MANAGEMENT OF DIABETES

GEORGE A. HARROP, JR.

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Treatment by Dietary Regulation and the Use of Insulin

A MANUAL FOR PHYSICIANS AND NURSES BASED ON THE COURSE OF INSTRUCTION GIVEN AT THE PRESBYTERIAN HOSPITAL, NEW YORK

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INTRODUCTION

A problem ever increasing in perplexity for the medical profession is the proper diffusion of contributions to our knowledge of disease. Investigators and specialists have little contact with the majority of busy practitioners, except through the current periodicals. The practitioner of medicine, with his long and fatiguing days, finds little time to read. The short vacations he is able to snatch here and there are necessarily spent in relaxation of a non-professional character. Meanwhile, with the remarkable increase in research, particularly in the United States and Canada, a decade brings new literature, and with it frequently a new nomenclature, making it all the more difficult for the man in active clinical life to sort out facts from fiction in the medical press. Physics and chemistry have become the chief instruments for extending our knowledge in medicine, and with the remarkable advances made in these fundamental sciences in recent years, the difficulty of keeping abreast of medical progress has increased enormously. This development is reflected in the appearance of specialists, whose numbers multiply with great rapidity. No one would deny the value of specialization; but a sound and safe general knowledge of medicine is indispensable for the average clinician.

During the past decade, we have witnessed notable advances in the knowledge of diabetes mellitus, not only in the chemical processes involved in the disturbed metabolism, but also in the treatment of this very prevalent disease. The introduction of the restricted and intelligently balanced diet by Allen brought about a great change in the attitude of the profession toward diabetes, resulting in marked improvement in therapy.

Although for years, since the days of Minkowski, the seat of the trouble was attributed to the pancreas, and later was shown to be due to a faulty internal secretion of the islands of Langherhans, it remained for Banting of Toronto to isolate the active substance, and apply it successfully to the treatment of diabetes in human individuals. Great credit is due Dr. Banting for his courage and industry in bringing about this wonderful advance in medicine.

As is so often true in the development of recent therapeutic aids, we are dealing, in insulin, with a two-edged sword. When properly employed, it is a great boon; when improperly used, a danger to the patient.

Through the generosity of John D. Rockefeller, Jr., it has been possible at the Presbyterian Hospital to demonstrate the proper use of insulin to nearly six hundred physicians. It very soon became evident that a manual, such as is here presented, was necessary for reference after completing the hospital course. Such a manual, to be useful to the general practitioner, cannot be too technical or exhaustive. On the other hand, it should summarize our present knowledge of the disease and of the use of insulin which is adequate for the successful care of individuals ill with diabetes. The following pages contain the necessary information clearly and briefly stated. This little book should serve not only as a handbook of treatment, but also to stimulate interest in careful observation of the disease and future contributions to the problem.

WALTER W. PALMER.

NEW YORK, N. Y.,
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PREFACE

The material presented in this manual is based upon a course of instruction given to six hundred practicing physicians at the Presbyterian Hospital, of New York, extending from June to September, 1923, on "The Treatment of Diabetes Mellitus by Means of Dietary Regulation and the Use of Insulin." It was given in a series of fourteen bi-weekly sections (one of which was devoted to graduate nurses and dietitians) under the joint auspices of the Presbyterian Hospital and the Columbia University School of Medicine, and was rendered possible by a grant of money from John D. Rockefeller, Jr.

Those who took part in the instruction, all members of the staff of the Department of Medicine of the Hospital and of the University, were: Alvan L. Barach, M. D., Louis Bauman, M. D., Ethel M. Benedict, B. A., H. Rawle Geyelin, M. D., William S. Ladd, M. D., Bertram J. Sanger, M. D., M. J. Schoenberg, M. D., Gerald Shibley, M. D., Edgar Stillman, M. D. and Randolph West, M. D. Grateful acknowledgement is made for their many useful suggestions and unfailing help in planning and carrying out the instruction. We wish further to mention the great help afforded by Mrs. Mary deG. Bryan in working out the administrative details of the dietetic instruction.

We also desire to acknowledge the whole-hearted support and cooperation of Mr. Dean Sage, President of the Board of Managers of the Presbyterian Hospital; of Mr. J. F. Bush, Superintendent of Administration, and his assistants, Miss Ruth T. Dean, R. N., Miss Ruth Campbell and Miss Mabel Davies, R. N.; and of Miss Helen Young, R. N., Director of the School of Nursing, and of Mr. S. Steinberger, technician in the chemical laboratory.

The instruction in blood and urine analysis was directed by Miss E. M. Benedict, Assistant in Medicine and Clinical Chemist to the Hospital, who has prepared the outline of laboratory methods given in Chapter XI.

The instruction in dietetics was given by Miss Sarah Hickcox, who has prepared the diabetic recipes and food tables and has also written Chapters VIII and IX. The management of the clinics and the nursing care of the patients were in charge of Miss Olive Welch, R. N., Head Nurse of the Metabolism Service, and Miss Iris M. Gaut, R. N., and Miss Juliet Branham, R. N.

Finally, we desire to thank the many physicians taking the course for their valuable suggestions and kindly criticisms.

The Food Tables are based on those used in the Metabolism Service of the Presbyterian Hospital. They have been thoroughly worked over and recalculated, using standards from many sources. We have dropped the use of decimals in the calculations of food values. The elaborate working out of food values, where the final margin of error cannot possibly be less than 10 per cent in the diet as eaten, leads only to waste of effort and self-deception. We believe the current trend of practice to be, and rightly, toward greater simplicity in this particular.

It is confidently hoped that this manual may present to the general practitioner only well-established information of practical acid to him in the management of diabetes, and that the methods outlined will prove both efficient and safe. New facts are rapidly coming to light, and the impetus given by Banting's epoch-making discovery will doubtless open up fertile ground for research. No one can possibly be so rash as to believe that the last word has been said concerning the use of insulin in the therapy of diabetes. But we believe that sufficient knowledge has already been gained and sufficient clinical experience has been accumulated to render valuable the presentation of a comprehensive view of the subject as it appears to be developing at the present time.

G. A. H.

New York, N. Y.,
March, 1924.

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CHAPTER I

NORMAL METABOLISM AND ITS DERANGEMENT IN DIABETES

THE chemical changes undergone by substances in contact with the cells of the living body constitute the processes embraced under the term *metabolism.* Diabetes is essentially a disorder of metabolism, and a proper understanding of this disease and the principles on which its modern treatment is based, demands an elemental working knowledge of these fundamental processes. The foodstuffs, which furnish the raw material from which the body builds itself, repairs itself, and derives the energy wherewith to carry on vital activities, are three in number: *proteins, carbohydrates* and *fats.* Equally important, although not sources of energy, are *water, inorganic salts* and the group of substances known as *vitamines.*

PROPERTIES OF PROTEINS. All three foodstuffs contain the elements carbon, hydrogen and oxygen. Protein alone, which comprises the greater part of most animal products used as foods (meats, eggs, cheese and the like), also contains the element nitrogen, as well as small quantities of sulphur and phosphorus. So uniform is the composition of protein, that the contained nitrogen always bears a definite percentage relation to its total weight (1 gm. nitrogen is obtained from 6.25 gms. protein), and therefore an estimation of the total nitrogen excretion in the urine, in which nearly all the nitrogen is excreted, enables one to calculate the amount of protein used up by the body in the given interval of time. Protein is essential for the diet, and from it alone are tissues built up, repaired and replaced. Under ordinary circumstances, in an adult, the nitrogen intake and output exactly balance one another, a condition called *nitrogen equilibrium.* But where tissue is being built up, as in the growing child, or where it is being repaired or replaced after wasting disease or starvation, the nitrogen of the food exceeds that excreted, and a condition of *positive nitrogen balance* exists. Where the opposite condition occurs, as during the course of the wasting diseases, cachexia, or during the rapid loss of weight which occurs in severe untreated diabetes, excretion exceeds intake and *negative nitrogen balance* is found. The intimate relation which exists between the nitrogen balance and gain or loss in weight is well seen after the use of insulin in cachectic diabetics. For a considerable period after insulin treatment is started and large amounts of nitrogen are ingested, nitrogen excretion usually exceeds intake, and only when positive balance is established, do gain in weight and striking clinical improvement occur.

The metabolism of protein is of further importance in diabetes because glucose is normally one of the products of protein decomposition in the body, and this glucose has the same fate, so far as is known, as has glucose from any other source. The relation between protein and glucose may be demonstrated in dogs rendered completely diabetic by the drug phloridzin. These animals are totally unable to burn glucose, which is accordingly completely excreted in the urine. When due attention has been paid to certain standard precautions, especially the preliminary depletion of the glycogen stores of the body and the proper dosage intervals for the drug, it is found that for every gram of nitrogen excreted in the urine, 3.65 gms. of glucose appear. This is called the D:N ratio. Since each gram of nitrogen represents 6.25 gms. of protein, the maximum glucose derivable from protein is $\frac{3.65}{6.25}$ or 58 per cent of the protein originally ingested. This carbohydrate produced from the protein should be borne in mind in calculating the diabetic diet and in estimating the amount of sugar which the patient is burning. The nitrogenous part of the protein is excreted in the urine as urea (80 to 90 per cent), ammonia (5 per cent) and certain other substances which appear in smaller amounts.

Properties of Carbohydrates. Carbohydrates, which occur to some extent in most articles of the diet, and which are the chief constituents of vegetable matter and fruits, furnish ordinarily by their oxidation in the body two-thirds of the body's energy requirements. This ability to furnish energy is the more significant because it enables protein to be replaced in the diet to a large extent. Actually nitrogen may be spared to such a degree that equilibrium can be maintained on less than 4 gms. of intake, if carbohydrate be given in adequate amounts, either alone or in conjunction with fats. But the minimum of about 4 gms. is indispensable under any circumstances, and constitutes what is called the wear and tear quota of protein metabolism, needed for replacing broken-down tissue itself. Carbohydrate is the cheapest of the foods and its energy is the most completely available to the body. It is readily stored in the normal body as animal starch or glycogen, which is reputed to exist in about equal amount in the liver and muscles, and hence is at all times readily available for furnishing energy. Under normal circumstances, carbohydrates burn completely to carbon dioxide and water, which are excreted.

Properties of Fats. Fats are derived from both animal and vegetable sources, and constitute a great reservoir of energy in the body, due to their high caloric value. The formation of fat from carbohydrate in the body has been conclusively proven, but that the contrary process takes place has never been adequately demonstrated, and that it occurs to a physiologically significant extent is very unlikely. In contrast to carbohydrate, fat alone will not prevent protein destruction in the body, but within limits it does have a protein-sparing action when given in conjunction with carbohydrate. Fats usually are oxidized completely to carbon dioxide and water. Their incomplete combustion is the chief source of the acetone bodies, which produce the acidosis of diabetes.

THE KETOGENIC-ANTIKETOGENIC RATIO. Of great moment in the study of diabetes is the remarkable relation existing between the metabolism of fat and that of carbohydrate. This relationship has been particularly studied in this country during the past five years by a number of writers. Zeller was the first to point out that when a man is placed on a maintenance diet consisting of 3000 calories, with a constant amount of protein but with varying amounts of carbohydrate and fat, ketone bodies appear in the urine when less than 10 per cent of the calories are in the form of carbohydrate. He found that when the amount was only 5 per cent, a well-marked acidosis occurred. Carbohydrate in definite amounts is indispensable for the burning of fat. The quantitative relationship between complete fat combustion and the minimal amounts of carbohydrate required to cause it, seems now to be quite firmly established, but just what the mechanism is remains very obscure and constitutes one immediate problem of great importance in metabolic research. A number of methods have been suggested for computing diets high in fat content but with a safe *keto-antiketogenic ratio.* These vary in complexity depending upon the account taken of the acetone bodies derivable from the protein, and the carbohydrate available from fat and protein. One of the most practical formulas for clinical purposes is that of Palmer and Ladd:

$$\frac{\text{Total Carbohydrate in gms.} + 60\% \text{ Protein in gms.}}{\text{Total Fat in gms.}} = \frac{1}{3}$$

Where the Palmer-Ladd ratio is below 1 to 3, acidosis usually does not occur, but when it is higher, acetone bodies generally appear. However, fairly wide individual variations undoubtedly exist and a safer and yet quite liberal ratio is 1 to 2.5.

