161
32	113	115	117	119	121	123	125	128	132	136	140	144	148	152	155	158	162
33	114	116	118	120	122	124	126	129	133	137	141	145	149	153	156	159	162
34	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
35	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
36	116	118	120	122	124	126	128	131	135	139	143	147	151	155	158	161	164
37	116	118	120	122	124	126	129	132	136	140	144	148	152	156	159	162	165
38	117	119	121	123	125	127	130	133	137	141	145	149	153	157	160	163	166
39	118	120	122	124	126	128	131	134	138	142	146	150	154	158	161	164	167
40	119	121	123	125	127	129	132	135	138	142	146	150	154	158	161	164	167
41	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	165	168
42	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	166	169
43	121	123	125	127	129	131	134	137	140	144	148	152	156	160	163	167	170
44	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
45	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
46	123	125	127	129	131	133	136	139	142	146	150	154	158	162	165	169	172
47	123	125	127	129	131	133	136	139	142	146	151	155	159	163	166	170	173
48	124	126	128	130	132	134	137	140	143	147	152	156	160	164	167	171	174
49	124	126	128	130	132	134	137	140	143	147	152	156	161	165	168	172	175
50	125	127	129	131	133	135	138	141	144	148	152	156	161	165	169	173	176
51	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
52	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
53	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
54	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177
55	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177

[1] Association Life Insurance Directors and Actuarial Society of America, New York, 1912, p. 67. Published by a committee. Allow 1½ inches for shoes and 6 pounds for clothes.

Gain in weight in the course of diabetes is encouraging, but the weight gained should be moderate and not quite sufficient to bring the weight of the patient up to normal standard. Even with insulin one sees the harmful effect of a marked gain in weight, because it is more difficult to keep the urine sugar free. It is a good rule to keep the weight a little below normal, unless you are under thirty-five years of age; in the latter event it is safer to be above normal weight. The fad among girls for being underweight apparently has increased their tendency to develop tuberculosis.

Changes in Weight During Treatment.—Diabetic patients are often surprised at the sudden change in weight when they undergo a short course of treatment. It may go up or down 5 or 10 pounds in as many days. The reason for these queer changes is the retention or discharge of water from the tissues. The following experiment conducted by me many years ago illustrates this well: A student was given a diet sufficient to maintain his body weight so far as nutritive value was concerned, but from his food salt was entirely removed. As a result, in the course of thirteen days the weight fell 11.66 pounds. Upon the resumption of his former diet with salt as desired, 9 pounds of those lost were regained in three days. Diabetic patients often gain weight from exactly the same cause—namely, the ingestion of too much salt. Such gain in weight, however, should be looked upon at its face value, in other words simply as a retention of fluid in the body.

When the water collects in excess it is termed dropsy. Frequently this can be relieved and the patient lose weight by restricting the intake of salt, although not to the degree practised in my experiment. On the other hand during diabetic coma there is a marked loss of weight. The body dries up and to correct this is one of the chief aims in treatment. Salt solution subcutaneously or intravenously is almost always indicated in addition to water by mouth. So too in diarrhea the desiccation of the tissues may be considerable.

A man or woman shudders at the thought of carrying about a pailful of dropsy, but how many ladies and gentlemen

transport with composure several buckets of fat! They are not water-logged, but fat-logged. Few of them are willing to face those elemental truths that no farmer has yet found a way to fatten hogs except with excess of food and little exercise. I fear I am a little hard-hearted toward my obese friends. A New England conscience compels the disclosure that my grandfather weighed 300 pounds, did not have diabetes, and death came from that old man's friend, pneumonia, upon his eightieth birthday. He was the exceptional man and to him I attribute the optimism which is so helpful in medicine.

Removal of the carbohydrate in an individual's diet, though it is replaced by an equivalent number of calories in the form of fat, causes a prompt fall in weight, and if the reverse procedure is adopted, the weight will rise. The loss or gain of weight which occurs under such conditions may amount to 2 pounds in a day for several days. It is explained by the varying quantities of water which are retained in the body according to whether carbohydrate or fat is stored.

Finally, there is a real reason for a loss of weight during the treatment of diabetes, due to the fact that at times the diet is deficient in calories. Under such circumstances the patient lives upon his own tissues. Calculations show that in this way for every pound lost approximately 1500 Calories are derived. To gain or lose 1 pound of actual tissue, therefore, there must be, approximately, an excess or deficit of 1500 Calories. If a patient therefore is taking just the proper quantity of food for his daily needs and gains 1 pound, the discriminating doctor knows it simply means retention of water.

CHAPTER XXII.

DIABETIC COSTS.

THE diet of the diabetic patient with its fresh vegetables, fruit, and cream is somewhat expensive, but it costs far less if he is treated than if he is untreated. In the latter state the waste of food in the form of sugar in the urine is enormous. Similarly the cost of treating the disease is minimal compared with the treatment of its complications which is maximal. An attack of diabetic coma involves on the average an expense of $100; a sore toe on the average $300, and the acquirement of tuberculosis $1500 or thereabouts. Diabetic doctors practically never develop coma, seldom acquire gangrene and for years I have not seen a diabetic doctor with tuberculosis. Lay diabetic patients, too, should avoid these extravagant complications.

Case No. 1171 told me that before treatment was begun, he ate 13 eggs for breakfast, not by any means as a stunt, but because he wanted them.

Case No. 1147, a lady, aged thirty-five years, ate a dozen eggs a day, and in response to my request gave me a report of her daily diet before she began treatment. This was estimated to contain carbohydrate 179 grams, protein 194 grams and fat 327 grams, but I suspect the carbohydrate must have been much greater before treatment was actually begun. Although the diet contained 60 Calories per kilogram body weight instead of the normal 30 Calories, the patient, while upon it, lost 66 pounds in a little over two and a half years. The reason for this was apparent, for on October 6, 1916, the volume of the urine was estimated at 6000 cc. (6 quarts) and the sugar was found to be 5 per cent, or 300 grams (10 ounces), the equivalent of a loss of 1200 Calories in the urine in twenty-four hours, or as we have seen on page 166 to four-fifths of 1 pound of body weight. In one year this would amount to 240 pounds of sugar! The duration of diabetes was 5.5 years, she died in September, 1919, of diabetic coma, three years before insulin was available.

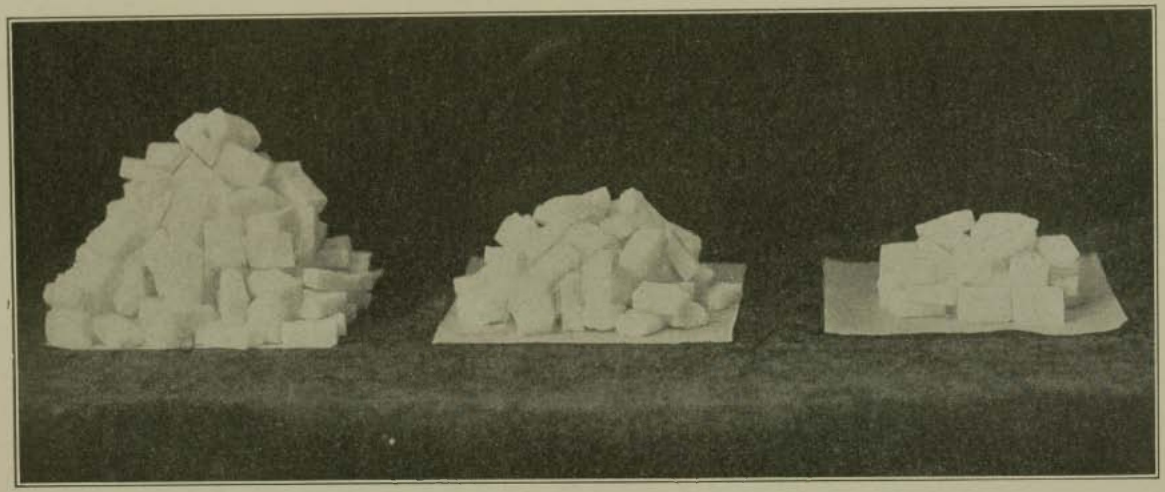


FIG. 40.—SUGAR, MEASURED AS LUMP SUGAR, LOST IN THE URINE IN ONE DAY BY UNTREATED DIABETIC PATIENTS.

Case No. 295	Case No. 1147	Case No. 653
A Severe Diabetic	A Moderate Diabetic	A Mild Diabetic
680 grams a day	300 grams a day	174 grams a day
546 pounds (1½ barrels) a year	240 pounds (⅔ barrel) a year	140 pounds (⅖ barrel) a year

The modern treatment of diabetes is so good that patients and their friends often forget how savage and serious diabetes really is.

Case No. 295 voided in twenty-four hours, on October 23–24, 1909, approximately 10 quarts of urine (nearly 20 pounds), containing 680 grams of sugar, the equivalent of 2720 Calories. The weight of his urine for one day was equal to one-fifth of that of his body. In other words, he lost in the urine 54 Calories per kilogram, an amount sufficient in calories to supply almost double his own needs if taken in the form of food which he could assimilate.

Diabetic patients with acid poisoning lose calories in the urine in the form of acid bodies (acetone, di-acetic acid, β-oxybutyric acid) as well as of sugar. The quantity of acid bodies thus lost is quite considerable. These acid bodies represent wasted food just as much as does the sugar in the urine. Case No. 344 is a good illustration of this. On December 25–26, 1911, he excreted 188 grams of sugar, the equivalent of (188 $\times$ 4) 752 Calories, and in addition 55 grams of acid bodies, equivalent to (55 $\times$ 5) 275 Calories. Acid intoxication is really a dreadful robber, for besides stealing the food of a patient, it frequently steals his life! Against it the diabetic can insure himself by not overeating, particularly by not overeating of protein and fat, and by keeping the urine sugar-free with insulin.

The diabetic can save money if discretion is employed. Tea and cocoa shells are cheaper than coffee and cracked cocoa. Oleomargarine or other preparations may be substituted for butter and employed instead of bacon and cream. Vegetables, whether fresh or canned can be purchased in bulk. Broth is expensive and a luxury, The home canning of vegetables in diabetic families should be encouraged. A garden is a great advantage.

Lettuce may be the best vegetable for a diabetic, but cabbage is the cheapest. Patients seldom tire of cabbage any more than normal individuals tire of potato. Perhaps this is because it can be served in so many different forms. Fats are costly as compared with carbohydrate foods, but there is great variation in the cost of fat. One of my patients made the following computations:

	Calories.
One cent in 20 per cent cream yields	26
One cent in butter yields	52
One cent in oil yields	110

The expense of treatment of diabetes has decreased markedly in the last decade. Patients remain a few days instead of a few weeks in the hospital. The use of insulin allows more food in the form of carbohydrate and this is cheaper than protein and fat. Patients now study and learn how to coöperate with their doctors. But perhaps the most important factor of all is that relatively expenses have dropped because patients are so much more vigorous that they can be self-supporting.

Much more can be done in reducing expenses for diabetics. Fees for laboratory tests could be greatly reduced if the number was increased. In this way costs would be greatly lessened. It requires nearly as much time to perform one blood-sugar test as ten tests. By arranging for the performance of these wholesale for a group of doctors or patients, the outlay would be so much reduced that they would be far more generally available. The same policy applies to Roentgen-ray examinations of the teeth and of the chest. I am convinced, because I have good reasons, that if all my diabetic patients could have a Roentgen-ray examination of the chest the number of instances of tuberculosis detected early would be trebled and in consequence expense avoided and fatalities reduced.

CHAPTER XXIII.

AN INSULIN SYRINGE.

An insulin syringe usually is graduated to hold 1 cubic centimeter (1 cc.) or about 15 drops of water. Some syringes contain 1.5 cubic centimeters and still others 2 cubic centimeters. Each syringe should be inspected to determine its capacity.

All syringes show the cubic centimeter divided into 10 major divisions.

Insulin comes in different strengths. Some bottles contain 10 units for each cubic centimeter and this insulin is called U-10 insulin, others contain 20 units per cubic centimeter, called U-20 insulin, still others 40, called U-40 insulin and occasionally one sees so concentrated a solution of insulin as 80 units per cubic centimeter, called U-80 insulin. Therefore, if a patient gives himself a full cubic centimeter of insulin he will receive 10, 20, 40 or 80 units according to the strength of the insulin in the bottle. Always read the label on the bottle and note the strength of the insulin it contains.

One division of the ten divisions upon the 1 cubic centimeter syringe would contain one-tenth of a cubic centimeter or 1 unit if the syringe was filled with U-10 insulin, 2 units of U-20, 4 units of U-40 and 8 units of U-80. It is thus easy to calculate the dose no matter the kind of insulin available. Of course the more concentrated the insulin, *i. e.*, the more units in 1 cubic centimeter, the less fluid there is to inject. To get 20 units would take 2 entire cubic centimeters (2 syringes) of U-10, 1 cubic centimeter of U-20 but only one-half cubic centimeter of U-40.