Measurement of Food Energy. It is well known that the animal organism derives the energy for carrying on its life processes from the oxidation of the food-stuffs. This energy is measured in terms of the heat unit called the large calorie. This designates the amount of heat required at 15° C. to raise 1 kg. of water 1° C. The foodstuffs vary somewhat in their caloric values, but for practical purposes, in the calculation of mixed diets, the following values are adequate:

1 gm. carbohydrate yields 4 large calories
(actually 4.1 calories)
1 gm. protein yields 4 large calories
(actually 4.1 calories)

1 gm. fat	yields 9 large calories
(actually 9.3 calories)	
1 gm. alcohol	yields 7 large calories

It is thus clear that if the composition of a diet is known in terms of the weight in grams of carbohydrate, fat and protein, the maximum energy which it may yield to the body in terms of calories can be readily calculated. But it by no means follows that this energy is always yielded. For example, the carbohydrate lost to the body as glucose in diabetic urine represents a total loss of 4 calories for each gram. The fat may be incompletely burned and every gram of acetone bodies excreted in acidosis from the incomplete combustion of fat represents a loss of 7 calories per gram calculated as beta-oxybutyric acid.

CHAPTER II

THE NORMAL ACID-BASE MECHANISM AND ITS DERANGEMENT IN ACIDOSIS

The fundamental metabolic fault in diabetes lies in the inability of the body properly to metabolize carbohydrates, more specifically, sugar. There seems to be no lack of ability to break down the higher carbohydrate structures into sugar, but the power to handle glucose, whether it be to polymerize it into the storage form, glycogen, or to burn it and thus derive energy from it, is wholly or in part lost. For some years there have been good grounds for believing that an internal secretion of the pancreas is in some way necessary for carbohydrate metabolism, and that deficiency of this secretion is responsible for diabetes. The discovery of such a secretion, in insulin, appears to have proven this hypothesis. Its presence in the most varied biological forms, both mammal and fish, finds analogy in another important internal secretion, adrenalin, isolated during the last decade. That it may occur not alone in the pancreas, but in other organs as well, is indicated in recent work.

This inability of the diabetic organism to burn glucose has far-reaching consequences upon many other processes of metabolism and of great moment is its effect upon the metabolism of the fats, the defective burning of which is instrumental in the production of acidosis. In order to understand the treatment of this important complication of diabetes, a brief consideration of the acid base mechanism of the normal body is essential.

Regulation of the Normal Acid-base Mechanism. As is well known, the reaction of the blood and body tissues, which is dependent upon the hydrogen-ion concentration, is normally regulated with a high degree of constancy and within very narrow limits. Like the other physiological constants, for example, osmotic pressure and temperature, a constant hydrogen-ion concentration is also probably indispensable for a multitude of the chemical reactions which take place during normal metabolism. The adjustment, which permits only an extremely small margin of variation, is accomplished by the presence of certain chemical substances, called buffers. These are the salts, chiefly sodium and potassium, of certain weak acids. Most important of these salts are phosphates and carbonates. However the proteins, and, more recently, hemoglobin, have also been shown to be important as buffers. The presence of buffers permits the taking up of considerable amounts of rather strong acids without changing the reaction appreciably. Normally the reaction in the body is not quite neutral, but is very slightly on the alkaline side.

THE EXCRETORY REGULATION. A definite ratio between carbonic acid and sodium acid carbonate is always maintained in the blood and an analogous relationship obtains in the case of the phosphates. Upon this the stability of the reaction of the blood and tissues chiefly depends. At the normal reaction of the blood, these ratios are:

$$\frac{H_2CO_3}{NaHCO_3} = \frac{1}{20} \text{ and } \frac{NaH_2\,PO_4}{Na_2H\,PO_4} = \frac{1}{5}$$

A number of mechanisms are available for maintaining this reaction. They act especially in neutralizing the excess of acid which is constantly being produced during normal metabolism. This tends to upset the normal acid-base balance. What may be termed a coarse adjustment acts through the urinary excretion, and a fine adjustment through the respiration. The coarse adjustment is brought about in part by the selective excretion of varying ratios of acid and basic phosphates. The extent to which base may thus be saved is best illustrated by the fact that it is possible for the kidney to excrete phosphates in the ratio of

$$\frac{NaH_2\,PO_4}{Na_2H\,PO_4} = \frac{100}{1}$$

while in blood, as stated above, they exist in the ratio

$$\frac{Na\,H_2PO_4}{Na_2H\,PO_4} = \frac{1}{5}$$

Similarly, the ratio of

$$\frac{\text{Beta Hydroxybutyric Acid}}{\text{Sodium Beta Hydroxybutyrate}}$$

is $\frac{1}{800}$ in the blood and $\frac{1}{3}$ in the urine.

The coarse adjustment of the reaction is further brought about by means of the physiological base, ammonia, which the body can form and excrete in large amounts when it becomes necessary to remove large amounts of acid. This saves for the body very large amounts of sodium and potassium. A certain amount of evidence is available to show that the formation of ammonia actually occurs in the kidney, so that the mineral bases, sodium and potassium, simply act as vehicles to bring the acids there for excretion, the ammonia then replacing the mineral bases. Normally, but 3 to 5 per cent of the total nitrogen of the urine is in the form of ammonia, but in cases of severe acidosis the proportion of total nitrogen excreted as ammonia may be 75 per cent or even more. Under normal circumstances the bowel does not play an important rôle in the acid-base regulatory mechanism.

The Respiratory Regulation. The fine adjustment which plays a part in regulating the hydrogen-ion concentration of the blood acts through the respiratory mechanism. Depending upon depth and frequency of respiration, larger or smaller amounts of carbonic acid, or carbon dioxide (and water) can be excreted from the lungs in the expired air. When other stronger acids are present in the blood stream, as in acidosis, an elimination of carbonic acid to compensate for the presence of these stronger acids automatically occurs, and the concentration of carbonic acid in the blood and tissues is thereby reduced. As this reduction is directly proportional to the amount of foreign acids present, the concentration of carbonic acid in the blood furnishes an excellent quantitative guide to the severity of the acidosis, and a number of methods for the measurement of acidosis depend on this principle. One of these methods consists of measurement of the concentration of carbon dioxide in the lung alveolar air. Because this air is constantly in intimate contact with the blood circulating through the lungs, the concentration of carbonic acid in this air is the same as in the blood, and therefore may be taken as a measure of the concentration in the blood. Within the last decade, however, the method devised by Van Slyke[1] for measuring the carbon dioxide concentration of the blood, has come into common usage. Because this method is practically direct and does not require cooperation on the part of the patient, as is the case in obtaining samples of alveolar air, it has now, in this country at least, entirely superseded the other methods.

ACIDOSIS

The term acidosis is really a misnomer, because it conveys the idea of an acid condition of the

[1] Chapter XI.

blood and tissues, a condition quite impossible in a living organism; but it is another of those misnomers, common in medicine, as elsewhere, that have become firmly fixed and the original meaning has been transposed into something quite different. It is defined by L. J. Henderson as a disturbance of the acid-base balance of the body in the direction of a diminished ratio of base to acid. Since the body maintains a surplus or reserve of base, usually called alkaline reserve, acidosis becomes a diminution of the body alkali.

Measurement of Acidosis. As above stated, the estimation of the bicarbonate of the blood as a measure of acidosis is the principle of the Van Slyke method, now so generally used clinically. The device employed simply measures, under standard, comparable conditions, the amount of carbonic acid gas which may be obtained from a unit sample of blood serum. Normally this amount is 50 to 65 c.c. per 100 c.c. of blood, under standard conditions of temperature and pressure. In mild acidosis it usually ranges from 50 to 40 c.c., in moderately severe cases from 40 to 30 c.c. When it is below 30 c.c. there is a severe acidosis; Kussmaul breathing is generally present when the amount is under 25 c.c.; and until the introduction of insulin, recovery was a very rare event when it was as low as 15 c.c.

Acidosis in Diabetes. The nature of acidosis in diabetes is now fairly well understood, although the ultimate cause of its occurrence, it must be confessed, is still rather obscure. It is associated with the presence in the blood and tissues of acetone bodies. As has been previously stated, the principal source of these substances in the blood and tissues is the fats, which, when they are broken down in the absence of an adequate supply of metabolizing glucose, burn only incompletely, and not as normally into carbon dioxide and water. What it is that renders the burning of carbohydrates essential to the proper oxidation of fat is at present not known. The old saying is a true one, however, that fats burn in the fire of the carbohydrates. The acetone or ketone bodies are three in number: beta hydroxybutyric acid, acetoacetic acid and acetone. The first two of these substances are rather strong organic acids. Normally these acetone bodies occur in negligible amounts in the body fluids and in the urine, but in severe diabetic acidosis, they are present in very large amounts. Since reasonably reliable qualitative tests for acetone bodies are available, the detection of these substances in the urine is an important means of diagnosis of acidosis in diabetes. However, the faulty metabolism which causes acetone body production may be present in other conditions as well. Important among these conditions are the intestinal disorders of children, prolonged uncontrolled vomiting, severe burns and inanition. But acidosis in these latter conditions is usually of distinctly lesser significance.

CHAPTER III

INSULIN AND ITS PHYSIOLOGICAL EFFECT IN THE BODY

Insulin is an internal secretion of the pancreas. It was discovered in 1921 by F. G. Banting and C. H. Best, of the University of Toronto. The original method of preparation was from pancreas tissue, the glandular part of which had degenerated following ligation of the pancreatic duct. A second method was by extraction from fetal pancreatic tissue in which the islands of Langerhans had developed, but in which the acinous tissue had not yet matured. The present method of preparation is from normal glands. The method consists, in brief, of extraction of the freshly washed material with acidified alcohol, and subsequent purification by removal of most of the protein and inorganic salts. It is then standardized biologically in order to make the concentration of the active substance as nearly uniform as possible.

Physiological Effect of Insulin. When insulin is administered in proper dosage to a patient suffering from diabetes, there follows not only a lowering of blood sugar but also a disappearance of sugar and acetone bodies from the urine. The effect on the blood sugar usually takes place within thirty minutes after a subcutaneous injection, and for this reason insulin is usually administered to the patient from fifteen to thirty minutes before the mealtime. Studies of the respiratory metabolism have shown that carbohydrate begins to be metabolized within five to ten minutes after it is taken into the stomach. The attempt is made therefore to obtain the maximum insulin effect at the time at which carbohydrate enters the blood stream. If the effect on the blood sugar is an accurate measure of the total effect of the insulin on the carbohydrate metabolism, its maximum would appear to be reached within two to four hours after the injection, and would appear to be practically over at the end of six or eight hours. There can be little doubt that, normally, mechanisms exist in the body to adjust, with reasonable accuracy, the quantity of insulin released from the available stores to the quantity of carbohydrate which awaits metabolism. Our attempts to simulate this mechanism by the spacing of insulin dosage with relation to the ingestion of food must be, by comparison, very crude indeed. The site of interaction between insulin and carbohydrate, and the possible necessary presence of one or more additional hormones to complete the process, are matters concerning which no definite statements can be made at present. Certainly the evidence at present indicates that oxidation or polymerization of sugar does not occur in vitro in the presence of insulin alone.

Administration of Insulin. The unit of insulin is the amount required when injected subcutaneously, to lower the blood sugar of a fasting rabbit weighing 2 kg., to 0.45 gms. per liter. At this blood-sugar level physiological symptoms usually occur within one to five hours. The clinical unit used in the preparation of Iletin (Insulin, Lilly) was ⅓ of this amount. The clinical unit causes the utilization of from 1 to 4 gms. of carbohydrate, depending on the individual case and the severity of the disease. The average amount is probably from 2 to 2.5 gms. Recently the iletin unit has been altered to conform with the unit of insulin used in Canada. The new Iletin (Insulin, Lilly) unit is 40 per cent stronger than the old one, so that 0.7 of a unit now is the equivalent of 1.0 unit as previously standardized.

Administration of insulin by mouth is ineffective, as the preparation appears to be destroyed by the digestive juices. It is therefore necessary to give it by hypodermic injection. The stability of the commercial preparation of insulin is maintained by a rather acid reaction, and as a result the injections are often painful. It is best to give subcutaneous, and not intramuscular injections, as the latter are associated with more discomfort. Luer tuberculin syringes of the 1 or 2 c.c. type, graduated in hundredths of a cubic centimeter, are suitable for this purpose. They should be sterilized in boiling water. Soaking in alcohol is not advisable. A short massage following the injection aids absorption.