Some syringes contain 1 cubic centimeter, but instead of being subdivided and designated as tenths of a cubic centimeter are marked for the convenience of the patient in units. Upon one side of the scale the units are given for the use of U-20 insulin: upon the other side of the scale for the stronger

U-40 insulin. This avoids the necessity of calculations, but the patient must be careful and read the strength of the insulin printed upon the label on his bottle and then use the corresponding scale of the syringe. As a matter of fact the syringes are always divided into 10 parts.

Do not blunder. Be sure you know how much insulin you are taking. The sooner you learn how to give yourself insulin, the better.

This syringe holds 10 units if filled with U-10 insulin up to the mark 1, and 1 unit if filled to the mark 0.1; if filled with U-20 insulin it contains 20 units and 2 units at the 0.1 mark; if filled with U-40 insulin it contains 40 units, and 4 units at the 0.1 mark; and if filled with U-80 insulin, there would be 80 units, and at the 0.1 mark there would be 8 units.

FIG. 41.

The strength of insulin used does not change the insulin dosage. The prescribed dose in units remains the same, whether one uses U-10, U-20, U-40, or U-80 strength.

CHAPTER XXIV.

DOGS, DIABETICS AND THEIR FRIENDS.

A DOG is a diabetic's thoughtful friend.

A dog never says to a diabetic "You are thin," never speaks about his diet, never tempts him to break it and to eat a little more, never refers to the delicacies he himself has eaten

CASE NO. 2007.

	1928	1933
Age, yrs.	13.8	18.8
Diabetes, yrs.	8.0	13.0
Height, in.	63.2	68.0
Weight, lbs.	112.5	146.0
Carb., gm.	141	220
Protein, gm.	79	121
Fat, gm.	94	114
Insulin, units	76	80

	1937
Age, yrs.	21.8
Diabetes, yrs.	16.2
Height, in.	68.0
Weight, lbs.	162.0
Carb., gm.	215
Protein, gm.	96
Fat, gm.	97
Insulin, units	63

FIG. 42.—Case No. 2007. A diabetic child and his dog, Bob, in 1923.

or the good bones he expects to eat, in fact never implies by any signs or action in public or in private that he knows his master has diabetes. A diabetic is never embarrassed by his dog. How often he wishes his friends were as considerate!

A dog is a diabetic's teacher. His dog shows the diabetic how to rest and sleep at odd moments, shows him how to

exercise and play, recognizes the value of sunshine and sets him a good example by cleaning his paws every night. A dog is cheerful. The friends of a diabetic sometimes wish that he would take lessons from his dog.

From experiments on a dog Minkowski found out that diabetes originated in the pancreas. From experiments on a dog Allen learned that undereating helped and overeating harmed diabetics. From experiments on a dog Banting and Best discovered insulin.

FIG. 43.

FIG. 44.

FIG. 43.—Case No. 2007. George with his crew, Bob, have won many races. George is one of the diabetic children who is sailing uncharted seas to discover how older diabetics and other children can live. (Photograph taken in 1926.)

FIG. 44.—Even the dog Bob was alive at the end of ten years, but at length he died at the ripe old age, for a dog, of twelve years or the equivalent of eighty-four years for a man.

When I see this little boy, George, and his dog, Bob, and their devotion to one another, I am reminded of the million diabetics and future diabetics in the United States who may not be holding a dog in their arms, yet are alive today or will be alive, enjoying better health and happiness, all because a few dogs through the instrumentality of multitudes of scientific workers have revolutionized the treatment of diabetes.

Would you want to be a member of a society if it had for its object the prevention of a dog saving the life of a child? Do you think this dog, Bob, would want to join such a society?

CHAPTER XXV.

DIABETIC CHILDREN.

THE diabetic child at the onset of his disease is usually taller and heavier than the average child and is mentally precocious. When properly treated he grows and develops like a normal child. As a rule he has better teeth. The diabetic child, and perhaps the child of a diabetic, is a superior being and should be so regarded.

Intelligence is inborn in the diabetic child. At the age of ten years he acquires a knowledge of diabetes far more readily than the average diabetic of fifty years. It is true he lacks judgment and has not learned to reason, largely because he has not had the opportunity to study in the school of experience. He knows his Benedict test and is well aware of its significance. He understands the reckoning of his diet and recognizes errors in the same. He can administer his own insulin and occasionally prefers to do so. After a few experiences he detects the advent of an insulin shock almost intuitively. He appreciates what coma is, how it comes on, but is no more skillful in deciphering its stealthy approach than are nurses or most of us doctors.

Diabetic children are more sinned against than sinning and it is because of this that they do not get a fair show. They are underfed and overfed by a physician's fiat, often without rhyme or reason, because we do not take the time to study the individual case and unearth their real needs. Some of us even have fads and may try to see on how little protein, carbohydrate or calories they can maintain their existence. Insulin and the diet are so wonderful we are wont to dispense with our brains. We are generally more responsible than they for their shortcomings, and if a doctor is frank, he will acknowledge it, hence this story. Martin, R., aged six years, came to the office, but was "just a naughty boy," according to a most experienced diabetic nurse, and to avoid a scene his parents took him home without his being met by

me. When I heard of it, I upbraided all concerned and commented on the impropriety of a child dictating to his parents. Four hours later Martin returned smiling and it was suggested to me, supposedly versed in diabetic lore, that the fit of temper was simply due to an insulin reaction, because it had been easily cured by a few grams of carbohydrate.

Diabetic children mean to be honest. If they break a rule of diet, because they follow their instinct of self-preservation and sense of hunger, be careful what you say or do. If you say they steal food in their presence or before others, I protest and declare you are performing a criminal act before the bar of a child's soul if not before the bar of the law. Children will tell whether they have done right or wrong if kindly questioned. They will furnish the explanation of unexpected phenomena. Just as it is easier to be a total abstainer than a moderate drinker, so the old strict diet with starvation was easier to follow than the present liberal diets. Formerly diets were concrete, now they are intricate, and decision must be left to the discretion of the child to determine whether he should eat the sugar you make him carry in his pocket to protect himself from unconsciousness and convulsions because of an insulin reaction.

It is not so simple a matter to control the diet today as formerly. Then a slight error in diet showed instantly in the Benedict test, but now it is less apt to be a true indicator of what has been eaten, because of insulin and the larger meals, since moderate additions to the diet are often tolerated. The child sees you constantly testing his tolerance by additions to his carbohydrate and it is natural for him to test it too.

Never ask a diabetic child if he has broken his diet any more than you would ask your best friend if he had been dishonest. Never accuse any one of breaking his diet. Instead proceed in the plainest and most logical manner to seek the truth. Express wonder and surprise about what has happened. Together with the child search for the reason. Build up the evidence point by point without disclosing your intent or suggesting that you realize its convincing force until

the child has no desire to do else than account for the enigma. But do not force him to put this in words. Recall Hawthorne's Scarlet Letter and the agony of Arthur Dimmesdale who wanted to confess, but was prevented from confessing. Never fear, the poor little child is punished enough by his own conscience and far more than as if you blamed him. And when you are done with holding court, dismiss and forget the case.

A child lacks perspective so far as time is concerned. An hour is a day, a day is a week, a month a year and a year is eternity. Hence be cautious and use great discretion in discussions before children. If questions about the future are asked, they must be promptly answered. Of course no one expects that diabetes will be treated ten years from now as it is today. There are a hundred working upon diabetic problems at present for a single one a generation ago and the chances of notable discoveries and improvements in treatment are infinitely better. I believe that something will be found which will make those lazy islands of Langerhans secrete good insulin. In the meantime every diabetic who prolongs his life for one day is encouraging another to live bravely too.

Transgression of the diet is frequently the fault of the doctor and for one of two causes. Either the doctor, and of course here I am referring to myself, has not explained clearly enough to Johnnie the reason for recommending those strange and funny meals which his mother never used to give him or a regimen of diet, exercise and insulin has been planned, which is incompatible with elementary principles of health.

The most important education for a diabetic child anyway is his diabetic education, because upon that his life depends. No matter how devoted the parents, no matter whether wealth allows a nurse, nothing will take the place of a child acquiring for himself the fundamentals of his disease and how to combat it successfully. To do this encourage association with other diabetic children so that their successes or failures will serve as examples.

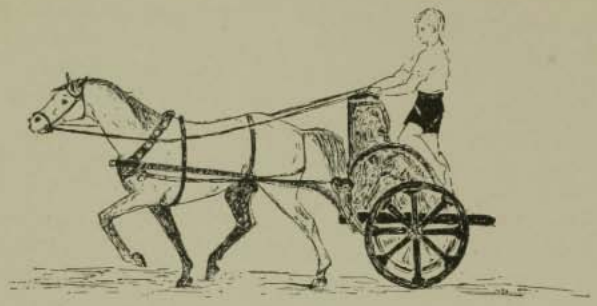


FIG. 45.—Diet is a steady steed.

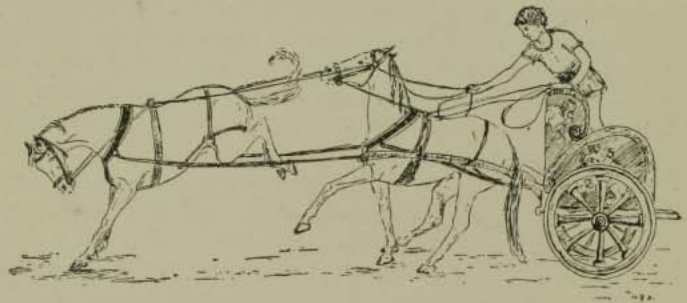


FIG. 46.—The performance of Diet and Exercise is not consistent.

FIG. 47.—Diet and Exercise work together happily when harnessed with Insulin.

Every diabetic child has his three mischievous ponies to drive and their names are Diet, Exercise and Insulin, just as are the diabetic horses of the adult diabetic. It is no joke for a child to manage one wilful pony, but a real struggle, and to harmonize the capriciousness of three such ponies is a tremendous triumph. The child must continually adjust the diabetic load between Diet, Exercise and Insulin, and he should not be discouraged despite frequent failures, because it can be done. Experience, the nurse, the doctor, and the parents and grandparents and brothers and sisters will finally bring success. I know whereof I speak because, whereas three years ago there were 148 who had gone beyond ten years of diabetes and 15 had passed the fifteen-year milestone, today there are 323 of the former and 75 of the latter. Moreover, last year the Metropolitan Life Insurance Company computed that a child in this group, aged ten years, could look forward to a life expectancy of 31.7 more years even though no improvements in diabetic treatment were introduced.

The lives of diabetic children should resemble as nearly as possible the lives of other children. Very likely it is better to graduate from the high school at eighteen or nineteen instead of at seventeen years. This will allow more time for exercise, broad reading and maturity.

The general health of diabetic children should be kept at its highest pitch. Sources of infection should be promptly removed. It is almost more important to remove an appendix, if there is a hint of trouble with it, than tonsils and teeth, because the symptoms of an appendicitis often resemble diabetic coma and both conditions may be coexistent. Children should be vaccinated against smallpox like any child and similarly protected against diphtheria and pneumonia. They can be inoculated against tetanus (lock-jaw) after the same preliminary testing which is employed for any child.

Tuberculosis is more common in diabetic children than in non-diabetic children, 1 in 100 as compared with 1 in 1000. Therefore, emphatically we advise against a diabetic girl taking up a nursing career, because exposure would be increased. She could become a technician in a laboratory.

Diabetic children can eat essentially as can diabetic adults, but they require more food. The food must be eaten slowly and the child must be in a rested state both before and after meals. The few minutes between insulin and the meal can be advantageously employed resting and reading. It is a mistake to pamper the appetites of children. Healthy children like plain foods and the same foods day after day. They love routine and habit. Mary's grandfather mischievously dropped a blueberry in the middle of the saucer of oatmeal Mary was contentedly eating and it spoiled her breakfast. It is a good plan for diabetic children or adults to make their breakfast a routine. In this way no calculations are necessary for at least one-third of the meals.

To keep pace with the development of diabetic children is not an easy undertaking. Not only must one be keen to discern gains in tolerance for carbohydrate, but one must provide for the all-around development of body, mind and soul. At puberty, especially, these children are unstable and require extra quantities of food. To deprive them then of an adequate diet either leads to their taking it for themselves or what is almost worse, namely, retarded development. One must keep abreast of their mental growth as well and direct them along channels so that they can choose a suitable life's career.

Regular exercise is just as important as diet and insulin in the routine treatment of diabetic children. These children are such delightful little indoor companions for their parents or care-takers that outdoor exercise is often overlooked. But, remember that when the Exercise pony pulls hard, Diet and Insulin have less to do.