The absence of untoward complications resulting from the injections has been quite remarkable. Abscess formation is very rare; and with the marked improvement in the preparation of the commercial product, serum sickness as a result of sensitiveness to the protein of the animal from which the preparation was derived, no longer occurs.

HYPOGLYCEMIC SHOCK

When an amount of insulin in excess of the carbohydrate available to counteract its effect is administered, a definite train of acute symptoms occurs. Since these symptoms are accompanied by marked lowering of the blood sugar (in man the critical blood-sugar level is about 0.75–0.60 gms. per liter, and in rabbits 0.45 gms. per liter) the condition has received the name of *hypoglycemic shock.* It constitutes a new clinical syndrome. The symptoms are strikingly like those observed in animals in which total extirpation of the liver has been performed. In these animals a similar fall in the blood sugar also occurs.

The time of appearance of the symptoms and their severity bear some relation to the size of the overdose. In patients receiving insulin three times a day before meals, the symptoms usually occur in the late afternoon or in the evening. This time relation is best explained by assuming that the reaction represents the cumulative effect of two or more doses. Where no carbohydrate is given to counteract the effect of the extract, symptoms may occur as early as thirty minutes after the injection. The first symptoms are subjective. A vague feeling of lack of well-being is often complained of, or the patient experiences an "inward trembling," which he cannot well describe, but which he is sure he has never experienced before. Sudden and pronounced hunger, and less frequently, thirst, is often the first symptom noted. Pain is not usually complained of. At times there are psychic phenomena, especially in children. These take the form of cries, delusions, disorientation and resistance. A marked lowering of body temperature occurs, sometimes as low as 96.5° F. (rectal), and an increase in pulse-rate is found, especially in children. Except in the latter stages of profound shock, there is no constant change in the blood pressure. Dilation of the pupils occurs. Facial pallor, or flushing, which may later extend over the entire body, has been noted. The most striking objective phenomenon is profound sweating, at first on the forehead and face, then drenching the entire body. Later trembling and twitching of the extremities occur and, unless proper treatment is given, the condition progresses to convulsions, unconsciousness and death.

Treatment. The specific and simple treatment of this condition is the administration of carbohydrate, usually in the form of orange-juice or sugar. Relief almost immediately follows. Candy, glucose, crackers, or any other form of carbohydrate, is useful. Certain palliative measures not infrequently obviate the use of carbohydrate. Even a hot drink, if the attack is not severe, may overcome it. The hypodermic injection of 0.6 c.c. epinephrin is a quick temporary expedient, but affords no permanent relief if the shock is severe. It has recently been discovered that pituitary extract acts like epinephrin. In case of a severe reaction when the patient cannot swallow and emergency treatment is necessary, it is wise to give first a hypodermic injection of adrenalin and to follow this with an injection of glucose, either subcutaneous or intravenous.

CHAPTER IV

GENERAL PRINCIPLES OF THE MANAGEMENT OF DIABETES: DIETARY REGULATION AND INSULIN

During the recent modern period, prior to the introduction of insulin, the treatment of diabetes, aside from attention to local complications and the supervision of hygiene, consisted solely of dietary regulation. This regulation had for its immediate aims the prevention of acidosis, the clearing up of the glycosuria and, ideally, the restoration of normal values of the blood sugar. The theory of a faulty internal secretion of the pancreas was generally accepted as the probable cause of the disease. The method of treatment widely used was based on the belief that the presence of glycosuria indicates a continuing strain and insult to the already damaged pancreatic function, and that when the diet is so adjusted as to keep the urine continually sugar-free, this strain is relieved and recuperation of the injured function is permitted. It must be confessed that experimental proof for all of these assumptions is not entirely clear. Nevertheless, a powerful argument by analogy is afforded by the downward course of the diabetic dog in which the disease has been experimentally produced, when it is fed on high diets, especially diets high in carbohydrate, and by the improvement or arrest of the condition when the opposite dietary course is pursued. Moreover, the clinical improvement of patients treated by dietary restriction, particularly the relief of the characteristic and distressing clinical symptoms of the disease, as well as the relief of the symptoms of the accompanying acidosis, is nearly always very striking. Real proof that prolongation of life or improvement in the essential severity of the disease results from this careful dietary treatment is very difficult to obtain. That undernutrition and reduction of the normal carbohydrate ration may have a marked effect upon the incidence of the disease is very strikingly and convincingly shown by reports from the countries of central Europe in which there occurred marked food restriction during the recent war. Diabetes in many places is said to have disappeared and university clinics often had difficulty in finding enough cases for adequate clinical teaching.

During recent years it has been attempted by dietary regulation in diabetes to prevent overnutrition, even to induce undernutrition, and, by regulation of the carbohydrate intake especially, to prevent glycosuria. In many instances this form of treatment rigidly adhered to resulted in the development of extreme states of undernutrition. A great advantage which the introduction of insulin has afforded is that extreme grades of undernutrition are now no longer necessary or desirable, and that sufficient carbohydrate can now be added to the diet to make it palatable. Nevertheless, it is not advisable to disregard certain precautions which were observed when dietary treatment alone was available. The justification and necessity for keeping the urine free of sugar and acetone bodies still exist as much as ever. If this precaution is not observed, the use of insulin will only convert a more severe form of disease into a milder one still presenting the potential danger of spontaneous downward progress. That by employing insulin this ideal of sugar-free urine may be reached and safely maintained has now been sufficiently well demonstrated; and no patient is receiving the best possible care whose medical attendant does not endeavor to maintain this standard.

To summarize: the general aim of the present treatment in diabetes is the relief of symptoms and the restoration of normal bodily weight, vigor and activity. This can be accomplished only if a diet adequate for the individual's needs is properly utilized. If this occurs without insulin there is no need for insulin. Where the body cannot utilize a proper diet insulin makes this possible.

MANAGEMENT OF THE DISEASE

History. Let us now turn to a consideration of the actual treatment of the patient. When a patient presents himself for treatment an adequate history should be obtained and physical examination made. The taking of a good diabetic history demands attention to certain details such as: Data on hereditary influences; the occurrence of severe, acute infections during childhood or later; the previous state of bodily nutrition and of food habits, especially overeating of candy; the weight at various earlier stages of life; and the occurrence of symptoms indicating disturbances of the glands of internal secretion. One should take careful note of the onset of the disease, the date of first occurrence of each of the several symptoms, and of the discovery of the glycosuria. Particular attention should be directed to the less obvious disturbances in the neurological and psychic fields, gastrointestinal disturbances, genitourinary disorders, skin diseases and the general train of symptoms so commonly ascribed to neurasthenia. The patient's treatment since onset should be considered in detail, for from it very valuable data may often be obtained regarding the essential severity of the disease and the probable response to further treatment. Finally, of the greatest importance are any data which may lead to the discovery of complications or of associated diseases.

Physical Examination. Careful physical examination of patients suffering from metabolic disease is too often neglected. Measurement of the height and weight is essential. A thorough search for focal infections is of great importance for therapy since insulin is less effective where infection is present. Too much stress cannot be laid upon the importance of painstaking examination of the lungs, and of sputum, if present; examination of the nasopharynx and accessory sinuses; of the teeth and tonsils; of the ears and mastoid regions; of the abdomen; of the urine for abnormal microscopic constituents; of the blood and stools; of the skin and superficial tissues, for the occurrence of skin infections or abscesses; and, finally, of the eyes and central nervous system.

Regulation of the Diet. Having acquired these preliminary data, the next point is the regulation of the diet, as the first step in therapy. In order to determine the proper diet for a diabetic, it is necessary to consider briefly the proper diet for the average normal individual. This depends upon a number of factors: Size, age, state of nutrition, the kind of work and habits of life. There are also racial and individual peculiarities which should be considered. Studies of basal metabolism have indicated clearly that size and age are of great importance. For a given height and weight, the younger individual requires more calories than the older; the man of outdoor life doing hard exercise requires much more than the man of sedentary occupation. Practically speaking, the minimum dietary requirement for most persons lies between 30 and 45 calories per kilogram of body weight. For the average hospital patient, the lowest figure is not far from 30 calories per kilogram. But the requirement for maintenance of weight and vigor in any given individual can only be judged by somewhat extended observation and trial.

Having decided what the total caloric requirement for the patient is likely to be, it becomes necessary to examine the proportion of the various food constituents in a properly balanced diet. The normal diet for a person of average size, say 70 kg., leading a life of usual activity, will be in the neighborhood of 400 gms. of carbohydrate, 100 gms. of protein and 100 gms. of fat, or about 3000 calories. Many persons, however, will be found to take a diet containing but from 25 to 75 gms. of fat, making up the caloric deficiency with an increased carbohydrate ration, so that the carbohydrate may be 6 to 10 times as much as the fat.

In order to maintain health and vigor, and to provide for tissue repair, the individual must be in nitrogen equilibrium. Since nitrogen is derivable only from the protein in food, an adequate supply of this constituent is of prime importance. The amount necessary has been found to be between 0.66 and 1.5 gms. per kilo body weight, and a good working figure is to make the diet contain 1 gm. of protein per kilo. In growing children or in emaciated persons, it should be higher, say 2.0 to 2.5 gms. per kilo body weight (1 gm. per pound). The amounts of carbohydrate and fat which should make up the balance of calories must be adjusted in such a way as to prevent too great excess of fat, still keeping the carbohydrate ration within the individual's tolerance.

The diabetic diet of the past decade contained a large excess of fat in proportion to the carbohydrate. This excess of fat in moderately severe diabetes can be reduced by the use of insulin, which permits a somewhat higher carbohydrate ration. Most individuals do not find a diet containing less than 100 gms. of carbohydrate very palatable, and where economic or other limiting factors do not interfere, a carbohydrate tolerance of less than 80 to 100 gms. justifies the use of insulin.

The method at present used in the Presbyterian Hospital is to give the patient 1 gm. of protein per kilo body weight, unless the undernutrition is very marked indeed, and an equal amount of carbohydrate, making up by addition of fat a caloric intake of 25 to 30 calories per kilo body weight. Should the urine become sugar-free on this diet, it is wise to ascertain the full amount of carbohydrate which can be taken without insulin by gradually increasing the amount of this foodstuff 10 gms. per day until sugar appears in the urine. If the amount of carbohydrate reaches 150 to 200 gms. before glycosuria develops, the administration of insulin is considered not to be indicated.

Treatment with Insulin. Should the urine fail to become sugar-free after one or two days of the low diet as outlined above, an amount of insulin may be given corresponding numerically in units to one quarter of the total twenty-four-hour sugar excretion in grams. One-third of this amount should be given ten to fifteen minutes before each of the three meals. Since the amount of carbohydrate burned per unit of insulin is from 1 to 4 gms., the amount varying in the individual case, this dosage is perfectly safe. During the preliminary period, it is well to make the carbohydrate ration for each of the three meals about equal. Should this amount of insulin fail to make the urine sugar-free (and it generally does fail because the dosage has purposely been made low to avoid likelihood of shock) the insulin is gradually increased until the urine becomes sugar and acetone-body-free. Diet and insulin may then be raised step by step, always aiming to keep the urine sugar-free, until an adequate and satisfactory caloric intake is reached. There are very few individuals, except young children, in whom this will be found to be less than 2000 calories. No hard and fast rules regarding caloric intake can or should be laid down. Every patient presents a new problem which requires individual study. Some people live better, work better and are happier on high diets and more liberal allowance of body weight than others, and there is no reason why, within limits, this optimum should not be attained and maintained. It should be remmebered, however, that life-insurance statistics have demonstrated that people who are slightly under the ideal body weight live longer than those who are over this weight, and there are good grounds for believing that the diabetic is in the best condition for combating the disease when he is not over-nourished. Furthermore, clinical observation indicates that the patient is much better able to combat infections, and particularly acidosis, when he is not over-fat. Certainly one thing is pretty well demonstrated, namely, that excessive over-nutrition must be scrupulously avoided. A good rough practical rule for ascertaining the ideal weight of any given adult individual is to take as a proper weight 110 lbs. for a person whose height is 5 ft., and to add 5½ lbs. for each additional inch above that height.

Finally, a word may be in order regarding the amount of carbohydrate upon which the patient should be maintained. In any but the mildest cases, there must inevitably be a material restriction below the amount taken by the average normal individual of the same height and weight. At best, the amount should probably never exceed 200 gms. and there are many severe diabetics to whom it is best to give only 100 gms. Most persons will find that a diet which entails still further restriction is unpalatable.

CHAPTER V

PRACTICAL PROBLEMS IN THE USE OF INSULIN

In the last chapter we discussed in general outline the method which has been found useful in rendering and maintaining the urine sugar-free on a sufficient diet with the aid of insulin. The plan which has been recommended, particularly during the preliminary period, is to divide the three meals as to their carbohydrate content as equally as possible, and to give the total daily ration of insulin in three equal doses, one before each meal.

Occasionally, in the severe case, it is found that the evening dose of insulin, when given just before a rather early supper, does not suffice to keep the urine sugar-free throughout the night. In a number of these instances the expedient of administering a dose late at night has been utilized. Obviously this is not a practical nor a safe permanent arrangement, particularly without nursing or hospital care. The difficulty can best be overcome by giving the supper and the insulin preceding it as late as possible in the evening. In especially stubborn cases the carbohydrate content of this meal should be reduced. The largest dose of insulin is most commonly required before breakfast. A lesser amount is usually required at supper time, and least of all at luncheon. Where the case is not of great severity, the urine may be kept sugar-free with only two injections a day, morning and evening. Some patients indeed prefer taking food but twice a day, in order to avoid the extra injection. Where only few units are required, even a single dose before breakfast may be found sufficient. We have found, however, that a single daily dose is neither adequate nor advisable except in very mild cases; and it is often just these patients who do quite as well under dietary regulation alone.

A word of caution should always be given to the patient not to delay too long after the insulin injection before taking food, as otherwise there is danger of shock. Determination of blood sugar may be of great help in giving early warning of danger from hypoglycemic shock. For the same reason that shock symptoms are more apt to appear in the late afternoon and evening the blood sugar is likely to be lowest at these periods and highest early in the morning, just the reverse of what was formerly the case under dietary treatment alone. While blood-sugar estimations on patients being treated with insulin are of no great prognostic significance, they are undoubtedly of great value in indicating at just what level the treatment is being maintained. Examples of this are given below. The blood sugar should be kept as near the normal level as is safe, and this can be done by the cautious addition of a unit or two of insulin at those times of day when the level is much higher than it should be.

The practical management of cases of diabetes may be best illustrated by a consideration of several representative cases.

The food and urine chart of Case I shows the method used in an adult patient with diabetes of moderate severity.

Case I. The patient was a man of thirty-five, weighing 70 kg., (154 lbs.) and he was 179 cm. (71.5 in.) in height. According to the rule given at the end of the last chapter, he should have weighed $110 + [(71.5 - 60) \times 5.5] = 173$ lbs. He was, therefore, 19 lbs. under ideal weight. Before onset of his disease eighteen months ago, he weighed 196 lbs.; so his weight on admission indicates a loss of 42 lbs. in eighteen months. He was given a diet consisting of 1 gm. of protein per kg. body weight, an equal amount of carbohydrate, and sufficient fat to make up 23 calories per kg. body weight. On the third day of this preliminary diet he excreted 61.6 gms. of glucose. Since 1 unit of insulin has not been found to cause the utilization of over 4 gms. of carbohydrate, the initial dosage of 9 units which he was given was quite within the margin of safety. In fact it was only with 17 units on the seventh day that his urine became sugar-free.

For unknown reasons patients being treated with insulin may excrete small amounts of sugar at certain periods of the day, and be free from glycosuria during the other periods. It is then advisable to increase the dosage at those particular periods during which glycosuria is present. For this reason it is advisable to collect separately, the urine excreted from the time of arising until just before lunch, in a second lot, that excreted between lunch and supper, and finally that between supper and the following morning. These three specimens will then indicate the effect of each of the three doses of insulin. Examination of such divided specimens was made on the seventh and fourteenth days. As may be seen from the chart, the addition of one or two units to the dose administered during the periods in which glycosuria was discovered, promptly rendered the urine sugar-free. Often it will be found that the dose at one particular time is more than is actually needed, and that if one or two units are taken off this dose and added to the dose administered in the period in which sugar appears, the urine for the whole day will become free of sugar.

During the month following this patient's discharge it was possible to lower his insulin dosage from 21 to 11 units, keeping him on the same diet and still free from glycosuria. As he is able to carry on his work with reasonable vigor, it does not seem necessary to give more food with correspondingly larger doses of insulin. The fact that it is now possible to get on with two small doses daily is to him a source of great satisfaction, and he feels that his diet is quite adequate.

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Case I.—Male. Age 35.
Married. Clerk.

Date	Urine 24 hrs. c.c.	Ht. cm. / Wt. kg.	Food				Urine				Blood		Insulin				Remarks
			COH.	Prot.	Fat	Total calories	Ferric chloride	Nitroprusside	Sugar per cent	Sugar total gms.	Sugar	CO_2 vol. per cent	M	N	E	Total	
Day in hospital 1	2000	179 / 70	70	70	110	1550	+++	+++	4.8	96.0	3.1	44.2	..	..	..	..	
2	1900	......	70	70	110	1550	++	+++	3.7	70.4	.....	......	..	..	..	..	
3	2200	......	70	70	110	1550	+	++	2.8	61.6	.....	......	..	..	..	..	
4	2350	......	70	70	110	1550	0	0	1.5	35.2	.....	......	3	3	3	9	
5	1860	......	70	70	110	1550	0	0	0.8	14.9	.....	......	5	5	5	15	
6	1550	......	70	70	110	1550	0	0	0.7	10.9	.....	......	5	5	5	15	
7	1680	......	70	70	110	1550	0	0	—	3.0	.....	......	6	5	6	17	*Urine partition* 600 0.5 3.0; 550 0.0 0.0; 530 0.0 0.0; 3.0. Slight adjustment of the insulin dosage has rendered urine free from sugar
8	1600	......	70	70	110	1550	0	0	0	0	.....	......	7	5	6	18	
9	2100	......	70	70	140	1820	0	0	0	0	2.54	......	7	5	6	18	
10	1850	......	70	70	170	2090	0	0	±	—	.....	......	7	5	6	18	
11	1930	......	70	70	200	2360	0	0	0	0	.....	......	7	5	6	18	

12	1780	......	80	70	200	2400	0	0	±	0	.....	......	7	5	6	18	
13	1900	......	80	80	200	2440	0	0	0	0	.....	......	7	5	6	18	
14	1750	......	90	80	200	2480	0	0	0.4	7.4	.....	......	7	5	6	18	*Urine partition* 700 0.7 4.9 550 0.0 0.0 500 0.5 2.5 7.4 The carbohydrate increase in the food produced excretions of sugar which has been counteracted by insulin increase
15	2200	......	90	80	200	2480	0	0	±	0	2.31	......	9	5	7	21	
16	2250	......	90	80	230	2780	0	±	0	0	.....	......	9	5	7	21	
17	1800	70.5	90	80	250	3000	0	0	0	0	.....	......	9	5	7	21	
First week of discharge		70.7	90	80	250	3000	0	0	0	0	1.38	......	9	5	7	21	
Second week of discharge		71.2	90	80	250	3000	0	0	0	0	.....	......	8	4	6	18	Reduction of insulin dosage
Third week of discharge		71.5	90	80	250	3000	0	0	0	0	.....	......	6	3	5	14	
Fourth week of discharge		71.4	90	80	250	3000	0	0	±	......	1.48	......	6	0	5	11	Further reduction of dosage has raised level of blood sugar though urine is still sugar-free. It therefore seems advisable not to reduce it further.

Case II. This patient was a boy of thirteen suffering from acute diabetes. He entered the hospital three months after his illness was discovered. He was somewhat undernourished but not emaciated. He was suffering from a moderate acidosis. As may be seen from the chart, he was at once given a diet, and on the fifth day his urine was free from sugar. As this diet contained only 900 calories and the glycosuria had responded so readily, it seemed safe and feasible to increase the diet rapidly. On the fourteenth day of his stay in the hospital, he was sugar-free on a diet of 1880 calories, with 12 units of insulin, and, by keeping the noon meal rather low, it was necessary to give only two daily doses of insulin, morning and evening. The somewhat erratic course of the blood sugar, shown on the chart, indicates that the blood-sugar level may be considered the resultant effect of three more or less opposing influences—amount of diet, dosage of insulin and carbohydrate tolerance. The prompt and gratifying improvement continued, and on discharge it was found that he could be maintained sugar-free without insulin on a diet of 2220 calories with a satisfactory increase in weight and with marked clinical improvement. This case illustrates the common rapid and satisfactory response of young persons with early diabetes to insulin therapy. One cannot predict the ultimate outcome, but it would seem wise to maintain this patient as long as possible without insulin, observing him carefully at bi-weekly intervals. Probably the eventual course of the disease will be the same as that seen in other juvenile diabetics: the carbohydrate tolerance will fall and insulin will have to be resumed within the next few months.

Case III. A man of forty-five, with diabetes of several years' standing, entered the hospital for treatment. Lack of proper care, both hygienic and dietary, had resulted, a few days before admission, in the onset of diabetic coma. Before admission he had been given subcutaneous injections of glucose and insulin in large amounts, and orange-juice and sugar by mouth. On admission his blood sugar was 4.65 gms. per liter and his blood bicarbonate 11.8 vol. per cent. With the use of large amounts of insulin, sodium bicarbonate intravenously and fluids, he was out of danger in the course of the next forty-eight hours. The further course of his treatment is shown on the accompanying chart. It will be noted that he now requires comparatively small doses of insulin, though this reduced dosage became effective only after several weeks of treatment. The necessity for large doses of insulin over considerable periods after severe acidosis seems to be common, and the pancreatic function usually returns to its former state only after a prolonged rest.

Case IV. This was an obese woman (weighing 210 lbs. at onset of the disease) who developed glycosuria at the age of fifty-six years, and on admission, at 62, weighed 114 lbs. Gradual and

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CASE II.—Male. Age 13.
Schoolboy.

Date	Urine 24 hrs. c.c.	Ht., cm. / Wt., kg.	Food: COH.	Food: Prot.	Food: Fat	Food: Total calories	Urine: Ferric chloride	Urine: Nitroprusside	Urine: Sugar per cent	Urine: Sugar total gms.	Blood: Sugar	Blood: CO_2 vol. per cent	Insulin: M	Insulin: N	Insulin: E	Insulin: Total	Remarks
Day in hospital 1	1440	27.4	25	27	100	1108	++++	++++	2.9	42.3	2.41	42.4	..	..	..	......	Moderately severe acidosis as indicated by blood and urine findings
2	1500	......	25	27	100	1108	++++	++++	2.4	35.6	....	....	..	..	..	....	
3	1230	......	25	27	100	1108	++++	++++	2.0	24.6	....	....	..	..	..	....	
4	915	......	20	27	80	1108	++++	++++	0.9	8.2	....	....	..	..	..	....	
5	1440	......	20	27	80	908	+	+++	±	....	....	....	..	..	..	....	
6	940	27.0	20	27	80	908	+	++	±	....	....	....	3	0	3	6	
7	990	....	26	30	80	944	+	+	0.0	0.0	0.89	....	3	0	3	6	
8	1400	....	35	35	140	1540	+	++	0.0	0.0	....	....	3	0	3	6	
9	1600	....	55	55	140	1980	0	+	0.0	0.0	....	....	3	0	3	6	
10	1990	....	80	55	140	2080	0	±	0.4	7.6	....	....	3	0	3	6	
11	1880	....	80	55	140	2080	0	0	0.8	15.4	....	....	3	3	3	9	
12	1260	27.2	80	55	140	2080	0	0	0.4	5.2	2.65	....	5	3	4	12	
13	1420	....	80	55	140	2080	0	0	±	....	....	....	5	3	4	12	
14	1860	....	90	65	140	1880	0	0	±	....	....	....	6	0	6	12	The noon meal was here reduced in carbohydrate content. The excess was added to the breakfast and supper

15	1280	....	100	70	150	2030	0	0	±	....	1.58	....	6	0	6	12	
After 4 days																	
19	1180	....	100	70	160	2120	0	0	0	0	1.13	....	6	0	6	12	
After 7 days																	
26	1720	28.0	100	70	160	2120	0	0	0	0	....	....	6	0	6	12	
27	1230	....	100	70	160	2120	0	0	0	0	....	....	6	0	5	11	Reduction in insulin dosage was commenced
28	1840	....	100	70	160	2120	0	0	0	0	1.19	....	5	0	5	10	
29	1360	....	100	70	160	2120	0	0	0	0	....	....	5	0	4	9	
30	1000	....	100	70	160	2120	0	0	0	0	....	....	4	0	4	8	
31	1050	28.7	100	70	160	2120	0	0	0	0	....	....	4	0	3	7	
32	2000	....	100	70	160	2120	0	0	0	0	....	....	3	0	3	6	
33	1725	....	100	70	160	2120	0	0	0	0	....	....	3	0	2	5	
34	2000	....	100	70	160	1220	0	0	0	0	....	....	2	0	2	4	
35	1780	....	100	70	160	2120	0	0	0	0	1.17	....	2	0	0	2	The blood-sugar level on this day indicates that the reduction of insulin has not caused a heaping up in the blood
36	1625	29.5	100	70	160	2120	0	0	0	0	....	....	0	0	0	0	
On this same diet for two weeks before discharge																	
		30.2															

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Case III.—Male. Age 45.
Married. Sedentary occupation.