The diets of diabetic children like those of ordinary children should be more liberal than those of diabetic adults. How much more liberal I never realized until these last two years from studying what our children required at our various diabetic camps. Last year, 1936, the camp diets of boys and girls were as follows, according to Dr. Priscilla White.

Coma is the chief danger which overhangs the diabetic child. Already accidents of hypoglycemia (insulin reactions),

TABLE 21.—CAMP DIETS OF BOYS AND GIRLS IN 1936.

Year.	Age, years.	Carb., gms.	Prot., gms.	Fat, gms.	Calories.	Cal. per kg.	Ins. units.	Wt., lbs.
1936	0–5	163	64	72	1556	82	15 + 19	41
	6–10	196	84	85	1885	67	18 + 28	62
	11–15	215	98	95	2107	51	30 + 39	91
	16–20	221	99	88	2072	38	31 + 45	120

due to environmental conditions, claim increasing attention, but diabetic coma ever will be the one condition which the child should thoroughly understand and be in a position to avoid. Prior to insulin practically all diabetic children died of coma. Today not one of them needs to die of coma.

Every child needs a "Buddy." His mother is his true friend when he is at home, but it is his Buddy who will look out for him at school, at college, and in play. Sam and Earl, my diabetic twins, are a great comfort to one another and guard well each other's interests.

Summer camps for diabetic children are splendid. In 1936 we had about 200 diabetic children distributed in five camps. The children have done wonderfully well, but the vacations have not been limited to the children, because their parents have been relieved of their responsibility often for the first time in years. Diabetic camps should be encouraged. Children are far more easily and naturally treated in them than in hospitals and at less expense. We are greatly indebted to the Universalist Church which has made possible our largest camp at the Clara Barton Homestead in North Oxford, Massachusetts. I wish the Universalist Church might inaugurate a multitude of such camps in the United States. It

would be a worthy undertaking. The Prendergast Preventorium has been a wonderful addition to our camping privileges. Through the initiative of the Unitarian Ladies' Association we were enabled to send patients to it and a multitude of friends have helped us at these and other camps. Any large diabetic clinic for children should have access to such a camp.

The diabetic child should be taught hygiene and while he learns this for himself he should grasp its potentialities so fully that he will disseminate sound ideas among the rest of his family, and thereby make himself helpful in the house. If a child holds to his diet, should not his relatives avoid being fat at forty or above and thus avoid diabetes? The time may come when we may utilize these children more in medicine. Every diabetic unavoidably becomes a center of medical influence in his family. One in 2 of my ten-year diabetic children already has a diabetic relative. One cannot begin too early with inculcating the idea that a diabetic should choose a non-diabetic from a non-diabetic family for a partner in life.

Children love to assume responsibility. Trust them and they will carry out their duties well. Jane and Jeane lived 1500 miles apart, but their poor mothers were worn out. When Jane and Jeane were told this, their whole attitude changed and I had no more worry about those girls or about their mothers because I knew their children would compel them to take recreation and rests. Give any child, diabetic or otherwise, an opportunity and the chances are he or she will come out all right.

For several years every old man or old woman at the Deaconess who had a leg or a toe cut off for gangrene had a flag of the United States of America hung at the head of his bed for morale. The morale of the diabetic child quite as much as that of the adult must be preserved. I have no hesitation in showing children severe types of diabetes or even diabetic coma, but I would never think of doing this without at the same time calling attention to the possibility of improving our treatment, specifying and showing instances where this has been done and how the dread complications

can be avoided. That is why I am so glad to learn of the successes of those whose diabetes began in childhood and to report these to children whose diabetes is just beginning. Happily it is not difficult to maintain their spirits, because these children excel in school and in many sports. They should be given opportunities to distinguish themselves. It is partly to help their morale that I train them to stand straight, regard their personal appearance and act alert.

Thirty years ago when I began treating diabetic children I counted the days they lived. It is hard to believe, but it is true, that now I am beginning to measure their lives in decades of years and to see for myself that thus far there is no limit to their duration of life.

Unusual Precautions for Treatment of Insulin Reaction.—Relief from an insulin reaction is usually obtained promptly. Patients and their relatives and friends accomplish this with the use of one or two lumps of sugar, orange juice or some other form of carbohydrate. If the reaction is severe, doctors occasionally train their patients to take 0.3 to 0.5 of 1 cc. of 1 to 1000 solution of adrenalin subcutaneously. Occasionally an injection of glucose into the vein by the doctor is required. For emergencies when out of reach of a physician, as upon a camping trip especially prepared 10 per cent glucose in a 20 cc. ampoule can be injected under the skin by a relative or nurse, but recourse to such a procedure has only been needed with one of our patients. It has been a real comfort to many patients, however, to know that they had with them outfits for the subcutaneous injection of glucose.

CHAPTER XXVI.

FOODS AND THEIR COMPOSITION.

THE improvement in the treatment of diabetes owes much to the dissemination of knowledge regarding the composition of foods. To the United States Government we are indebted for an excellent monograph by Atwater and Bryant entitled "The Chemical Composition of American Food Materials," Bulletin 28, Revised Edition, which was first issued in 1906. Later government publications have revised and enlarged upon sections of this work, notably Department of Agriculture Circular 50, Proximate Composition of Fresh Fruits, by Chatfield and McLaughlin, and Circular 146, Proximate Composition of Fresh Vegetables, by Chatfield and Adams. These publications can be obtained by sending ten cents in coin to the Superintendent of Documents, Washington, D. C.

The State of Connecticut from its Agricultural Experiment Station in New Haven has also published excellent reports on special foods offered for use in the diet of diabetic patients and from year to year adds analyses of new preparations of this sort as well as analyses of common foods. Professor Street formerly and Professor Bailey recently who have been intimately concerned in these investigations have been kindness itself not alone to me, but to my inquisitive patients.

McCance and Lawrence[1] have published an exhaustive study of the carbohydrate content of plant foods including a discussion of the food value of vegetable carbohydrates.

A suitable diet for a diabetic patient depends upon so many variable factors, particularly the tolerance of the individual, that no general definition of a "diabetic" food can be satisfactorily fixed. The discovery of insulin, for example, has materially modified both the theory and practice of diabetic dietetics.

[1] The Carbohydrate Content of Foods, Medical Research Council, Special Report Series, No. 134, London, 1929.

The narrow confines of the diabetic diet in years past greatly stimulated the manufacture of so-called diabetic foods. These were often serviceable, but to be employed with discretion. The patient should never become dependent upon special diabetic foods, for they are often unobtainable, always make him conspicuous, and when he acquires a disgust for foods of this class it is all the harder to abide by the original diet. When the patient buys one of these foods, unfortunately he is often given a list of other diabetic foods and a new diabetic diet list, and confusion in the diet frequently results. The patients under my care who have done best either never use special diabetic foods or use only a few varieties. Such foods to be of service to the physician or to the dietitian should bear correct statements of the percentages of protein, fat, and carbohydrate which they contain; and under no circumstances should the label bear any statements which convey the impression that such foods may be eaten without restriction.

The high content of protein is one of the most serious drawbacks to diabetic foods. Formerly when it was not realized that from 100 grams protein 58 grams of carbohydrate might be formed, these special foods with low actual carbohydrate content were considered a great boon. Today we look at the matter differently.

The following food tables were prepared for me under the supervision of Prof. E. M. Bailey of the Connecticut Agricultural Experiment Station situated in New Haven, Connecticut. Prof. Bailey makes the following comments upon Table 22.

In the table "Composition of Common Foods" many of the analyses are based on the authority of Atwater and Bryant's compilation. Professor Sherman's "Food Products,"[1] Leach, "Food Inspection and Analysis,"[2] the government bulletins already cited, and various reports of this Station have also been freely consulted. A few analyses have been taken from reports of other Experiment Stations and from other sources.

[1] The Macmillan Company, New York, 1918.
[2] Wiley & Sons, New York.

In choosing analyses many discrepancies are found between the reports of various authors that are perplexing to the physician and to the dietitian. This is in part due to analytical differences that are bound to occur between various analysts, and in part, and more especially ,to actual variations in the composition of the foods examined because of such factors as variety and degree of ripeness or maturity. In this compilation the analysis which represents the average of the greatest number of samples, or the one which for one reason or another seems preferable, has been used.

The dietitian frequently wishes to know how much of the carbohydrate is "available" in digestion. This question cannot be answered without reservations.

That portion which is composed of starch, sucrose and other sugars and dextrin is assimilable; the remainder, consisting of hemicellulose complexes, is of doubtful or undetermined availability.

The carbohydrate values given in Table 22 do not pretend to represent the carbohydrate that is assimilable. They have the significance already explained. Dietary allowances calculated on the bases of such figures will generally be too low, but the error is on the side of safety. As the patient's tolerance is demonstrated his allowance can be made more liberal. Chatfield and her co-workers have reported sugars and starch for a number of fruits and vegetables in the publications here cited, and this affords an approximate estimate of the carbohydrate that is assimilable. McCance and Lawrence have gone a step farther and have reported available carbohydrate for a number of fruits, nuts and vegetables. Their work is a valuable contribution to our knowledge of the composition of foods and it is to be hoped that work will be enlarged to include other natural and manufactured food.

The dietitian will be impressed, however, by the fact that the total carbohydrate content of fruits and vegetables is of an order of magnitude of 10 or 12 per cent, and often much less, and also by the fact that the natural variations in composition due to variety, degree of maturity and, in cooked foods, method of preparation, are very considerable; so that

within this range distinctions between gross carbohydrate and that which is available are often academic rather than practical. It would appear also that in calculating diets based upon *available* carbohydrate values it would be safer to use maximum figures than those representing the average or mean in order that the patient's tolerance may not be overestimated. There is not the same objection to average values representing gross carbohydrate because these no doubt already provide an ample margin of safety.

The average carbohydrate for 22 fruits given in Table 22 is 12.8 per cent. The average available carbohydrate given in the table of McCance and Lawrence for 22 fruits of corresponding name is 6.7 per cent; but the average of maximum figures for available is 9 per cent. Included in this group are several items, viz., cherries, nectarines, persimmons and raspberries having wide differences between available and total carbohydrate. In these cases it seems quite certain that the materials analyzed by McCance and Lawrence were different from those represented by American analyses. Chatfield, *et al.*, have reported sugars in these fruits that are more in accord with the values given in Table 22 and distinctly higher than the total reducing sugars, uncorrected, reported by McCance and Lawrence.

In cases where caloric values have been given in the absence of determined values for fat or other constituents, the items not determined are assumed to be negligible.

TABLE 22.—COMPOSITION OF COMMON FOODS.

MEAT PRODUCTS.

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Beef, fresh:				
Brisket, medium fat, edible portion	15.8	28.5	..	319
Chuck rib, edible portion, all analyses	19.0	13.4	..	197
Flank, edible portion, all analyses	19.6	21.1	..	268
Loin, edible portion, all analyses	19.0	19.1	..	247
Neck	20.7	12.7	..	197
Plate	16.8	26.9	..	309
Ribs, edible portion, all analyses	17.8	24.6	..	293
Round	20.9	10.6	..	179
Rump, lean	20.9	13.7	..	207
Shank, fore	21.4	8.1	..	158
hind	21.7	8.7	..	165
Shoulder and clod, edible portion, all analyses	20.0	10.3	..	173
Soup stock	5.8	1.5	..	36
Miscellaneous cuts, free from visible fat	22.4	2.9	..	116
Brain, edible portion	8.8	9.3	..	119
Heart, edible portion	16.0	20.4	..	248
Kidney, as purchased	13.7	1.9	Trace	72
Liver, as purchased	20.2	3.1	2.5[1]	119
Lungs, as purchased	16.4	3.2	..	94
Marrow, as purchased	2.2	92.8	..	844
Sweetbreads, as purchased	16.8	12.1	..	176
Suet, as purchased	4.7	81.8	..	755
Tongue, edible portion	18.9	9.2	..	158
Beef, cooked:				
Roast	22.3	28.6	..	347
Steak, round	27.6	7.7	..	180
sirloin	23.9	10.2	..	187
tenderloin	23.5	20.4	..	278
Beef, canned:				
Corned[2]	26.6	11.4	..	209
Dried and smoked[3]	32.6	7.5	..	198
Kidneys, stewed	18.4	5.1	2.1	128
Luncheon beef	27.6	15.9	..	254
Roast	25.9	14.8	..	237
Sweetbreads	20.2	9.5	..	166
Tongue, ground	21.4	25.1	..	312
whole	19.5	23.2	..	287
Tripe	16.8	8.5	..	144
Beef, corned and pickled:				
Corned beef, all analyses, edible portion	15.6	26.2	..	298
Spiced beef, rolled	12.0	51.4	..	511
Tongue, edible portion	12.8	20.5	..	236
Tripe	11.7	1.2	Trace	58

[1] Largely, or in part, glycogen.
[2] Average, 3.4 per cent salt (sodium chloride).
[3] Average, 9.7 per cent salt (sodium chloride).