Date	Urine 24 hrs. c.c.	Ht., cm. / Wt., kg.	Food				Urine				Blood		Insulin				Remarks
			COH.	Prot.	Fat	Total calories	Ferric chloride	Nitroprusside	Sugar per cent	Sugar total gms.	Sugar	CO₂ vol. per cent	M	N	E	Total	
Day in hospital 1	3490	....	30	30	30	530	....	....	3.2	111.7	....	..	..	..	..	..	
2	4820	....	30	30	30	530	....	....	1.1	52.0	4.16	43	..	..	..	..	
3	1480	....	50	30	30	590	++	++	3.3	48.8	....	..	..	..	..	..	
4	510	....	50	30	30	590	++	++	1.6	8.4	....	..	..	..	..	..	*Urine partition*
5	1540	....	50	40	80	1080	++	++	...	27.3	2.86	53	15	15	15	45	560 c.c., 8.6 gm. sugar, breakfast to lunch; 240 c.c., 8.4 gm. sugar, lunch to supper; 740 c.c., 10.3 gm. sugar, supper to breakfast
6	1460	....	50	40	100	1260	+	+	....	10.2	....	..	15	15	15	45	
7	2220	....	50	40	100	1260	+	+	...	4.3	....	..	15	15	15	45	*Urine partition* 730 c.c., 4.3 gm. sugar, breakfast to lunch; 740 c.c. 0 gm. sugar, lunch to supper; 730 c.c. 0 gm. sugar, supper to breakfast. Indicated advisability of breaking dosage at noon increasing the morning dosage. This maneuver was successful

8	1840	55.9	50	40	100	1260	+	++	±	....	....	..	20	10	15	45	
9	1610	....	50	40	100	1260	+	+	±	....	....	..	20	10	15	45	
10	2340	....	50	60	120	1520	0	+	±	....	....	..	20	10	15	45	
11	2840	56.4	50	70	130	1650	0	+	±	.....	2.09	..	20	10	15	45	The blood-sugar level to-day indicates a verysatisfactory drop toward normal on a constant diet and dosage of insulin
12	2470	....	50	70	130	1650	0	0	±	.....	....	..	20	10	15	45	
13	1200	....	60	70	140	1780	+	+	±	.....	....	..	20	10	15	45	
14	940	....	70	70	150	1910	0	±	±	.....	....	..	20	10	15	45	
15	1680	56.6	70	80	160	2040	0	0	0	.....	....	..	20	10	15	45	
							First week after discharge										
22	2375	56.4	70	80	160	2040	0	0	0	0	....	..	20	10	15	45	
							Second week after discharge										
29	1850	....	70	80	160	2040	0	0	0	0	....	..	18	8	12	38	Gradual reduction or insulin dosage
							Third week after discharge										
36	1700	55.8	70	80	160	2040	0	0	0	0	....	..	14	8	8	30	
							Fourth week after discharge										
43	2075	....	70	80	160	2040	0	0	0	0	1.90	..	8	6	8	22	
							Fifth week after discharge										
50	1800	....	70	80	160	2040	0	....	0	0	....	..	7	5	7	19	
							Sixth week after discharge										
57	1950	56.7	70	80	160	2040	0	....	0	0	1.75	..	7	5	7	19	

CASE IV.—Female. Age 62.
Married. Housewife.

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Date	Urine 24 hrs. c.c.	Ht.	Food				Urine				Blood		Insulin				Remarks
		Wt.	COH.	Prot.	Fat	Total Calories	Ferric chloride	Nitroprusside	Sugar per cent	Sugar total gms.	Sugar	CO_2 vol. per cent	M	N	E	Total	
Day in hospital																	
1	1300	50.9	30	30	30	530	++++	++++	2.32	30.2	3.08	37.4	..	..	..	..	Rather severe acidosis
2	920	....	30	30	30	530	++++	++++	2.83	26.0	....	....	3	3	3	9	
3	1420	....	30	30	30	530	+++	+++	1.75	24.9	....	....	3	3	3	9	
4	1000	....	50	50	50	650	+++	++++	3.2	32.0	....	....	7	6	7	20	
5	1360	....	50	50	50	650	++	++	0.98	13.3	....	....	7	6	7	20	
6	1450	....	50	50	50	650	+	+	±	±	....	....	9	9	9	27	
7	1760	....	50	50	50	650	0	0	±	±	1.94	....	9	9	9	27	
8	1480	....	60	50	70	1070	0	0	±	....	....	....	9	9	9	27	
9	2340	....	70	50	90	1290	0	0	±	....	....	....	9	9	9	27	
10	1530	....	70	50	110	1470	0	0	±	....	....	....	9	9	9	27	
11	1640	....	70	60	120	1600	0	0	±	....	....	....	9	9	9	27	
12	1320	....	70	60	140	1780	0	0	0	0	....	....	9	9	9	27	
13	1440	....	70	60	155	1915	0	0	±	....	....	....	9	9	9	27	
14	1320	51.3	70	60	170	2050	0	0	0	0	....	....	9	9	9	27	
15	1500	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	

16	1540	51.7	70	60	200	2320	0	0	0	0	1.98	....	9	9	9	27	Blood sugar being maintained at a constant level on a much higher diet than ten days ago
17	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
18	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
19	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
20	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
21	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
22	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
23	....	....	70	60	200	2320	0	0	0	0	....	....	9	9	9	27	
24	....	51.6	70	60	200	2320	0	0	0	0	1.84	....	9	9	9	27	Constant blood-sugar level indicates a balance between diet and insulin dosage

progressive loss of weight and weakness occurred during this period. Her diet had been somewhat restricted as to sweets and starchy foods, but no attempt had ever been made to keep her urine free from sugar. She had suffered from severe pruritus, and was an example of rather mild diabetes in an elderly person, slowly progressing without treatment.

On admission she showed a fairly severe acidosis. She was placed on a diet of 30 gms. of carbohydrate, 30 gms. of protein and 30 gms. of fat, and as the urinary excretion of sugar averaged 20 to 30 gms. in 24 hours, 9 units of insulin were given. Diet and insulin were raised, the former to 70 gms. carbohydrate, 60 gms. protein, and 200 gms. fat; the latter to 27 units per day. The urine became sugar-free and the blood sugar fell markedly on this dosage.

This is an example of an unusually prompt response to insulin in an elderly individual whose diabetes was of comparatively long standing. In general it is found that the longer the glycosuria has been present, particularly if the patient has passed middle life, the more difficult it is to render the urine sugar-free, and the larger the number of units which are required for this purpose. This patient also showed very satisfactory relief from the symptoms of pruritus and neuritis coincident with the disappearance of glycosuria and hypoglycemia.

Instructions to the Patient. During the first weeks of treatment, or until the patient has been placed on an adequate diet and dosage of insulin, it is advisable for the physician himself to examine the daily mixed twenty-four-hour sample of urine. The patient should be instructed to bring in the total amount of urine excreted in twenty-four hours; or, if his trustworthiness may be relied upon, to bring in only a few ounces of the mixed specimen. Proper instructions must of course be given as to collection and preservation. Later only an occasional weekly or bi-weekly examination by the physician may be necessary; but we feel it to be important for the patient himself to do a daily qualitative test for sugar and a ferric chloride test for diacetic acid. The results of these tests, as well as the records of the daily volume of urine, the daily dosage of insulin and the diet consumed, may be recorded on a convenient form of chart and brought to the physician at each regular visit.

Instruction in the administration of insulin should be given to the patient and also to at least one relative. The patient should then practice upon himself under observation until it is quite certain that both the technique of using the hypodermic and the proper measurement of the dosage are well understood.

Outfits for the use of patients receiving insulin can readily be made up by any druggist. The supplies which are used by patients at the Presbyterian Hospital can be obtained at a cost of $6.00. They consist of the following:

A 1-liter measuring glass.

A 1- or 2-c.c. Luer tuberculin syringe.

Two large needles for withdrawing insulin from the vial.

One dozen hypodermic needles.

A basin in which to sterilize syringe and needles by boiling.

A pair of steel forceps for handling needles.

A packet of sterile sponges.

A test-tube holder and Pyrex test-tubes.

One can of Sterno.

One medicine dropper.

It is very useful to have Luer syringes graduated only in cubic centimeters, as the markings in minims are often found to be very confusing to patients.

In instructing patients who are receiving insulin, stress must be laid on the importance of care and accuracy in every detail of treatment. With proper instruction, stimulation and encouragement, even individuals otherwise careless and untidy may learn to give insulin properly and to make the necessary examinations.

It is advisable in all cases to instruct the patient or a member of the family concerning hypoglycemic shock, so that if symptoms occur they may be promptly recognized and treated. Many patients find it useful to carry about with them, for use in case of emergency, small powders containing a few grams of cane-sugar or glucose, or a few pieces of candy.

In conclusion, the patient should be told of the danger of the sudden withdrawal of insulin treatments, especially when the dosage is large. One striking example of the disastrous effects which may follow sudden stoppage recently occurred in this hospital. The withdrawal for one day of the insulin ration (55 units) in an extremely severe juvenile diabetic ten years old, resulted, within eight hours, in the development of profound coma, from which the patient was revived with great difficulty. Changes in the dosage of insulin, either increase or reduction, should be made slowly and cautiously, and both patient and physician must always be on the lookout for symptoms of untoward significance.

CHAPTER VI

THE TREATMENT OF ACIDOSIS AND COMA WITH THE AID OF INSULIN

The most important complication of diabetes, one which should ever be in the mind of the physician and nurse, is acidosis and its possible sequel, diabetic coma.

ACIDOSIS

The symptoms of this condition may vary from the mere irritability, mental torpor and lessened alertness which are present in chronic low-grade acidosis, to the hyperpnea, drowsiness and headache in more severe intoxication, or the nausea and vomiting which presage the onset of diabetic coma. The slightest unfavorable or unusual sign should suggest acidosis. Of special importance in the severe cases are gastrointestinal symptoms—loss of appetite or nausea, unexplained diarrhea, epigastric pain. Complaints of difficulty in breathing, even before it becomes quite obvious in the well-known Kussmaul type of breathing, or hyperpnea, are not uncommon, and this symptom must be constantly kept in mind. The first symptoms may be cramps, headache, or dimness of vision or other eye symptoms. Later comes drowsiness, often interrupted by periods of restlessness, and finally actual coma.

The conditions most commonly responsible for the sudden occurrence of acidosis in patients previously doing well are first, infections, and second, the abrupt ingestion of large amounts of food. The onset of an acute disease has been the responsible condition in many instances, and the author has observed one young woman in whom menstruation on three occasions was accompanied by sudden and severe acidosis, the last attack terminating fatally.

The clinical picture of acidosis is quite clearly defined, and the diagnosis is not difficult. On observing any of the above-mentioned symptoms it is the first duty of the physician to test the urine for sugar and to test for acetone bodies by means of the ferric chloride or nitro-prusside reactions. Should these tests be positive and facilities for determining the plasma bicarbonate capacity be available, a sample of blood should be taken and this determination made, as it offers a quick and certain method for ascertaining the extent and severity of the acidosis. The odor of the breath is of considerable diagnostic importance, for acetone is volatile, and when present in large amounts in the blood, is excreted in the expired air. But unless the odor is very marked, it is difficult to detect. Even experienced observers vary greatly in their ability to recognize it.

Treatment. The aims in treatment of diabetic acidosis are the prevention of the formation of acetone bodies, their neutralization when once formed, and their rapid excretion. To accomplish the first result fats are withdrawn from the diet, and insulin is given. The insulin causes carbohydrate to be burned and thus stimulates complete fat catabolism. Second, soda bicarbonate is given to neutralize the abnormally formed acids, and finally, the excretion of the acetone bodies is aided by the administration of large quantities of fluid.