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

MEAT PRODUCTS—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Beef, dried, salted, smoked, edible portion	30.0	6.5	..	179
Veal, fresh:				
Breast, edible portion, all analyses	20.3	11.0	..	180
Chuck, edible portion, all analyses	19.7	5.8	..	131
Flank, edible portion, all analyses	20.1	12.7	..	195
Leg, edible portion, all analyses	20.7	6.7	..	143
cutlets, edible portion	20.3	7.7	..	151
Loin, edible portion, all analyses	19.9	10.0	..	170
Rib	20.2	9.4	..	165
Rump	19.8	16.2	..	225
Shoulder	20.7	4.6	..	124
Heart, as purchased	16.8	9.6	..	154
Kidney, as purchased	16.9	6.4	..	125
Liver, as purchased	19.0	5.3	..	124
Lungs, as purchased	17.1	5.0	..	113
Lamb, fresh:				
Breast, edible portion	19.1	23.6	..	289
Leg, hind, medium fat, edible portion	19.2	16.5	..	225
Loin, without kidney and tallow, edible portion	18.7	28.3	..	330
Shoulder, edible portion	18.1	29.7	..	340
Lamb, cooked:				
Chops, broiled, edible portion	21.7	29.9	..	356
Leg, roast	19.7	12.7	..	193
Lamb, canned:				
Tongue, spiced, cooked, edible portion	13.9	17.8	..	216
Mutton, fresh:				
Chuck, edible portion, all analyses	14.6	36.8	..	390
Leg, hind, medium fat, edible portion	18.5	18.0	..	236
Loin, without kidney and tallow, edible portion	16.0	33.1	..	362
Shoulder, medium fat, edible portion	17.7	19.9	..	250
Heart, as purchased	16.9	12.6	..	181
Kidney, as purchased	16.5	3.2	..	95
Liver, as purchased	23.1	9.0	5.0[1]	193
Lungs, as purchased	20.2	2.8	..	106
Mutton, cooked:				
Leg roast, edible portion	25.0	22.6	..	303
Mutton, canned:				
Corned	28.8	22.8	..	320
Tongue	24.4	24.0	..	314
Pork, fresh:				
Ham, lean	25.0	14.4	..	230
Ham, medium fat, edible portion	15.3	28.9	..	321
Head cheese, edible portion	19.5	33.8	..	382
Loin (chops), lean, edible portion	20.3	19.0	..	252
Loin (chops), medium fat, edible portion	16.6	30.1	..	337

[1] Largely, or in part, glycogen.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

MEAT PRODUCTS—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Pork, fresh:—Concluded:				
Shoulder, edible portion	13.3	34.2	..	361
Side, lard and other fat included, edible portion	9.4	61.7	..	593
Side, lard and kidneys not included, edible portion	9.1	55.3	..	534
Brains, as purchased	11.7	10.3	..	140
Heart, as purchased	17.1	6.3	..	125
Kidney, as purchased	15.5	4.8	0.7	108
Liver, as purchased	21.3	4.5	1.4[1]	131
Lungs, as purchased	11.9	4.0	..	84
Pork, pickled, salted or smoked:[2]				
Ham, lean, smoked, edible portion	19.8	20.8	..	266
Ham, medium fat, smoked, edible portion	16.3	38.8	..	414
Ham, luncheon, cooked	22.5	21.0	..	279
Shoulder, medium fat, smoked, edible portion	15.9	32.5	..	356
Pig's tongue, pickled, edible portion	17.7	19.8	..	249
Pig's feet, pickled, edible portion	16.3	14.8	..	198
Salt pork, clear fat	1.9	86.2	..	783
Bacon, smoked, all analyses, edible portion	10.5	64.8	..	625
Ham, deviled	19.0	34.1	..	383
Sausage:				
Arles, edible portion	26.8	50.6	..	563
Bologna, edible portion	18.7	17.6	0.3[3]	234
Frankfort	19.6	18.6	1.1[4]	250
Pork, as purchased	13.0	44.2	1.1[5]	454
Deerfoot Farm, cooked (analysis furnished by manufacturer)	19.9	54.2	0.3	569
Pork and beef, as purchased	19.4	24.1	..	295
POULTRY.				
Poultry, fresh:				
Chicken, broilers, edible portion	21.5	2.5	..	109
heart, as purchased	20.7	5.5	..	132
gizzard, as purchased	24.7	1.4	..	111
liver, as purchased	22.4	4.2	2.4[6]	137
Fowls, edible portion	19.3	16.3	..	224
Goose, edible portion	16.3	36.2	..	391
Goose liver, edible portion	16.6	15.9	3.7[6]	224
Turkey, edible portion	21.1	22.9	..	291

[1] Largely, or in part, glycogen.

[2] The range of salt content for cured pork products may be taken as 3 to 5 per cent.

[3] Carbohydrate range, 0.2 to 3.1 per cent.

[4] Carbohydrate range, 0.0 to 6.6 per cent.

[5] Carbohydrate range, 0.0 to 8.6 per cent.

[6] Largely, or in part, glycogen.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

FISH PRODUCTS.

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Fish, fresh:				
Alewife, whole, edible portion	19.4	4.9	..	122
Bass, black, edible portion	20.6	1.7	..	98
red, edible portion	16.9	0.5	..	72
sea, edible portion	19.8	0.5	..	84
striped, edible portion	18.6	2.8	..	100
Blackfish, edible portion	18.7	1.3	..	87
Bluefish, edible portion	19.4	1.2	..	88
Butterfish, edible portion	18.0	11.0	..	171
Cod, edible portion	16.7	0.3	..	70
steak, edible portion	18.7	0.5	..	79
Eels, salt water, edible portion	18.6	9.1	..	156
Flounder, edible portion	14.2	0.6	..	62
Haddock, edible portion	17.2	0.3	..	72
Halibut, edible portion	18.6	5.2	..	121
Herring, edible portion	19.5	7.1	..	142
Mackerel, edible portion	18.7	7.1	..	139
Perch, edible portion	19.0	2.4	..	98
Pickerel, edible portion	18.7	0.5	..	79
Porgy, edible portion	18.6	5.1	..	120
Salmon, edible portion	22.0	12.8	..	203
Shad, edible portion	18.8	9.5	..	161
Shad roe, as purchased	20.9	3.8	2.6	128
Smelt, edible portion	17.6	1.8	..	87
Trout, brook, edible portion	19.2	2.1	..	96
Trout, lake, edible portion	17.8	10.3	..	164
Whitefish, edible portion	22.9	6.5	..	150
Fish, preserved or canned:				
Cod, salt, "boneless," as purchased[1]	27.7	0.3	..	114
Haddock, smoked, edible portion	23.3	0.2	..	95
Halibut, smoked, edible portion[2]	20.7	15.0	..	218
Herring, smoked, edible portion[3]	36.9	15.8	..	290
Mackerel, salt, edible portion[4]	17.3	26.4	..	307
salt, canned, as purchased	19.6	8.7	..	157
salt, canned in oil, edible portion	25.4	14.1	..	229
Salmon, canned, edible portion	21.8	12.1	..	196
Sardines, canned, edible portion	23.0	19.7	..	269
Sardines, canned in mineral oil, edible portion	22.8	2.7[5]	..	116

[1] Contains 11.0 per cent ash, largely salt.
[2] Contains 15.0 per cent ash, largely (12.1 per cent) salt.
[3] Contains 13.2 per cent ash, largely (11.7 per cent) salt.
[4] Contains 12.9 per cent ash, largely (10.4 per cent) salt.
[5] Total oil present, 13.3 per cent; approximately 20 per cent (= 2.7 per cent), digestible.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

FISH PRODUCTS—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Fish, preserved or canned:—Concluded:				
Sturgeon, caviare, preserved, Russian, as purchased	30.0	19.7	7.6	328
Tunny (tuna), as purchased	21.7	4.1	..	124
canned in oil, edible portion	23.8	20.0	0.6	278
Turtle meat, canned	23.4	0.7	..	100
Shellfish, etc., fresh:				
Clams, long, in shell, edible portion	8.6	1.0	2.0[1]	51
round, in shell, edible portion	6.5	0.4	4.2[1]	46
Crabs, hard shell, whole, edible portion	16.6	2.0	1.2[1]	89
Crayfish, edible portion	16.0	0.5	1.0[1]	73
Lobster, edible portion	16.4	1.8	0.4[1]	83
Mussels, in shell, edible portion	8.7	1.1	4.1[1]	61
Oysters, in shell, edible portion	6.2	1.2	3.7[1]	50
Scallops, as purchased	14.8	0.1	3.4[1]	74
Terrapin, edible portion	21.2	3.5	..	116
Turtle, green, edible portion	19.8	0.5	..	84
Shellfish, etc., canned:				
Clams, long, as purchased	8.3	0.4	2.7[1]	48
round, as purchased	8.9	0.8	0.9[1]	46
Crabs, as purchased	15.8	1.5	0.7[1]	80
Lobster, as purchased	18.1	1.1	0.5[1]	84
Oysters, as purchased	8.8	2.4	3.9[1]	72
Shrimp, as purchased	25.4	1.0	0.2	111
Turtle meat	23.4	0.7	..	100
AMPHIBIA.				
Frog's legs, edible portion	15.5	0.2	..	64
GELATIN.				
Gelatin	84.2[2]	0.1	None	338
EGGS.				
Eggs, fresh:[3]				
Hen, whole egg, edible portion	13.4	10.5	..	148
white	12.3	0.2	..	51
yolk	15.7	33.3	..	363
Duck, whole egg, edible portion	13.3	14.5	..	184
white	11.1	Trace	..	44
yolk	16.8	36.2	..	393
Goose, whole egg, edible portion	13.8	14.4	..	185
white	11.6	Trace	..	46
yolk	17.3	36.2	..	395

[1] Largely, or in part, glycogen.

[2] Nitrogen × 5.55.

[3] In shell eggs the shell comprises from 10 to 17 per cent of the weight of the whole egg; water content ranges from 60 to 67 per cent. Sea-turtle eggs contain about 76 per cent water.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

EGGS—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Eggs, fresh:[1]—*Concluded:*				
Turkey, whole egg, edible portion	13.4	11.2	..	154
white	11.5	Trace	..	46
yolk	17.4	32.9	..	366
Guinea fowl, whole egg, edible portion	13.5	12.0	..	162
white	11.6	Trace	..	46
yolk	16.7	31.8	..	353
Plover, whole egg, edible portion	10.7	11.7	..	148
Turtle, fresh water	18.1	11.1	..	172
sea	18.8	9.8	..	163
Eggs, edible portion, cooked:				
Hen, boiled	13.2	12.0	..	161
whites	12.3	0.2	..	51
yolks	15.7	33.3	..	363
Eggs, dehydrated, average	40.0	43.7	..	556
DAIRY PRODUCTS, ETC.				
Milk:				
Milk, whole	3.3	4.0	4.8	68
condensed (evaporated, concentrated)	6.9	8.2	9.9	141
sweetened, condensed (sweetened evaporated, sweetened concentrated)	7.9	9.0	54.6[2]	331
skimmed	3.4	0.3	5.1	37
sweetened, condensed	9.1	1.0	59.1[3]	282
Buttermilk	3.6	0.5	4.1	35
Kephir	3.1	2.0	1.6	37
Kumiss[4]	2.8	2.1	5.4	51
Cream, "heavy" (approximately 40 per cent)	2.1	41.0	1.5	383
"light" (approximately 20 per cent)	2.8	22.0	2.7	220
heavy, sour	4.1	41.6	1.5	397
Whey	1.0	0.3	5.0	27
Milk powder (dried milk):				
From whole milk	25.3	25.3	37.5	479
From partly skimmed milk	25.8	14.5	49.9	433
From skimmed milk, average	34.6	1.9	50.9	359
Malted milk (milk powder with malted cereal) average	13.8	6.8	71.9	404

[1] In shell eggs the shell comprises from 10 to 17 per cent of the weight of the whole egg; water content ranges from 60 to 67 per cent. Sea-turtle eggs contain about 76 per cent water.

[2] Cane sugar, 40.6 per cent; milk sugar, 14 per cent.

[3] Cane sugar, 40.9 per cent; milk sugar, 18.2 per cent.

[4] According to Van Slyke (Leach: Food Inspection and Analysis, p. 174), Kumiss, from cows' milk, contains lactose, 5 per cent; protein, 4.1 per cent; fat (calculated), 1.2 per cent.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

DAIRY PRODUCTS, ETC.—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Cheese:				
American, pale	28.8	35.9	0.3	440
red	29.6	38.3	..	463
Camembert	21.0	21.7	..	279
Cheddar	26.4	32.7	3.0	412
Cheshire	32.5	26.1	4.5	383
Cottage	20.9	1.0	4.3	110
Cottage, Jewish	27.9	9.2	None	194
Dutch	37.1	17.7	..	308
Edam	24.1	30.3	4.6	388
Full cream	25.4	30.3	2.0	382
Limburger	23.0	29.4	0.4	358
Neufchâtel	18.7	27.4	1.5	327
Pineapple	29.9	38.9	2.6	480
Roquefort	22.6	29.5	1.8	363
Skimmed milk	31.5	16.4	2.2	282
Swiss	27.6	34.9	1.3	430
Ice cream, typical	3.8	12.6[1]	19.6	207
FATS AND OILS.				
Fats and Oils:				
Butter,[2] average	1.5	84.6	None	767
Oleomargarine,[3] average	0.8	92.4	None	835
Nut margarine,[4] average	1.4	84.8	None	769
Salad oils and cooking fat, typical	Trace	99.7	None	897
SOUPS AND BROTHS.				
Soups, home-made:				
Bean	3.2	1.4	9.4	63
Beef	4.4	0.4	1.1	26
Chicken	10.5	0.8	2.4	59
Clam chowder	1.8	0.8	6.7	41
Meat stew	4.6	4.3	5.5	79
Soups, broths, etc., canned:				
Asparagus, cream of	2.5	3.2	5.5	61
Bouillon, beef	2.2	0.1	0.2	11
clam, typical	1.0	0.1	0.6	7
Celery, cream of	2.1	2.8	5.0	54
Chicken gumbo	3.8	0.9	4.7	42
soup	3.6	0.1	1.5	21
Consommé	1.4	0.1	0.4	8
Corn, cream of	2.5	1.9	7.8	58
Julienne	2.7	..	0.5	13
Mock turtle	3.0	1.0	5.7	44

[1] Standards for fat in different States vary from 8 to 14 per cent.
[2] Average salt content, 1.6 per cent; range, 0.2 to 4.1 per cent.
[3] Average ash content (largely salt), 0.9 per cent; range, 0.4 to 3.1 per cent.
[4] Average ash content (largely salt), 2.9 per cent; range, 1.1 to 6.1 per cent.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

SOUPS AND BROTHS—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Soups, broths, etc., canned:—Concluded:				
Mulligatawny	3.7	0.1	5.7	39
Oxtail, edible portion	3.7	1.3	7.1	55
Pea soup	3.6	0.7	7.6	51
Pea, cream of green	2.6	2.7	5.7	58
Tomato	1.8	1.1	5.6	40
Turtle, green	6.1	1.9	3.9	57
Vegetable	2.9	..	0.5	14
Bouillon cubes:				
As purchased, average analysis[1]	11.4	1.8	5.8	85
Prepared as directed, average analysis[2]	0.2	Trace	0.1	1
Clam extract:				
As purchased	23.2	0.2	11.8	142
Prepared as directed[3]	0.5	Trace	0.3	3
Yeast extract, as purchased	31.3	0.2	12.5	177

CEREAL PRODUCTS, ETC.

Alimentary pastes:				
Macaroni	13.4	0.9	74.1[4]	358
" cooked	3.0	1.5	15.8[4]	89
Noodles	11.7	1.0	75.2	357
Spaghetti	12.1	0.4	75.9	356
Vermicelli	10.9	2.0	72.0[4]	350
Bread, soft:				
Bread, alfalfa	10.6	1.3	64.0	310
brown	5.4	1.8	47.1[4]	226
corn (Johnnycake)	7.9	4.7	46.3[4]	259
Graham	8.9	1.8	51.0	256
peanut	33.6	12.8	19.7	328
rye	9.0	0.6	52.7	252
rye, Jewish	9.1	1.1	52.0	254
whole rye	11.9	0.6	34.7	192
rye and wheat	11.9	0.3	51.5[4]	256
wheat, average of many analyses	9.2	1.3	52.6	259
wheat, whole	9.7	0.9	48.5	241
wheat gluten, average	25.0	3.6	28.9	248
Buns, hotcross	7.9	4.8	49.7[4]	274
Biscuit, homemade	8.7	2.6	54.6	277
Maryland	8.4	5.6	58.8	309
soda	9.3	13.7	52.6[4]	371
Rolls, all analyses	8.9	4.1	56.1	297

[1] Average salt content, 70.2 per cent.

[2] Average cube weighs 3.8 gms.; 1 cup of broth is assumed to weigh 240 gms.; salt content of prepared broth, 1.1 per cent.

[3] Salt content, 0.4 per cent.

[4] Includes fiber.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

CEREAL PRODUCTS, ETC.—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Bread, hard, and crackers:				
Bread, white, toasted	11.5	1.6	61.2[1]	305
Zwieback	9.8	9.9	73.5[1]	422
Crackers, Boston (split)	11.0	8.5	70.3	402
butter	9.6	10.1	71.2	414
cream	9.7	12.1	69.1	424
egg	12.6	14.0	66.2	441
flatbread	14.9	0.5	73.6[1]	359
Graham	10.0	9.4	72.3	414
oatmeal	11.8	11.1	67.1	416
oyster	11.3	10.5	70.3	421
pilot	11.1	5.0	73.9	385
pretzels	9.7	3.9	72.3	363
saltines	10.6	12.7	68.0	429
soda	9.8	9.1	72.8	412
water	11.7	5.0	75.3	393
Pastry, etc.:				
Cake, coffee	7.1	7.5	62.8	347
cup	5.9	9.0	68.2	377
frosted	5.9	9.0	64.8[1]	364
fruit	5.9	10.9	64.1	378
gingerbread	5.8	9.0	62.6	354
sponge	6.3	10.7	65.9[1]	385
Cookies	7.0	9.7	73.2	408
Doughnuts	6.7	21.0	52.4	425
Fig bars	4.6	6.6	68.1	350
Ginger snaps	6.5	8.6	75.3	405
Lady fingers	8.8	5.0	70.4	362
Macaroons	6.5	15.2	64.1	419
Pie, apple	3.1	9.8	42.8[1]	272
cream	4.4	11.4	51.2[1]	325
custard	4.2	6.3	26.1[1]	178
lemon	3.6	10.1	37.4[1]	255
mince	5.8	12.3	38.1[1]	286
raisin	3.0	11.3	47.2[1]	303
squash	4.4	8.4	21.7[1]	180
Pudding, Indian meal	5.5	4.8	27.5[1]	175
rice custard	4.0	4.6	31.4[1]	183
tapioca	3.3	3.2	28.2[1]	155
Wafers, miscellaneous	8.7	8.6	74.1	409
vanilla	6.6	14.0	71.3	438
Breakfast foods:				
Barley preparations:				
Cream of Barley	11.1	1.6	76.1	363
Farwell & Rhines' Barley Crystals	11.5	1.3	75.2	359
Quaker Scotch Brand Pearled Barley	9.5	0.9	76.2	351

[1] Includes fiber.

TABLE 22.—COMPOSITION OF COMMON FOODS.—*(Continued.)*

CEREAL PRODUCTS, ETC.—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Breakfast foods:—Continued:				
Corn (maize) preparations:				
Cerealine	6.9	0.4	79.9	351
E-C Corn Flakes, Toasted	6.6	0.3	78.6	344
F. S. Granulated Hominy	8.0	1.0	77.1	349
Hecker's Cream Hominy	9.8	0.4	77.3	352
H-O New Process Hominy	8.0	0.3	79.8	354
Jackson's Roman Meal	13.3	3.4	66.1	348
Jersey Corn Flakes	8.5	0.3	82.3	366
Kellogg's Toasted Corn Flakes	6.4	0.2	78.8	343
Korn Kinks	7.4	0.4	77.9	345
Nichols' Snow White Samp	7.8	0.3	77.7	345
Post Toasties	6.6	0.3	79.4	347
Quaker Best Yellow Corn Meal	7.5	0.8	78.7	352
Quaker Corn Puffs	8.7	0.3	78.5	352
Quaker Hominy Grits	7.9	0.5	77.7	347
Quaker Toasted Corn Flakes	6.8	0.4	79.9	350
Ralston Hominy Grits	9.0	2.9	75.4	364
Street's Perfection Hominy	7.9	1.3	77.9	355
Sunbeam Pearl Hominy	9.4	0.6	75.0	343
Sunseal Cream Corn Meal	8.9	1.0	77.2	353
Sunseal Hominy Grits	8.5	1.2	77.8	356
Sunseal Sunny Corn	8.3	0.4	78.2	350
Washington Corn Crisps	7.8	0.2	76.8	340
Oat preparations:				
Bestovotes	16.2	6.6	63.1	377
Bufceco Rolled Oats	15.1	6.8	64.0	378
Fruited Oats	13.1	4.9	68.2	369
Grandmother's Crushed Oats	14.9	6.5	65.4	380
Health Brand White Oats	13.8	7.8	64.5	383
Hecker's Cream Oat Meal	15.6	5.6	64.6	371
Hornby's Steam Cooked Oat Meal	16.1	6.7	64.1	381
Keen & Robinson's Granulated Scotch Oatmeal	13.7	9.1	64.1	393
Leggett's Premier 15 Minute Oat Flakes	17.2	5.4	63.7	372
McCann's Irish Oat Meal	15.1	8.7	64.9	398
Mother's Crushed Oats	15.6	6.1	64.9	377
Paw-Nee Rolled Oats	15.8	6.7	64.0	380
Purity Rolled Oats	16.3	6.1	61.1	365
Quaker Oats	15.9	6.0	64.5	376
Robinson's Patent Groats	12.8	8.6	67.7	399
Scotch Porage Oats	13.3	9.6	64.9	399
Sovereign 15 Minute Oat Flakes	16.5	5.8	64.0	374
White Rose Rolled Oats	14.3	8.0	64.8	388

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

CEREAL PRODUCTS, ETC.—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Breakfast foods:—Continued:				
Rice preparations:				
Comet Cereal	7.2	0.3	80.7	354
Cook's Flaked Rice	7.8	0.1	78.9	348
Cook's Malto Rice	7.6	0.2	80.2	353
Kellogg's Toasted Rice Biscuit	10.1	0.3	80.7	366
Kellogg's Toasted Rice Flakes	10.0	0.4	81.3	369
Milk Rice	6.9	0.2	77.2	338
Quaker Puffed Rice	7.6	0.2	79.5	350
Rye preparations:				
Cream of Rye	12.0	1.6	71.8	350
Kellogg's Toasted Rye Flakes	11.4	1.5	76.2	364
Ry-Krisp	14.0	1.7	74.4	369
Wheat preparations:				
Alber's Wheat Flakes Mush	11.1	2.1	73.4	357
Cero-Vita	8.9	0.7	82.0	370
Cinnamon Rusks	10.3	7.2	71.7	393
Cream of Wheat	11.5	0.9	73.7	349
Cresco Grits	17.8	1.4	68.6	358
Crystal Wheat	11.3	2.0	73.6	358
Dieto Rusks	15.9	9.1	66.1	410
Force	10.6	1.1	73.7	347
F. S. Farina (Quaker Farina)	10.2	0.9	74.6	347
Fruited Wheat	15.6	2.3	66.2	348
Grandmother's A. & P. Farina	10.8	0.6	75.0	349
Granola	13.9	0.8	76.3	368
Granose Biscuit	10.3	1.6	71.1	340
Granose Flakes	10.3	3.9	75.4	378
Grape Nuts	11.5	0.6	74.2	348
Hecker's Farina	10.0	0.7	75.9	350
Holland Rusk	12.1	5.1	70.4	376
Jireh Frumenty	12.3	1.7	77.3	374
Jireh Whole Wheat Farina	12.9	2.3	74.6	371
Kellogg's Breakfast Toast	13.6	1.9	74.9	371
Kellogg's Krumbles	12.0	1.2	72.3	348
Kellogg's Toasted Wheat Biscuit	14.2	1.4	74.7	368
Kellogg's Toasted Wheat Flakes	9.3	1.1	80.5	369
Kellogg's Zwieback	14.3	1.6	76.1	376
Leggett's Premier Farina	11.1	0.9	73.3	346
Malt Breakfast Food	13.8	1.5	72.7	360
Manana Gluten Breakfast Food	42.6	2.0	43.6	363
Mapl-Flake	9.3	1.2	74.7	347
McCormick's Sunwheat Biscuits	11.4	12.5	63.3	411
Mother's Wheat Hearts	10.7	1.1	74.1	349
Pettijohn's Breakfast Food	9.1	2.0	74.9	354
Pillsbury Best Cereal	11.5	0.7	75.9	356
Quaker Cracked Wheat	9.3	2.3	73.3	351
Quaker Puffed Wheat	13.1	1.8	70.2	349