Very frequently the milder degrees of acidosis can be counteracted by giving large amounts of fluids by mouth and by restriction of the fats. The latter measure should be taken at once in all suspected cases, because the principal source of the acetone bodies in the food is the fat. The patient with diabetes who is fat is difficult to treat because he possesses in his body tissues a large supply of this potentially dangerous material.

Should the laboratory examinations or the clinical condition of the patient indicate advanced acidosis, he should, if possible, be removed to a hospital because adequate care in the home is very difficult.

General Measures. In commencing treatment, particular attention should be directed to the maintenance of body heat. These patients, especially those who are undernourished, are frequently cold and very restless. The constant presence of an attendant is needed in such cases to quiet them and keep them covered. All patients with severe acidosis should at once receive a thorough and efficient enema; impacted feces should be removed if present, and a colon irrigation employed if necessary. Should there be any question of the presence of undigested material in the stomach, gastric lavage should be performed.

ADMINISTRATION OF INSULIN. The diagnosis of diabetic coma should always be carefully confirmed before one administers large doses of insulin to unconscious persons. Individuals with diabetic acidosis usually show large amounts of acetone bodies, as well as sugar in the urine. These findings in an unconscious individual, with Kussmaul breathing, justify the diagnosis and institution of insulin therapy. However, it must be remembered that acetone-body acidosis occurs in other conditions than diabetes, particularly in young children, and we have no good grounds for believing that insulin is indicated in these latter cases.

Should the blood sugar be high, a large dose of insulin may be given at once intravenously. Depending on the size of the individual and the elevation of the blood sugar, this dose may be 20 to 60 units. The insulin may be given undiluted, or preferably, mixed in the syringe with a few cubic centimeters of saline solution. So far as known, insulin does not act more rapidly when given intravenously than when given subcutaneously.

There is, however, this advantage: absorption is presumably at once complete, and when large doses are being given frequently, there is less danger of causing hypoglycemic shock through cumulative action. After the first intravenous dose of insulin the blood sugar should be tested at intervals of three hours. One then has a definite guide as to the needs for further insulin. On the other hand, if it is desired to give the first large dose of insulin subcutaneously, it is advisable to give it with glucose (a 5 or 10 per cent solution of the latter to the amount of 500 to 1500 c.c.). Insulin is directly mixed in this solution in the proportion of one unit to one gram of glucose. Persons in severe acidosis or coma, especially when this is complicated by infections, tolerate large doses of insulin, and rarely does insulin cause the burning of glucose in a higher ratio than one unit of insulin to one gram of glucose.

Laboratory Examinations. When laboratory aids for the study of the blood are not available, reliance must be placed on the frequent testing of the urinary specimens. When the urine is voided frequently and in large amounts and where kidney function is unimpaired, examination of the urine supplies a reliable guide to treatment. If sufficiently numerous urinary specimens are not forthcoming, one or several catheterizations, as needed, should be performed without hesitation. For above all is it essential that the patient, particularly if unconscious, should not be subjected, by too vigorous and uncontrolled treatment, to the danger of hypoglycemic shock.

In case the blood sugar or the urinary sugar does not show a decided tendency to fall after the first intravenous dose of insulin, a second dose of 20 to 40 units may be given intravenously and this again followed after three hours by a blood-sugar estimation, or urinary examination; and if again indicated, the dose may be further repeated. Should either blood sugar or urinary sugar drop decidedly, however, one must proceed exceedingly cautiously with the further use of insulin. The amounts required to bring patients out of severe acidosis or coma not infrequently range between 100 and 150 units per twenty-four hours, and may be considerably greater. With the use of such massive doses the greatest caution must be observed to guard against hypoglycemic shock.

Administration of Fluids. Many of these patients are very desiccated, and tend to void very little. Since the excretion of urine in large amounts is of great importance for the elimination of acetone bodies, the amount of fluid given should be large; a satisfactory total for the twenty-four hours is about 10 per cent of the body weight. On the other hand, the administration of much over 8 to 10 liters of fluid in twenty-four hours is usually attended by great discomfort and is not advised.

Frequently, when the attendant is instructed to force fluids upon a patient, he gives large amounts at one time—four, five or six glasses, often very cold, and the result is that the stomach suddenly becomes greatly distended and vomiting is induced. The administration of fluids by mouth should be in small amounts, frequently repeated, 50 to 75 c.c. every fifteen minutes. In this way several liters of fluid can often be administered in the course of from twelve to twenty-four hours. Ice water should not be given, especially if the patient is cold.

Administration of Sodium Bicarbonate. Many arguments have been given for and against the use of sodium bicarbonate. The present opinion seems to be that it has a very definite place in the therapy of acidosis and coma. Particularly is it useful in relieving Kussmaul breathing and the early symptoms of drowsiness, although its use alone is seldom long effective. Like every other drug, it can be abused, and proper discretion must be employed in its use. The urine of the normal individual usually becomes alkaline with 4 to 5 gms. of soda given by mouth; and with large amounts the danger of producing alkalosis, with symptoms of tetany, is a real one. However, it is not of serious moment in severe acidosis, for the usual case will tolerate comparatively large quantities of the salt. In most instances 25 gms. of soda administered intravenously are sufficient to alleviate the acidosis until insulin begins to liberate alkali by the destruction of acetone bodies. If intravenous therapy is not practical, 5 to 10 gms.

of bicarbonate may be given every hour by mouth and by rectum until a limit of 50 gms. has been reached. After this, further use of soda for a period of 8 hours is unwise unless the blood bicarbonate level is distinctly below normal.

Because of their antiketogenic action, orange-juice and other fruit juices may well be given. At the slightest indication of nausea, it is well to stop oral administration of all fluids for a time, and particularly soda bicarbonate, because vomiting in diabetic acidosis is a bad prognostic sign.

Rectal Medication. Should the administration of sufficient fluid and medicine by mouth fail to be well tolerated, the rectal route may be employed. Perhaps the simplest and most effective way to administer fluids by rectum is to introduce, by means of a small tube and funnel, from 150 to 250 c.c., at intervals from one to four hours. With children the buttocks may be strapped together, but it is surprising how well fluids are retained without aid. The Murphy drip usually requires constant attention and the fluid is not, as a rule, much better retained. Several liters of fluid can be given through the rectum in twenty-four hours. Tap water, normal saline, glucose in 5 per cent solution or soda bicarbonate in 2 per cent solution may be used for this purpose.

Subcutaneous and Intravenous Infusion. Failing adequate absorption of fluids by mouth and by rectum, recourse must be had to subcutaneous clysis or intravenous infusion. For subcutaneous use, glucose and saline solutions may be employed. The use of soda bicarbonate is not advisable, on account of its liability to irritate the tissues and produce abscesses. Intravenous infusions of soda bicarbonate, glucose and saline solutions may readily be made. The use of amounts of fluid exceeding 700 to 1000 c.c. at a time should be avoided, and they should be injected very slowly. If soda bicarbonate is given the concentration should be from 4 to 5 per cent, and glucose should be administered in concentrations of 5 or possibly 10 per cent.

Other Measures. The use of other drugs in diabetic coma is less frequently indicated. Caffeine may be given by mouth or hypodermically, but its use is not often indicated. A very effective method of administering caffeine is the use of warm strong coffee by rectum. Digitalis is indicated in the same conditions in which it would be used elsewhere, that is, where there are signs of a failing heart or circulation.

Treatment of Infections. The effect of infections of all sorts upon sugar tolerance has long been known, and it has now been found that infections have a paralyzing effect upon the action of insulin as well. Prognosis in acidosis or in coma is rendered much worse by the presence of infections and their presence should be carefully searched for in such patients. Careful examinations of the ears, mastoid regions, accessory sinuses, nose and throat, chest, of the urine for pus and blood, and of the body surfaces for superficial or deep abscesses or other types of infection should always be made at the earliest moment. Where pus is found drainage must be promptly established, and the serious condition of the patient usually warrants the taking of considerable surgical risk. The improvement in tolerance and in the effectiveness of the insulin injected is sometimes very striking after proper drainage is effected. It may be stated in this connection that in the absence of infection or other severe complication, every case of severe acidosis or coma treated in this hospital with the aid of insulin has recovered.

Administration of Food. Until fluids are well retained by mouth and consciousness completely restored, it is usually futile to try to give foodstuffs other than the materials above mentioned. One should begin very cautiously with fruit juices and sugar solutions, cereals with a little milk and sugar, well-cooked vegetables and other simple foods high in carbohydrate content. The use of fats should be started later and cautiously. In general, following severe acidosis and coma, a period of some days of under-nutrition is advisable, with careful attention to recurring symptoms of acidosis and with the end in view of keeping the urine free of sugar and acetone bodies by giving as large doses of insulin as are found necessary.

CHAPTER VII

THE COMPLICATIONS OF DIABETES

Surgical Complications. From the point of view of the internist, the most important complications in diabetes requiring a therapeutic decision are those involving surgery. Infections around the fingers and toes, and gangrene of the lower extremities are of particularly common occurrence. Diabetic gangrene is usually secondary to vascular disease. Before radical surgical procedures are employed, dietary and insulin treatment with the usual measures of elevation of the part, local heat and cleanliness should be tried, as the results from medical therapy are excellent in many cases. The importance of wearing properly fitting shoes and the avoidance and proper treatment of ingrowing toenails, bunions and the like, should be insisted upon.

As for the proper procedure where infections requiring surgical attention exist, the practitioner ought to be guided by a few general principles. There is no more contraindication to surgical operation in the diabetic patient than in the normal individual, or in the person suffering from any long-standing chronic disease, except that in the diabetic patient there exists the one grave possibility of initiating or rendering worse an acidosis. With the introduction of insulin, however, this danger has been very markedly diminished.

In case operation on a diabetic patient is considered necessary or advisable, it is safest, as a preliminary measure, to clear up any existing acidosis and render the urine sugar-free if time permits. But delay may be dangerous and the acidosis, if severe, may only be rendered worse by procrastination. The results with proper care and the use of insulin are so brilliant that operation should ordinarily be performed without hesitation if an emergency exists. The medical preparation in such a case involves the use of those general measures which have been discussed in the section on the treatment of acidosis and coma. Of great use in our experience has been the subcutaneous administration of glucose and insulin. However, in individuals whose diabetes is not severe, and in whom acidosis is very slight or non-existent, we feel that the best results are obtained by conservative measures, and that large doses of glucose and insulin and intravenous infusions of various types should not be employed. In these cases the important measures are the forcing of fluids, the withdrawal of fat from the diet, and, most important of all, rapid and thorough surgical treatment, consuming as little time as possible, and with the avoidance of unnecessary anesthetic.

For patients with diabetes, local anesthesia is the method of choice. For general anesthesia, nitrous oxide gas and oxygen appear to have least untoward effect. According to clinical experience, ether should ordinarily be avoided. Why this is so is not understood, but evidence of the apparent specific destructive action of ether on insulin has recently been found. It has been shown that rabbits under ether anesthesia can be given relatively huge doses of insulin without lowering of the blood sugar, or producing any of the other usual effects of insulin.

INFECTIONS OF THE RESPIRATORY TRACT. Persons sufferng from diabetes should guard themselves especially against exposure to individuals with respiratory infection, and during the cold weather should avoid contact with large groups of people. Once acquired, such infections should be treated with the greatest respect. It is probably wisest in all except the mildest cases to send patients with head colds or bronchitis to bed at once, to remain there until their infection has completely subsided. The onset of pneumonia is nearly always a grave event, and the development of acidosis in these cases is very frequently fatal.

The skin complications of diabetes are exceedingly common. Furunculosis should be vigorously treated. The common and usually exceedingly troublesome pruritus vulvae and ani respond very well to treatment of diabetes. Reduction of the blood sugar and the clearing up of glycosuria is usually at once effective. Carbuncles, particularly about the head, demand immediate surgical attention. A not uncommon and frequently very vexing complication is cellulitis often spreading from a superficial furuncle. If there is any question about the presence of pus, there should be no hesitancy in making thorough incision. The use of antiseptics having alcohol for a base is particularly useful in the treatment and prophylaxis of skin infections. Finally, all patients with diabetes should be warned to observe scrupulous cleanliness of the skin surfaces and to bathe frequently.

Gastrointestinal complications may be said to begin at the mouth and extend to the lower end of the intestinal tract. Diseases of the teeth are very common in diabetes and their detection and proper treatment must be insisted upon. Extensive and unnecessary dental surgery however, with the possibility of traumatic bone infection, should not be undertaken.

The dietary treatment of constipation, the almost universal complaint of the diabetic, is taken up in detail in Chapter VIII. The principal measures to be employed in treatment are the use of bulk, the ingestion of large amounts of fluid and the use of mineral oil and other laxatives if they are required. The introduction of bran cakes has greatly aided the treatment of constipation in diabetes, and because these cakes have been at times used to excess, there has recently been some tendency to discredit this form of treatment. It is important to pay attention to the proper dosage, that is, the number of bran cakes used at each meal, because excessive administration often results in large and undigested stools, gas in the intestines and other disagreeable features. In many cases, systematic abdominal massage and exercises should be used.

Diarrhea is much less frequent in diabetes than is constipation, but is usually more troublesome. Dietary measures are of importance, and the avoidance of opiates is recommended. Intractable diarrhea has been observed to follow insulin treatment in a number of cases and usually disappears when the drug is removed. We have observed it to occur when sudden changes in diet and large increases in insulin have been given; and we believe that it can be largely avoided by a more cautious and gradual administration of the extract and by the use in susceptible individuals of as low a dosage as possible. A not uncommon and troublesome symptom is pain over the lower esophagus and in the epigastrium, often described as burning in character. Proper attention to diet and to the constipation usually associated with it generally causes it to disappear, but often it is very resistant.

The *eyes* are often involved, for the same reasons that the eyes become affected in any of the long-standing diseases of nutrition. There is frequently found a reduction in the range of accommodation and the patient usually needs stronger glasses than his age would ordinarily call for. Soft cataract and the so-called diabetic retinitis are very frequent in patients who have had diabetes for over ten years. During the course of coma there may occur several highly interesting ocular conditions. Hypotonia of the eye-ball is very common, and where high grades of lipemia exist the retinal vessels appear, upon ophthalmoscopic examination, almost as though they were filled with milk. Amblyopia during severe acidosis is very common, also weakness of the muscles of accommodation. The latter condition often requires the attention of the oculist. All of these conditions associated with coma or severe acidosis usually disappear when the disease is again under control.

Of the *neurological complications* the most important from the therapeutic point of view is neuritis, commonly found in the extremities. The thighs, hip, calf and shoulder regions are frequently involved, especially in elderly persons with diabetes. This neuritis is often associated with arterial sclerosis and with localized circulatory disturbance. The ordinary methods of treatment for neuritis are indicated. Baking and massage are often very useful and an electric pad or a hot-water bag, particularly at night when the condition is often at its worst, may be found helpful. Aspirin, atophan and tolysin, in small doses, often afford great relief in this type of neuritis. Allusion should also be made to that type of neuritic pain apparently caused by injection of insulin into local nerve branches. This complication is not frequent, but does occur and it may last for some weeks. All the cases we have seen have eventually recovered. A condition which should be mentioned is that known as pseudotabes of diabetes with absent patellar reflexes, moderate grades of disturbed superficial sensations and at times fixed pupillary light reflexes.

The genitourinary complications of diabetes constitute an important group. In the female these are, first of all, disturbances of menstruation of every grade from mild irregularities and pain to absolute cessation of function. This latter condition usually occurs in younger women. We now have several patients who have suffered from amenorrhea for varying periods but whose function has been restored following dietary regulation and insulin. As is well known, conception is infrequent in diabetic women and the danger of miscarriage is great. In general it may be stated that from the point of view of the diabetes alone there is no reason why these pregnancies, if properly treated, should not successfully run to term without harm to the patient. The possibility of pyelitis in women should always be borne in mind, because this infection is a frequent cause of lowered sugar tolerance.

The disappearance of libido and of potentia are common in the elderly male, but also not infrequently in younger individuals, and these symptoms also have cleared up very satisfactorily with insulin. The occurrence of these complaints with the onset of diabetes should be borne in mind, because in highly strung individuals they are not so very infrequently the first symptoms of the onset of the disease.

Cardiorenal disease is often associated with diabetes, as it occurs during the later decades of life, at which time diabetes is also prevalent. The bearing of chronic arterial disease upon prognosis in diabetes is doubtless not good, but definite ill-effects of this condition upon the progress of diabetes are not usually demonstrable. In this connection it is of importance to remember that a high renal sugar threshold often occurs in hypertensive cardiovascular disease.

Tuberculosis has always been implicated as a common complication of diabetes, presumably because it attacks just those individuals showing the emaciation which diabetes produces. Of the various forms, pulmonary tuberculosis is very common, and perhaps the next most frequent form is intestinal tuberculosis. The use of insulin bids fair to render the prognosis in these cases very much more hopeful, because it will secure the proper assimilation of the adequate nourishing diets which have been found of so much importance in the treatment of tuberculosis.

The treatment of *syphilis* associated with diabetes has, in general, been very satisfactory, particularly as, with the use of insulin, luetic disease may be more actively treated.

In conclusion, some reference should be made to *glycosuria* which occurs without other evidence of diabetes. This constitutes a problem in diagnosis. The usual explanation of this condition—"*essential*" or "*renal*" *glycosuria*, as it is called—is that the kidney excretes sugar from a lower level of concentration in the blood than is normal. It is supposed that the metabolic mechanism is not affected and hence no symptoms appear. But until the exact mechanism of sugar excretion is known, this theory is not of great value. There are those who regard renal diabetes as of little or no significance, while again, others believe that every case of glycosuria, no matter what the accompanying blood-sugar level, is potentially diabetic. Where glycosuria persists, and is carefully differentiated from emotional causes, endocrine (especially thyroid) disease, alimentary causes and urinary sugars, other than glucose (usually pentose or lactose), the latter point of view is certainly the safest, and continued observation with the modern dietary regulation is indicated.

CHAPTER VIII

THE DIET OF THE DIABETIC

The dietary requirements of a diabetic do not differ materially from those of the normal individual. The nature of the disease, however, makes the satisfaction of these requirements somewhat difficult.

The diabetic patient needs the same kinds and amounts of proteins and salts as does the healthy individual. It is in providing for the remaining caloric requirement that the two diets differ most strikingly. Because of the rigid carbohydrate restrictions only the 5 and 10 per cent vegetables are allowable and the calories usually derived from breads, cereals, potatoes and sugars must be compensated for by the use of fat.

This unusually large amount of fat is likely to prove unpalatable unless introduced into the menu with care. The most palatable fats are butter, cream, olive oil, bacon fat, meat fats of other kinds and fat fish, such as salmon, mackerel and canned sardines. Because these foodstuffs are expensive, whereas carbohydrates are relatively cheap, it follows that the diet of a diabetic is more expensive than that of a normal individual.

Ordinary canned fruits are not to be recommended because of their sugar syrup, but fruits are obtainable commercially which are canned without sugar and sold under the name of pie fruits or pastry packs.

As a rule, the best success in feeding comes from judicious use of the ordinary foods in the correct amounts. Special diabetic foods are expensive and not always reliable. They should never be used unless their exact composition is known. They vary in carbohydrate content and their cost depends upon how free from starch they have been made.

Suggestions presented in a later chapter may prove helpful because special devices are necessary to make acceptable dishes when one is deprived of sugar and the ordinary thickening agents, such as flour and cornstarch. The diet need not be monotonous and the psychic effect of attractively prepared food need not be lost if a little ingenuity is exercised in its preparation.

Notwithstanding the fact that the diet is usually a bulky one, constipation among diabetics is quite prevalent. The patient should be impressed with the importance of daily evacuations. Regularity of meals and of habit plays an important part in the normal intestinal movements. Foods rich in cellulose, such as celery, string beans and cabbage; foods that ferment slightly, such as onions and cauliflower; and foods yielding vegetable acids, such as lemons, oranges, tomatoes and rhubarb may be included even in greatly restricted diets and will usually produce the desired results. If still more bulk is required, bran may be used in various ways, washed, if no addition to the food value of the diet is desired. It can be made into wafers and muffins or added to cereals and vegetables. Agar-agar serves the same purpose. Mineral oil which is indigestible and has no food value will often aid in the elimination of waste by making it softer and allowing it to pass more readily along the intestinal tract. This oil may be substituted for salad oil in mayonnaise or French dressing and served on vegetables. These materials and their uses are discussed more fully in the chapter on Recipes for Diabetics.

High fat diets sometimes disagree with patients, and diabetes may be complicated with diarrhea. In order to counteract this difficulty, all laxative articles should be avoided and only such foods allowed as are easily digested and nearly all absorbed. Vegetables should be chopped fine or puréed, salads should be omitted, and if the diet includes fruits they are best served cooked. Soft cooked eggs, boiled milk, toasted bread, scraped beef, chicken, and in severe cases even flour pastes may be used if the carbohydrate tolerance is sufficiently high, and it is advisable that the patient take his full quota. Condensed protein foods may be added to soups and broths to make up the protein allowance of the diet. If the patient is not taking insulin, a few days of restricted quantities of food may be most helpful, or it may be advisable to reduce both insulin dosage and diet.

CALCULATION OF THE DIET

As the treatment of diabetes is based on diet regulation it is necessary that patients be taught to use food tables and to calculate and weigh accurately, especially if they are using insulin. After weighing their food for a few weeks patients may select utensils from their own cupboards which conform to the size of their special portions, and use these exclusively. For weighing a good gram scale is necessary.[1] A standard half-pint measuring cup divided into quarters and thirds, and a standard teaspoon and tablespoon are necessary measuring equipment. The cup has a capacity of 8 oz. or 240 gms., if one ounce is reckoned as 30 gms., and contains 250 c.c. fluid measure. The teaspoon holds 5 c.c. and the tablespoon 15 c.c. or ½ fluid oz.

Food tables follow (Chap. X) that will aid in teaching calculation and a diet form is also appended. In this diet form the diet is calculated on the basis of customary servings. Its

[1] John Chatillon Sons, New York City, manufacture an accurate scale. The Hanson is another that can be obtained at any hospital supply house. The dial is movable so that the weight of the serving dishes need not be considered in the weighing process.

use is illustrated with a diet of 70 gms. carbohydrate, 70 gms. protein and 150 gms. fat. The right half of the form, (p. 149), is for the patient's use, and the remaining half (p. 148) is the physician's record. Both in this form and in the food tables the approximate measure of the serving is given, so that one not familiar with food weights may have a definite picture of the amounts he is using. All measurements are level. As often as is expedient, the foods are grouped according to their per cent composition and an average figure for the group is given. This simplifies the calculation tremendously and makes possible variation in the diet from day to day without recalculation.

It has been found practical, since there is no duplication of figures, to calculate the diet for the whole day and then divide it into the meals. It is wise, however, during the process of making selections, to think of the foods in relation to the meals. It is advantageous to plan the carbohydrate allowance first, as practically all carbohydrate foods except sugar contain small amounts of protein and fat, while most protein and fat foods are carbohydrate-free. Cream, milk, cheese, liver and oysters are exceptions. For a diet of 30 gms. carbohydrate, 30 gms. protein and 30 gms. fat, the following grams of food may be used:

	Gms. food	Gms. carbo-hydrate	Gms. protein	Gms. fat	Approx. measure
		30	30	30	
		—	—	—	
Rolled oats	10	7	2	1	2T
Milk	120	6	4	5	½C
5% veg.	400	16	4	0	2C
		—	—	—	
		29	10	6	

In filling the carbohydrate part of the prescription 10 gms. protein and 6 gms. fat have been used. This must be borne in mind in calculating the protein and fat allowances.

Egg	100	..	13	11	2
Lean meat	30	..	8	2	1 oz.
			..		
Butter	12	..		10	1 × 1 × ¾ in.
		—	—	—	
		29	31	29	

Total calories 501

This diet may be varied from day to day by choosing different vegetables from the 5 per cent group and different meats from the list of meats low in fat. Changes in the method of preparing and serving the food will also lend variety to the restricted diet. Further opportunity is offered in the following substitutions:

For—

	Gms. food	Gms. carbohydrate
Rolled oats	10	7
Substitute:		
10% fruit	90	8
10% vegetable	90	8
5% vegetable	200	8

To vary the protein these substitutions may be made:

For—

	Gms. food	Gms. protein	Gms. fat
Lean meat	30	8	2
Butter	12	..	10
Substitute:			
Medium fat meat	40	8	9
with			
Butter	5	..	4
Lean fresh fish	40	7	1
with			
Butter	14	..	12
Fat fish	30	7	5
with			
Butter	10	..	9
Cheese	30	8	10
with			
Butter	3	..	3

In a low diet such as the above, thrice-cooked vegetables, bran wafers, agar jelly and broth may be used as "fillers." It is possible to pad the diet to any bulk that seems wise. These "filler" materials are discussed in detail in a later chapter.