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

CEREAL PRODUCTS, ETC.—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Breakfast foods:—Continued:				
Quaker Wheat Berries	14.0	2.0	71.6	360
Ralston Health Food	11.9	1.7	71.5	349
Ralston Wheat Food	11.3	1.8	73.1	354
Sanitas Granuto	10.1	1.7	81.6	382
Saxon Wheat Food	12.8	1.7	74.4	364
Shredded Wheat Biscuit	11.0	1.4	75.0	357
Street's Perfection Farina	10.3	1.1	74.9	351
Triscuit	11.0	1.4	73.9	352
Vitos	11.1	1.0	75.6	356
Wheatena	11.3	2.8	74.2	367
Wheatlet	12.8	1.6	72.3	355
Whole Grain Wheat (prepared)	6.6	0.8	23.7	128
Zest	9.0	1.2	75.3	348
Wheat bran preparations:				
Ballard's Obelisk Sanitary Edible Bran	17.3	5.4	55.7	301
Culp's Capitol Health Bran	13.4	4.3	57.6	323
Health Food Co.'s Wheat Bran	14.3	4.1	56.2	319
Jireh Wheat Bran	16.8	4.8	56.7	337
Johnson's Educator Wheat Bran	15.4	4.7	54.4	322
Kellogg's Sterilized Wheat Bran	16.3	5.2	54.4	330
Wheat bran biscuit and other laxative preparations:				
Bran Biskue	12.1	13.1	61.0	410
Bran-eata Biscuit	9.1	0.9	72.2	333
Bran Zos	13.2	2.5	65.6	338
Brose Good Health Breakfast Food	14.4	4.3	65.5	358
Cerag	11.3	0.9	73.0	345
Cerena	27.8	11.4	46.3	399
Christian's Laxative Bread	10.0	1.4	74.6	351
Christian's Laxative Cereal Flakes	10.4	1.4	72.5	344
Colax	1.1	0.8	82.8	343
Dietetic Bran Biscuit	9.9	5.0	69.1	361
Educator Bran Cookies	8.9	14.5	64.7	425
Educator Bran Meal	12.3	2.8	66.4	340
F. B. A. Laxative Health Biscuit	6.1	1.7	77.3	349
Fruit Nut Cereal	13.5	1.2	72.4	354
Good Health Biscuit (Kellogg)	7.7	1.2	74.5	340
Health Food Wafers	10.0	7.9	65.7	374
India (Digestive) Biscuit	12.8	2.2	66.1	335
Laxa	12.4	2.8	66.6	341
Laxative Biscuit (Kellogg)	16.7	10.8	57.7	395
Mansfield's Agar Agar Wafers	7.1	12.0	69.9	416
Oval Digestive Biscuit (H. & P.)	7.8	16.3	64.5	436
Uncle Sam Health Food	21.3	24.4	40.9	468
Zim	7.4	1.7	74.2	342

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

CEREAL PRODUCTS, ETC.—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Breakfast foods:—Concluded:				
Miscellaneous preparations:				
Dieto Nut Cereal	21.6	18.4	51.8	459
Dieto Wheat and Barley Cereal	11.6	2.2	75.7	369
Jireh Wheat Nuts	19.0	15.6	54.5	434
Malabar Manoca	0.6	0.1	84.1	340
Post Tavern Porridge	10.3	0.8	74.5	346
Post Tavern Special	10.9	1.1	76.9	361
Sea Moss Farina	9.1	0.3	59.9	279
Sunbeam Tapioca	0.6	0.1	85.5	345
Trix	14.5	0.2	77.3	369
Trufood (Trufood Co.)	11.5	2.5	77.1	377
Zed Biscuits	10.3	15.5	64.2	438
Zep (Battle Creek Food Co.)	14.0	2.2	74.6	374
Flours, meals, etc.:				
Barley flour	12.3	2.4	71.3	356
Buckwheat flour	6.4	1.2	77.5	346
Corn flour	8.4	1.8	76.2	355
Corn meal	9.2	1.9	74.4	362
Oat flour	15.1	6.4	65.7	381
Potato flour	0.5	0.1	83.0	335
Rice flour	7.3	0.6	79.3	352
Rye flour	6.8	0.9	78.3	349
Rye meal	13.6	2.0	69.7	351
Soy bean flour	42.5	19.9	24.3	446
Soy bean meal	38.3	14.9	26.6	394
Wheat flour, entire	13.8	1.9	71.0	356
Wheat flour, Graham	13.3	2.2	69.5	351
Wheat flour, patent, average	11.4	1.0	74.8	354
Wheat gluten flour, average	42.1	1.9	46.4	363
VEGETABLES.				
Vegetables, fresh (unless otherwise stated):				
Amaranth, leaves and stems	3.0	0.6	4.6	36
Aralia Cordata (Udo)	1.0	0.2	2.6	16
Artichokes	2.6	0.2	15.9[1]	76
Jerusalem	2.9	0.1	16.4[1]	78
cooked	2.4	0.1	16.5[1]	77
Asparagus	2.1	0.2	2.7	21
Bambo shoots	2.5	0.3	4.3	30
Basella, leaves and stems	2.0	0.3	2.4	20
Beans, butter	9.4	0.6	29.1[2]	159
cranberry, young pods	0.4	None	0.6	4
medium	1.3	0.6	1.7	17
fancy	1.0	0.1	2.1	13
Lima	7.1	0.7	20.3	116

[1] Chiefly inulin.

[2] Includes fiber.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

VEGETABLES—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Vegetables, fresh (unless otherwise stated):—Continued:				
Beans, refugee, young pods	0.5	None	0.8	5
medium	1.3	0.1	3.0	18
fancy	1.1	0.1	1.4	11
soy, green, shelled	13.6	6.3	11.0	155
string (carbohydrate range, 3.9 to 10 per cent)	2.3	0.3	5.5	34
string, cooked	0.8	1.1	1.9[1]	21
Beets (carbohydrate range, 6 to 10 per cent)	1.6	0.1	8.8	43
Broccoli	3.3	0.2	4.2	32
Borage (salad plant)	3.0	0.4	0.4	17
Brussels sprouts	4.4	0.5	7.6	53
Burdock, leaves	4.5	0.1	7.4	49
roots	3.0	0.1	21.1	97
Cabbage (carbohydrate range, 3–6.5 per cent)	1.6	0.3	4.5	27
Chinese	1.2	0.1	2.4	15
Carrots (carbohydrate range, 5.9–11.5 per cent)	1.1	0.4	8.2	41
Cassava, root	1.6	0.2	27.1	117
Cauliflower	1.8	0.5	3.7	27
Celeriac	1.8	0.2	6.0	33
Celery	1.3	0.2	3.0	19
root	2.0	0.4	6.3	37
Chard (Swiss), leaves	2.6	0.4	4.0	30
Chayote (tayote) fruit	0.9	0.1	5.9	28
leaves	3.2	0.7	2.5	29
roots	1.8	0.1	18.8	91
Chenopodium	8.5	1.1	2.7	55
Chicory, root	..	..	15.0	
leaves	1.6	0.3	2.1	27
Chinese vegetables:				
Kai Tsoi	1.7	0.2	1.8	16
Bak Toy	1.2	0.1	1.1	10
Chives, bulbs and tops	3.8	0.6	5.8	44
Collards	4.5	0.6	6.3[1]	49
Corn	3.1	1.1	19.2	99
Cucumbers	0.8	0.2	2.3	14
Dasheen, corms and tubers	2.9	0.2	28.2	126
leaves and stems	2.7	0.7	5.8	40
Dock, leaves and stems	2.1	0.3	2.6	22
Egg plant	1.2	0.3	4.3	25
Endive, leaves	1.6	0.2	3.2	21
Finocchio	1.5	0.1	1.6	13
Garlic, bulbs	4.4	0.2	19.0	95

[1] Includes fiber.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

VEGETABLES—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Vegetables, fresh (unless otherwise stated):—Continued:				
Greens, beet, cooked	2.2	3.4	3.2[1]	52
dandelion	2.7	0.7	7.0	45
turnip salad	4.2	0.6	6.3[1]	47
Kale	3.9	0.6	6.0	45
sea	1.5	0.2	3.5	22
Kohl-rabi	2.0	0.1	4.2	26
Lambs' quarters	3.8	0.7	5.7	44
Leeks	2.9	0.1	4.0[2]	29
Lettuce	1.2	0.3	2.2	16
Mushrooms[3]	3.5	0.4	6.0	42
Mustard, greens	2.3	0.3	3.2	26
Okra	1.8	0.2	6.4	35
Onions	1.6	0.3	9.1	46
cooked	1.2	1.8	4.9[1]	41
Orach	4.5	0.4	3.7	36
Oyster plant	1.2	0.1	7.0	34
Palmetto cabbage	3.3	0.6	6.1	43
cooked	2.9	0.5	5.6	39
Parsley, leaves	3.7	1.0	7.2	53
Parsnips (carbohydrate range, 6–14 per cent)	1.6	0.5	11.0	55
Patience (Rumex Patientia)	2.1	0.2	0.1[2]	11
Peas, green, cooked	6.7	3.4	14.6[1]	116
young	5.4	0.3	10.3	65
medium	6.5	0.4	14.2	86
Peppers, Neapolitan	1.1	0.3	5.7	30
sweet, green	0.8	0.1	4.1	21
Potatoes	2.2	0.1	18.0	82
air (tropical Asia)	1.9	0.4	16.3	76
boiled	2.5	0.1	20.3	92
cooked, chips	6.8	39.8	46.7[1]	572
mashed and creamed	2.6	3.0	17.8[1]	109
sweet	1.8	0.7	26.1	118
cooked	3.0	2.1	42.1[1]	199
Pumpkins	1.2	0.2	6.0	31
Purslane	1.6	0.4	2.5	20
Radishes (carbohydrate range, 2.7–7.5 per cent)	1.3	0.1	5.1	27
Rhubarb	0.6	0.7	2.5	19
Roquette (Rocket salad)	1.1	0.2	2.6	22
Rutabagas (carbohydrate range, 3–12 per cent)	1.3	0.2	7.3	36
Sauerkraut	1.7	0.5	3.8[2]	27
Sorrel (dock)	2.1	0.3	2.6	22

[1] Includes fiber. [2] Starch and sugar.

[3] Protein and carbohydrates largely unassimilable (E. P. J.).

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

VEGETABLES—*Continued.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Vegetables, fresh (unless otherwise stated):—Concluded:				
Spinach	2.1	0.3	2.3	20
cooked	2.1	4.1	2.6[1]	56
Squash	1.4	0.5	8.2	43
Tomatoes, green	1.2	0.2	2.8	18
ripe	0.9	0.4	3.3	20
juice	0.8	..	3.5	..
Truffles	9.1[2]	0.5	7.0[3]	..
Turnips	1.3	0.2	6.8	34
Vegetable marrow	0.5	0.1	4.0	19
cooked	0.4	0.1	4.1	19
Watercress	1.7	0.3	2.8	21
Yams	2.1	0.2	23.3	103
Vegetables, dried:				
Beans	22.5	1.8	55.2	327
carob	6.3	0.6	80.7	353
frijoles	21.9	1.3	65.1[1]	360
Lima	18.1	1.5	65.9[1]	350
mesquite	12.2	2.5	77.1[1]	380
soy	38.3	14.9	26.6[4]	394
Carrots, evaporated	7.7	3.6	80.3[1]	384
Lentils	25.7	1.0	59.2[1]	349
Peas	24.6	1.0	57.5	337
cow	21.4	1.4	56.7	325
Peppers, green	15.5	8.5	63.0[1]	391
red	9.4	7.7	70.0[1]	387
Potatoes, evaporated	8.5	0.4	80.9[1]	361
Tomatoes	12.9	8.1	62.3[1]	374
Vegetables, canned:				
Artichokes (carbohydrate range, 3.2–6.1 per cent)	0.8	..	4.4	21
Asparagus (carbohydrate range, 1.6–3.3 per cent)	1.5	0.1	2.3	16
Beans, baked	6.9	2.5	17.1	119
haricots verts	1.1	0.1	2.0	13
flageolets (carbohydrate range, 9.8–12.4 per cent)	4.6	0.1	11.5	65
Lima (carbohydrate range, 9.6–16.5 per cent)	4.0	3.0	13.4	97
little green	1.2	0.1	2.8	17
red kidney	7.0	0.2	17.3	99
string (carbohydrate range, 1.5–4.5 per cent)	1.1	0.1	3.3	19
wax	1.0	0.1	2.5	15

[1] Includes fiber.
[2] Largely non-protein.
[3] Largely unavailable.
[4] About one-fourth available.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

VEGETABLES—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Vegetables, canned:—Concluded:				
Brussels sprouts	1.5	0.1	2.9	19
Corn[1] (carbohydrate range, 11.7–25.1 per cent)	2.8	1.2	18.2	95
and tomatoes	1.6	0.4	9.1	46
Macedoine (mixed vegetables)	1.4	..	3.9	21
Okra[2]	0.7	0.1	2.9	15
Peas[3] (carbohydrate range, 4.3–17.2 per cent)	3.6	0.2	8.6	51
Potatoes, sweet	1.9	0.4	40.6	174
Pumpkins (carbohydrate range, 3.6–7.3 per cent)	0.8	0.2	5.6	27
Squash (carbohydrate range, 3.6–12.8 per cent)	0.9	0.5	9.8	47
Succotash (carbohydrate range, 13.9–21.3 per cent)	3.6	1.0	17.7	94
Tomatoes (carbohydrate range, 1–4.5 per cent)	1.2	0.2	3.5	21
Pickles, condiments, etc.:				
Capers	3.2	0.5	5.0	37
Catsup, tomato (carbohydrate range, 3–26 per cent)	1.8	0.2	10.0	49
Chili sauce (carbohydrate range, 14–28 per cent)	..	..	20.0	..
Horseradish	1.4	0.2	10.5[4]	49
Mayonnaise dressing (average of 10 commercial brands)	1.7	77.8	2.9	719
Mineral oil dressing (average of 3 commercial brands)	1.3	76.0[5]	4.5	..
Mustard, prepared	4.7	4.1	5.0	76
cereal added (carbohydrate range, 4–15 per cent)	3.5	1.9	7.0	59
Olives, green, edible portion (10 samples)[6]	1.3	12.1	2.5	124
ripe, edible portion (8 samples)[7]	1.4	18.0	2.0	176
Pickles, cucumber	0.5	0.3	2.7[4]	16
mixed	1.1	0.4	4.0[4]	24
spiced	0.4	0.1	21.0	87
Vinegar, cider (carbohydrate range, 0.3–1.5 per cent)	None	None	0.3	1
distilled	None	None	None	..
malt	..	..	0.5[8]	..
spiced salad	..	..	10.0	..
Tarragon	..	..	0.2[8]	..
wine	..	..	0.4	..

[1] Average, 0.4 per cent salt (NaCl).
[2] Average, 1.1 per cent salt (NaCl).
[3] Average, 0.7 per cent salt (NaCl).
[4] Includes fiber.
[5] Practically all unavailable.
[6] Salt, 5.9 per cent.
[7] Salt, 2.1 per cent.
[8] Manufacturer's analysis.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

FRUITS, BERRIES, ETC.
(*Analyses are of edible portion.*)

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Fruits, berries, etc., fresh:				
Apples (carbohydrate range, 7–16 per cent)	0.3	0.4	13.9	60
Apple juice	0.1	..	12.5	50
Apricots	1.0	0.1	12.3	54
Avocados (alligator pears)	2.1	20.1	7.4	219
Bananas	1.3	0.6	21.0	95
Blackberries	1.3	1.0	8.4	48
Blueberries	0.6	0.6	13.9	63
Cherries	1.0	0.8	16.5	77
Citrang juice	1.3	..	6.9	33
Crabapples	0.4	0.3	17.1	73
Cranberries	0.4	0.6	8.4	41
Currants	1.6	0.4	9.5	48
Egg fruit	3.4	1.9	41.0	195
Figs	1.4	0.4	17.9	81
Gooseberries	0.8	0.4	7.6	37
Grapes	1.3	1.6	14.9	79
Grapejuice (carbohydrate range, 11–20 per cent)	0.4	..	18.5	76
Grapefruit[1]	0.8	..	7.2	32
Grapefruit juice	0.4	0.1	9.8	42
Guaras	1.0	0.6	11.6	56
Huckleberries	0.9	0.6	7.8	40
Lemons	1.0	0.7	7.4	40
juice	..	..	9.8	..
Limes	0.8	0.1	12.3	53
juice	0.5	..	7.8	33
Loganberries[2]	4.6	0.6	7.2[3]	53
juice[4]	0.6	..	6.8	..
Loquat	0.3	..	23.0	..
Mangoes	0.7	0.2	16.2	69
Mulberries	1.2	0.6	12.6	61
Muskmelons	0.6	0.3	7.2	34
Nectarines	0.5	0.1	15.6	65
Oranges	0.9	0.2	10.6	48
Orange juice	0.6	..	13.1	55
Papaw	5.2	0.9	16.8	96
Papaya	0.6	0.1	9.1	40
Peaches	0.5	0.1	11.4	49
Pears	0.6	0.5	11.4	53

[1] Florida, California and Puerto Rico, carbohydrate range, 6.6–8.2 per cent (E. M. Frankel).

[2] Jour. Ind. and Eng. Chem., 1918, **10**, 30.

[3] Invert sugar.

[4] Jour. Ind. and Eng. Chem., 1917, **9**, 1043.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)
FRUITS, BERRIES, ETC.—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Fruits, berries, etc., fresh:—Concluded:				
Persimmons	0.8	0.7	29.7	128
Pineapple	0.4	0.2	13.3	57
Plums	0.7	0.2	12.4	54
Pomegranates	1.5	1.6	16.8	88
Prunes	0.9	0.2	21.3	91
Quince	0.3	0.1	13.2	55
Raspberries, black	1.5	1.6	12.1	69
red	1.1	..	11.6	..
Sapodilla	0.6	1.4	19.4	93
Sour sop	0.8	0.1	17.2	73
Strawberries	1.0	0.6	6.0	33
Tangelo juice	0.7	..	9.0	..
Watermelons	0.4	0.2	6.7[1]	30
Whortleberries	0.7	0.3	10.0	46
Fruits, berries, etc., dried:				
Apples	1.6	2.2	66.1[1]	291
Apricots	4.7	1.0	62.5[1]	278
Citron	1.5	1.5	78.1[1]	332
Currants	2.4	1.7	74.2[1]	322
Dates	2.1	2.8	78.4[1]	347
Figs	4.3	0.3	74.2[1]	317
Prunes	2.1	..	73.3[1]	..
Raisins	2.6	3.3	76.1[1]	345
Raspberries	7.3	1.8	80.2[1]	366
Fruits, berries, etc., canned; jellies and preserves:[1]				
Apples, crab	0.3	2.4	54.4[2]	240
Apple sauce	0.2	0.8	37.2[2]	157
Apricots	0.9	..	17.3[2]	..
Apricot sauce	1.9	1.3	48.8[2]	215
Bakapple (cloudberry)	1.9	0.3	9.7	49
Blackberries	0.8	2.1	56.4[2]	248
Blueberries	0.6	0.6	12.8[2]	59
Cherries	1.1	0.1	21.1[2]	90
Cherry jelly	1.1	..	77.2[2]	..
Figs, stewed	1.2	0.3	40.9[2]	171
Grape butter	1.2	0.1	58.5[2]	240
Grapefruit	0.5	0.1	8.3	36
Marmalade, orange	0.6	0.1	84.5[2]	341
Peaches	0.7	0.1	10.8[2]	47
Pears	0.3	0.3	18.0[2]	76
Pineapple	0.4	0.7	36.4[2]	154
Prune sauce	0.5	0.1	22.3[2]	92
Strawberries, stewed	0.7	..	24.0[2]	..
Tomato preserves	0.7	0.1	57.6[2]	234

[1] Includes fiber.

[2] Jams, jellies, preserves and marmalade contain 47 per cent or more carbohydrate. There is a wide variation in the sugar content of canned fruits. Pie peaches are packed in water while other grades may be found in 30, 40 or even 50 per cent syrup.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Continued.*)

NUTS.

(*Analyses are of edible portion.*)

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Nuts:				
Almond	21.0	54.9	15.3	639
Almond butter	22.1	61.5	7.9	674
Beechnuts	21.9	57.4	13.2[1]	657
Brazil nuts	16.8	69.4	5.0	712
Butternuts	27.9	61.2	3.5	676
Cashew nuts	19.1	47.1	26.2	605
Chestnuts	6.2	5.4	40.3	235
Cocoanuts	5.7	50.6	27.9[1]	590
Cocoanut milk	0.4	1.5	4.6	34
prepared	6.3	57.4	31.5[1]	668
Filberts	15.6	65.3	13.0[1]	702
Hickory nuts	15.4	67.4	11.4[1]	714
Lichi nuts	2.9	0.2	77.5[1]	323
Peanuts	25.8	38.6	21.9	538
Peanut butter	29.3	46.5	17.1[1]	604
Pecans	9.6	70.5	15.3[1]	734
Pine nuts, Pignolias	36.5	47.9	4.8	596
Piniones	6.5	60.7	26.2[1]	677
Pinon	14.6	61.9	17.3[1]	685
Sabine	28.1	53.7	8.4[1]	629
Pistachios	24.3	51.1	14.3	614
Walnuts, California	18.4	64.4	11.6	700
black	27.6	56.3	10.0	657
soft shell	16.6	63.4	13.5	691

ALCOHOLIC BEVERAGES.

Distilled liquors[2] (whisky, gin, rum, brandy)	..	..	None or trace	..
Wines,[3] dry (carbohydrate range, trace to 3.6 per cent)	..	..	0.3	..
sweet (carbohydrate range, 0.1–40.7 per cent)	..	..	8.0	..
Cordials[4] (creme de menthe, kümmel, benedictine, anisette, chartreuse)	..	..	30.0	..
Beer[5] (average of fifteen brands)	0.5	Trace	4.8	..

[1] Includes fiber.

[2] Sugar is sometimes added to brandy. One sample examined was sensibly sweet and contained 33.5 per cent of sugar (Connecticut Exp. Sta. Bull. 227, 1920, p. 232). Range of alcohol content, 35 to 50 per cent.

[3] Natural wines contain 6 to 12 per cent alcohol; "fortified" wines, 15 to 20 per cent.

[4] Range of alcohol content, 35 to 50 per cent.

[5] Averages made in July, 1933. Alcohol ranged from 3.3 to 4 per cent by volume; average, 3.7 per cent.

TABLE 22.—COMPOSITION OF COMMON FOODS.—(*Concluded.*)

ALCOHOLIC BEVERAGES.—*Concluded.*

Name and description of food.	Protein, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per 100 gms.
Ale[1]	..	..	5.1	..
Ginger ale, 120 samples (sugar range 5.8–12.3 per cent	..	..	9.0	..
Malt extract, commercial	..	..	10.6	..
true, concentrated	..	..	71.3	..
Cider,[2] sweet	1.0	..	12.5	..

OTHER BEVERAGES.

Tea (0.5 oz. to 1 pt. water)	..	..	0.6	..
Coffee (1 oz. to 1 pt. water)	..	..	0.7	..
Cocoa (0.5 oz. to 1 pt. water)	..	..	1.1	..
(0.5 oz. to 1 pt. milk)	..	..	6.0	..
Carbonated drinks (bottled soda, sarsaparilla, birch beer, root beer, ginger ale)	..	..	8.0	..
Chocolate[3]	12.4	52.2	24.8[4]	619
Cocoa[3]	18.3	26.7	37.5[5]	464

[1] Range of alcohol content, same as for beer.

[2] Sugar decreases as fermentation proceeds. Average alcohol in fermented cider about 5 per cent.

[3] Analysis of food itself; not as prepared for drinking. Sweetened chocolate contains from 50 to 60 per cent of sugar; sweetened cocoa contains from 25 to 50 per cent of sugar.

[4] Starch and sugars, about 10 per cent; availability of remainder doubtful or undetermined.

[5] Starch and sugars, about 14 per cent; availability of remainder doubtful or undetermined.

CHAPTER XXVII.

SELECTED LABORATORY TESTS USEFUL IN DIABETIC TREATMENT.

Who learns and learns,
Yet does not what he knows,
Is one who plows and plows
Yet never sows.

Translated from the Persian by
JAMES PHINNEY BAXTER.

AN early diagnosis in diabetes is as important as in tuberculosis and is far more easily made. The disease usually begins insidiously and its prompt detection depends upon the routine examination of the urine of everybody rather than upon the examination of the urine of patients who present symptoms of the disease. General practitioners should teach their patients, as a matter of routine, to have their own urines and the urines of the members of their families examined each birthday. Above all else since diabetes is hereditary each diabetic should protect his father, mother, brother and sister and children by making a yearly examination of the urine and a semi-annual examination, if the relative is over fifty years of age. Every boy and girl who studies chemistry should be taught the Benedict test.

The Metropolitan Life Insurance Company was kind enough to analyze my cases. The study shows that the mortality for cases of diabetes discovered by examinations for life insurance and thus presumably early cases had a much lower mortality than those discovered otherwise. (See Fig. 48.)

The mere presence of sugar in the urine does not warrant a diagnosis of diabetes. To prove diabetes exists a test for the blood sugar should be made. If the blood sugar percentage reaches 0.14 (140 mg.) fasting or 0.17 (170 mg.) venous blood after a meal diabetes can be assumed to be present.

Although diabetic patients can test their own urines for sugar, and almost invariably are warranted in relying upon the result of their examination, they should not feel that they are expert analysts. More than once patients have arrived at erroneous conclusions, in part due to the preparation of chemical reagents employed. It is therefore safer for all diabetic patients to send their urines once a month to their physician. If the urine is free from sugar, such an examination can be made by a physician within fifteen minutes. A microscopic examination or a quantitative examination for sugar demands half an hour more or less.

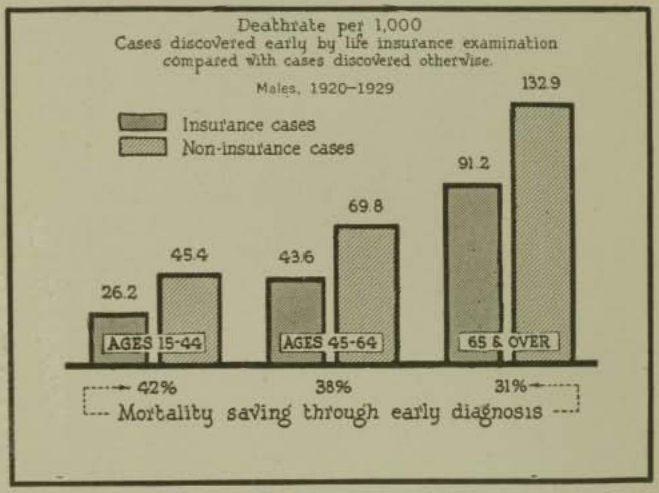


FIG. 48.

The Collection of Urine.—To collect the twenty-four hour quantity of urine, discard that voided at 7 A.M. and then save in a cool place all urine passed thereafter up to and including that obtained at 7 A.M. the next morning.

It has become increasingly important since the advent of insulin to examine separately the urine voided after meals and during the night. The urine voided between 7 A.M. and just before the noon meal constitutes the morning (M)

urine; that until the evening meal the afternoon (A) urine; that until retiring the evening (E) urine; after retiring until and including 7 A.M. the night (N) urine. If sugar is found in the twenty-four-hour urine one can learn by a study of the morning, afternoon, evening and night specimens whether this occurs uniformly throughout the entire day or at a single period. If the latter is the case, an investigation will disclose whether (*a*) an excess of carbohydrate has been taken at the previous meal; (*b*) the quantity of insulin has been inadequate, because of (1) insufficient quantity or (2) faulty administration due to repeated injections in a single area of the body or to the interval before the meal being too short or (*c*) lack of exercise. When sugar is found in all four specimens of urine the total diet including carbohydrate should be lowered, insulin raised and sometimes exercise increased. The question of increase or decrease in exercise however depends upon various factors, such as the existence of an intercurrent infection, which of itself usually brings back sugar in the urine. The bedridden patient without fever should always take bed gymnastics.

If a separate specimen of urine is voided between 7 A.M. and breakfast at 8 A.M., a true idea of the presence or absence of sugar in the fasting state is obtained. This is very desirable for those patients taking both regular and protamine insulin before breakfast. The 7 A.M. specimen represents the specimen which has been collecting for hours in the bladder; the 7.30 or 8 A.M. specimen represents urine recently secreted and therefore a better index of the sugar in the blood.

Reaction.—The normal urine is acid. Urine voided after a meal rich in vegetables and fruits is frequently alkaline, due to the alkaline salts which they contain. Therefore the report that the urine is acid does not imply in the slightest degree that a patient has acid poisoning.

Examination of the Urine for Sugar.—The urines of healthy individuals and of carefully treated diabetics do not show sugar by the routine Benedict test for sugar. Sugar can be demonstrated readily if it amounts to as little as 0.05 per cent, and it may rise to as high as 9 or 10 per cent when the diabetic diet is not followed. Most untreated cases show between

2 and 6 per cent of sugar. The total quantity of sugar in the urine in the twenty-four hours is easily estimated by multiplying the percentage of sugar which the urine contains by the total amount of urine voided. Thus, if the total quantity of urine is 3000 cc. (1 quart equals 946 cc. and for rough calculations can be considered equal to 1000 cc. or 1 liter) and the percentage of sugar is 4 per cent, the amount of sugar in the urine would be (3000 by 0.04) 120 grams, that is, since 30 grams equal 1 ounce, about 4 ounces or $\frac{1}{4}$ pound. It is not very often that one finds more than 1 pound of sugar excreted in the urine during twenty-four hours. The food value of sugar lost, if only 120 grams, is considerable. Each gram of sugar is equivalent to 4 Calories, and 120 grams would amount to 480 Calories in a day. This is one-fourth of the total food value required by an individual with a quiet occupation who weighs 60 kilograms (132 pounds). Thus, it is evident that 4 untreated diabetics, even though the disease is of very moderate severity, provided they eat enough to make up the loss, will waste in a day enough food to supply the needs of a normal individual of equal weight for the same space of time. A diabetic therefore can be a food spendthrift.

Doctors and diabetics too should realize that a large amount of sugar in a single specimen of urine does not necessarily mean a correspondingly large percentage in the urine for the entire twenty-four hours. Just as the blood sugar varies from hour to hour, so too does the percentage of sugar in the urine. One should always bear in mind the total quantity of sugar voided and not the per cent alone.

The Benedict Test for Sugar.—Many tests for sugar in the urine are employed. The Benedict test[1] is one of the best. As used with urine, the test is sufficiently delicate to detect quantities as small as 0.08 or 0.1 per cent sugar. The Benedict solution employed has the advantage of not decomposing, even after months.

The test is carried out as follows: Eight (not more) drops of the urine to be examined are placed in a test-tube and to this are added 6 cc. (an ordinary teaspoon holds about 5 cc.)

[1] Benedict, S. R.: Jour. Am. Med. Assn., 1911, **57**, 1193.

of Benedict's solution. The tube is shaken to mix the urine and solution and then placed in water that is already boiling. After being in the boiling water for five minutes the tube is removed and examined for evidence of sugar. In the presence of sugar the entire body of the solution will be filled with a precipitate, which may be greenish, yellow or red in color, according to whether the amount of sugar is slight or considerable. If the solution remains clear, the urine being tested is sugar-free; if one can read print through the solution the percentage of sugar is so slight that it can be disregarded; if a heavy greenish precipitate forms, it usually means there is a trace of sugar; the appearance of a yellow sediment indicates the presence of a few tenths per cent of sugar in the urine, and a red sediment more than 2 per cent. The colors should be read after shaking thoroughly.

Upon removal from the boiling water shake the test tube. The discoloration which occasionally forms upon the surface is unimportant and with shaking disappears.

The test can be performed by using 4 drops of urine and a trifle more than half a teaspoonful of Benedict's solution. If so carried out by all the diabetics in the country I once reckoned it would amount to a saving of more than $100,000 a year. What a sum to apply for the Study and Care of Patients with Diabetes!

The chief points to be remembered in the use of the Benedict reagent are: (1) The addition of not more or less than 8 drops of urine, delivered from an unbroken medicine dropper; (2) the use of not less than 5 cc. or more than 8 cc. of Benedict's solution; (3) the transfer of the tube to water, actually boiling, where it should remain for five minutes; (4) the change in color and transparency of the solution is the criterion for a positive test for sugar.

As said above 4 drops of urine and one-half the quantity of Benedict's solution can be employed providing great care and cleanliness are exercised. The use of the smaller quantity of urine and reagent is not a safe method for the performance of the test if the mixture of urine and solution is to be heated over a free flame.

The formula and directions for preparing the Benedict solution follow: They should be strictly adhered to in preparing the solution.

	Grams or cc.
Copper sulphate (pure crystallized)	17.3
Sodium or potassium citrate	173.0
Sodium carbonate[1] (anhydrous)	100.0
Distilled water to make	1000.0

The citrate and carbonate are dissolved together (with the aid of heat) in about 700 cc. of water. The mixture is then poured (through a filter if necessary), into a larger beaker or casserole. The copper sulphate (which should be dissolved separately in about 100 cc. of water) is then poured slowly into the first solution, with constant stirring. The mixture is then cooled and diluted to 1 liter. This solution keeps indefinitely.

If doubt arises in the patient's mind about the reliability of his Benedict solution, he can test it by performing the usual test for sugar but substituting 8 drops of orange juice for urine. Cane sugar which is our usual table sugar does not give the test. Cane sugar when eaten immediately changes to dextrose and levulose and both these forms of sugar act upon Benedict's solution. The test with orange juice changes the Benedict's solution to a bright red color.

Quantitative Tests.—It is one of the chief advantages of modern treatment that the need for these tests is greatly reduced. The simplification of the treatment of diabetes means everything to the practitioner and patient. At the beginning of treatment, however, it is desirable to follow the reduction of sugar excreted along with changes of the diet and the determination of the percentage of sugar in the urine is indicated.

The Millard Smith method is the one used routinely in the laboratory of the New England Deaconess Hospital. The quantitative test can be performed in a minimum of time, is very simple, and if carefully carried out furnishes sufficiently reliable data. It is not necessary to calculate the

[1] The crystallized (10 molecules of water) Na_2CO_3 is more soluble; 270 gm. of the crystals are equivalent to 100 gm. of the anhydrous salt.

final percentage of sugar for this can be read directly on a special pipette used for titrating. The method is described in detail below.

The apparatus[1] needed consists of a small ring stand with test tube clamp, a micro-Bunsen burner or small alcohol lamp, a pyrex test tube (18 by 150 mm.), a Millard Smith pipette No. 2, and one 1 cc. Ostwald pipette.

With the Ostwald pipette transfer 1 cc. of Benedict's original quantitative solution into the test tube (held in the ring stand clamp) and then add 0.2 to 0.7 gram of anhydrous sodium carbonate. A small well-dried pebble, or a piece of quartz, or a pinch of talcum powder should also be added to prevent bumping.

Heat the mixture to boiling and add the urine from the Smith pipette drop by drop until reduction is complete as evidenced by the disappearance of the blue color. Read the percentage of sugar directly from the pipette. The approximate strength of the urine, with a slight amount of experience, is easily estimated from the qualitative Benedict test. Urines expected to contain 1 per cent or less of sugar are titrated directly. Those over 1 per cent are diluted ($\frac{1}{10}$ or $\frac{1}{20}$) before titration and necessary calculations made after titrating. All dilutions of the urine reduce, of course, the accuracy of the results obtained due to dilution of the urinary salts.

For *rapid* reduction of the reagent, vigorous boiling is essential, which may result in too rapid evaporation. This is avoided by allowing more time for reduction between additions of urine.

The best results are obtained if the solution is kept *at* the boiling point by manipulation of the flame and the urine added slowly. A very small flame should be employed. *The tendency in this titration of sugar is to go past the end-point. When nearing the end-point the urine must be added slowly.* In urines of low sugar content the boiling should be rather vigorous at first in order to maintain a constant volume while the 1 to 2 cc. of urine necessary to give complete

[1] The apparatus may be purchased from many surgical supply houses or from the manufacturers, Emil Greiner Company, 55 Vandam Street, New York City.

reduction are being added. With a moderate amount of practice the regulation of the volume of the boiling solution becomes quite simple.

A simpler and more compact apparatus has been devised by Sheftel. It is practical for any intelligent patient to use at home or travelling. The outfit can be purchased from the Eli Lilly Company, Indianapolis, Indiana.

Methods for the Determination of the Urinary Acids.— Qualitative Tests.— *Diacetic Acid* (CH_3COCH_2COOH).—The simplest method for the detection of acidosis by urinary examination is Gerhardt's ferric chloride reaction for diacetic acid. The test may be performed as follows: To about 10 cc. of the fresh urine carefully add a few drops of an undiluted aqueous solution of ferric chloride, Liquor Ferri Chloridi, U. S. P. A precipitate of ferric phosphate first forms, but upon the addition of a few more drops is dissolved. The depth of the Burgundy red color obtained is an index to the quantity of diacetic acid present. I record the intensity of the reaction as follows: +, ++, +++ or ++++.

Confusion as to the significance of the test arises if the patient is taking sodium salicylate, aspirin, antipyrin, cyanates, or acetates. This is to a considerable extent avoided by vigorously boiling the urine after the addition of the ferric chloride, when the deep color markedly decreases or disappears if caused by diacetic acid, but remains the same if caused by the above drugs.

Acetone (CH_3COCH_3).—The different tests for acetone are in reality tests for diacetic acid. Legal's test is as follows: A few crystals of sodium nitroprusside are dissolved in 5 cc. of urine, which is then rendered alkaline with sodium hydrate. Shake vigorously. Two drops of glacial acetic acid are then allowed to run down the side of the test-tube and a distinct purple color appears.

Caution! Vorsicht! Prenez garde!

If you take insulin, it is a safe rule, when driving an automobile, to have a friend beside you and at more than two hours after a meal it is imperative that a diabetic should take a lunch of 10 grams or more of carbohydrate.

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