The food calculated for this diet can very easily be divided for the three meals so that the grams of carbohydrate, protein and fat and also grams of food are rather evenly distributed. Such a menu is given here.

Breakfast		*Lunch*		*Supper*	
Eggs	50 gms.	Lean meat	30 gms.	Clear broth	....
Rolled oats	10 gms.	5% vegetable	200 gms.	Egg	50 gms.
Milk	60 gms.	Bran wafer	....	5% vegetable	200 gms.
Bran wafer	....	Butter	4 gms.	Bran wafer	....
Butter	4 gms.	Milk	30 gms.	Butter	4 gms
Coffee	....	Tea	....	Milk	30 gms
				Tea	

The following table will illustrate a diet high in fat:

	Gms. food	Gms. carbo-hydrate	Gms. protein	Gms. fat	Approx. measure
		90	90	245	
Milk	300	15	9	12	1¼ cup
Cream, 40%	240	7	5	96	1 cup
Rolled oats, raw wt.	15	10	3	1	3 T
5% vegetable	600	24	6	0	3 cups
10% fruit, fresh	200	18	0	0	1 grapefruit
Bread, baker's	30	16	3	...	⅜-in. slice
		90	26	109	
Bacon	30	....	3	20	3 strips
Eggs	100	....	13	11	2
Medium fat meat	120	....	25	28	2 slices 4 × 4 × ¼ in.
Fat fish	90	....	21	15	¾ cup
Butter	60	....	1	51	4 one-in. cubes
Oil	10	....	..	10	2 t
			89	244	

The use of the group vegetable, fruit, meat, and fish figures in this diet allows considerable scope for variation and the following substitutions increase the possibilities:

For—

	Gms. food	Gms. carbo-hydrate
Bread	30	16
Substitute:		
Cereal	20	15
10% vegetable	180	16
10% fruit	180	16
15% fruit	120	16
Corn, canned	90	17
Potatoes, boiled	80	17
Lima beans, canned	100	15

For—

	Gms. fat	Gms. carbo-hydrate	Gms. protein	Gms. fat
Fat fish	90	....	21	15
Oil	10	....	..	10
Substitute:				
Eggs	150	....	20	16
with				
Oil	10	....	..	10
Cheese	80	....	21	26
Fresh fish	120	....	22	4
with				
Oil	20	....	..	20

This diet may be divided into meals in this way:

Breakfast		*Lunch*		*Supper*	
Bacon	30	Medium fat meat	120	Fat fish	90
Egg	100	5% vegetables	300	5% vegetables	300
Rolled oats	15	Bread	30	Oil	10
10% fruit	100	Butter	30	Cream, 40%	70
Cream, 40%	100	Cream, 40%	70	Milk	150
Milk	150	Tea	...	Butter	30
Coffee	...	....	...	10% fruit	100
				Tea	...

If less bulk is desired, this selection of foods may be made:

	Gms. food	Gms. carbo-hydrate	Gms. protein	Gms. fat	Approx. measure
		90	90	245	
Milk	500	25	15	20	1 pint
Cream, 40%	240	7	5	96	1 cup
15% fruit	150	20	2	2	1 apple
Bread, baker's	60	31	5	1	2 slices 3/8 in.
10% vegetable	80	7	2	0	3/8 cup
		90	29	119	

	Gms. food	Gms. carbo-hydrate	Gms. portion	Gms. fat	Approx. measure
Bacon............	30	..	3	20	3 strips
Eggs..............	200	..	26	22	4
Medium fat meat..	100	..	21	23	2 slices 4 × 4 × ¼ in.
Cheese............	45	..	11	15	1 × 1½ × 1½ in.
Butter............	50		1	43	3 cubes 1 × 1 × 1⅛ in.
		—	—	—	
		90	91	242	

The eggs, milk, cream and cheese may be served as eggnogs, custards, souffles and omelets; the vegetables may be creamed or made into soup; the bread will be acceptable as creamed toast; the 15 per cent fruit may be a baked apple or orange-juice; and possibly broiled tenderloin will be as attractive as any of the medium fat meats.

CHAPTER IX

USEFUL RECIPES FOR THE DIABETIC

The following recipes may be used with safety by any diabetic whose tolerance is sufficiently high to permit the use of the ingredients in the preparation of his diet. They will suggest to the mind of the user other combinations that may be equally good or better.

The following abbreviations are used:

C = cup
T = tablespoon
t = teaspoon
gms. = grams
grs. = grains

All measurements given are for a level teaspoon, tablespoon and standard one-half-pint measuring cup.

In all recipes for which the food value is given, the number of servings indicated should be prepared or the value of each serving changes.

The following preparations used in these recipes may be obtained through private companies and the various hospital supply houses:

Coarse feed bran from feed stores and flour mills.

Washed bran from Lister Brothers, New York City, and the Dietetic Cellulose Company, Chicago, Ill.

Cellu flour from the Dietetic Cellulose Company, Chicago, Ill.

Agar-agar, India gum, mineral oil, saccharin, flavoring extract and color pastes from any drug store.

All these materials, as well as cocoa shells and the gram scales, are obtainable through the Chicago Dietetic Supply House, Chicago, Ill.

BREADS

Of all the foods excluded from the diet of the diabetic, bread is perhaps the one he desires most; and this constant demand has stimulated the manufacture of so-called diabetic breads. These substitutes may be serviceable, but they should be used with discretion. Many of the preparations upon the market contain as much carbohydrate as ordinary baker's bread; a few contain less, and a few have no assimilable carbohydrate, or, if present, the carbohydrate content may vary from time to time. These substitutes should never be used unless their content in carbohydrate, protein and fat is known and calculated in the diet.

Gluten bread is made of flour from which the starch has been removed more or less completely.

The large amount of protein in this bread makes it objectionable for use in diets in which the protein as well as the carbohydrate is restricted. The indiscriminate use of casein and soy-bean breads is also questionable when we recognize the protein of the food as a contributing source of carbohydrate.

The point at which ordinary yeast breads, such as white, whole wheat, graham or rye, may be introduced into the diabetic diet depends upon the individual case; perhaps a safe rule to follow is to wait until the carbohydrate tolerance is at least 100–150 gms. Thirty gms. of bread—a ⅜-in. slice—contains as much carbohydrate as do 400 gms. of 5 per cent vegetable. For purposes of concentration bread may be used occasionally in a low-tolerance diet when the patient does not feel inclined to take the usual bulky diet.

Products made of bran washed until all the starch has been removed make safe bread substitutes that may be used more or less freely. They need not be considered in calculating the diet, as the food value they contain is negligible. It is recommended that miller's coarse bran be bought in a feed store or flour mill, and not in the form of the packages put up for table use. Prepared brans are expensive. When washed and made up with materials that have no food value, bran gives the diabetic a very palatable wafer or muffin. In the following recipes washed bran should be used. Washing removes 70 to 83 per cent of the available carbohydrate. Large and variable proportions of protein, ranging from 27 to 46 per cent, and of ash, ranging from 23 to 58 per cent, are also lost during the process.

Directions for washing bran: Tie the bran loosely in a double cheese-cloth bag and soak in a large amount of water for one hour. Wash thoroughly by squeezing the bag and changing the water until it is perfectly clear. The washing should be continued until the bran no longer gives the iodine test for starch. Then wring the bran free from water and dry in flat pans. As an alternate method, the bag of bran may be tied to the cold water faucet and the water allowed to run slowly through it until the bran is free from starch.

Some prefer to boil the bran, changing the water three times, the process which is used for ridding vegetables of their carbohydrate.

BRAN WAFERS (no food value)

Cellu flour	6 T	Boiling water
Dry washed bran	2½ C	Salt
India gum	1 T	
Saccharin	½ gr.	
Mineral oil	4 T	

Mix dry ingredients thoroughly. Add oil and the saccharin dissolved in a small amount of water. Add hot water sufficient to make a mixture which can be easily molded. Pat into muffin tins or a cookie sheet greased with mineral oil or petroleum jelly. Bake until dry and crisp in very slow oven. Mineral oil burns easily, and if the oven is too hot, the room will be filled with a blue smoke.

Wet bran may be used if the quantity of water added is diminished accordingly.

Spices, flavoring extracts or caraway seeds may be used to vary the flavor. If nuts or cheese are calculated in the diet, a pleasing addition to the plain wafers may be made for special occasions.

To interest children, pat the wafer mixture on a cutting board and cut with animal or flower cutters. The mixture may also be molded in deep saucers, baked, and used for a pie shell, or cut as for tarts and served with agar jelly.

BRAN MUFFINS (no food value)

Washed bran	2 C
India gum	1 T
Mineral oil	1 T
Ginger, anise or caraway seed	1 t
Salt	

Mix dry ingredients, then add washed bran and mineral oil and knead in thoroughly. Add hot water to make a stiff dough. Oil muffin tins with mineral oil. Pat the dough in the tin and dry until crisp in a very moderate oven. This requires about three hours.

BRAN WAFERS (no food value)

Washed bran	3 C
Agar-agar	2 T
Water	1 C
Salt	½ t
Cinnamon	¼ t

Place bran, salt and cinnamon in bowl. Add agar to the water and boil slowly until dissolved, then stir it into the mixture in the bowl to make a stiff dough. Spread thin on a cookie sheet and divide into squares. Let dry over night, then bake in a moderate oven until crisp.

This mixture is too sticky to roll with a rolling-pin unless covered with waxed paper.

BRAN MUFFINS (with food value)

Washed bran	1 C	Salt	½ t
Egg	1	Fat	(1T)—15 gms.
Water	¼ C	Baking powder	

Mix and bake as any muffin mixture. Make 6 muffins. The palatability and texture are much improved by this substitution of egg for India gum and of fat for mineral oil.

Food value of one muffin:

Carbohydrate, 0; Protein, 1 gm.; Fat, 3 gms.

GRIDDLE CAKES (with food value)

Washed bran	1 C	Salt	⅛ t
Egg	1	Baking powder	⅛ t
Water	¼ C		

Mix dry ingredients and add warm water. Fold this mixture into the well-beaten egg. (This is done by stirring or turning the mixture with a spoon in one direction only, the object being to avoid releasing the air in the beaten egg.) Fry on a hot griddle greased with mineral oil or with fat that is allowed in the diet.

If the mixture is too thick, add more water. This makes four cakes.

Food value of entire mixture, due to the one egg:

Carbohydrate, 0; Protein, 7; Fat, 5.

CELLU FLOUR GRIDDLE CAKES (with food value)

Cellu flour	4 T	Salt	⅛ t
Egg	1	Baking powder	¼ t
Water	¼ C		

Makes 4 cakes

Food value of entire mixture:

Carbohydrate, 0; Protein, 7; Fat, 5.

SUBSTITUTE MAPLE SYRUP (no food value)

Agar-agar	4 gms.	Mapleine extract	¼ t
Hot water	1 C	Saccharin	¼ gr.

Boil agar-agar and water until clear; add mapleine and saccharin after removing from the fire. Serve hot or cold. If the syrup is too thick when cold, thin to the desired consistency with hot water.

BEVERAGES

The amount of fluid which should be allowed the diabetic can in general be safely left to the demands of the individual.

Tea or coffee, iced or hot, without sugar and cream, may be used more or less freely in the diet of uncomplicated diabetic cases. If cream is used it must be a part of the amount calculated in the diet. A cup of hot tea or coffee will often help the diabetic to bridge the time between meals with comfort.

COCOA-SHELLS COCOA

Cocoa shells	½ C
Water	1 qt.

Add shells to water and boil 15 to 20 minutes. Strain and serve.

This infusion may be used for flavoring and is an acceptable substitute for cocoa. Children like this cocoa: its flavor is good, especially if there is cream or milk in the diet that may be served with it, and it gives them a hot drink that is preferable to tea or coffee.

Milk

Milk contains 4 to 5 per cent of sugar. Skimmed milk and buttermilk are not essentially different from whole milk in sugar content, but in cream the sugar seldom exceeds 3 per cent. Unrestricted use of these products is not allowable.

In childrens' cases milk should form the basis of the diet; the amounts used will depend upon the age and condition of the patient and upon the carbohydrate tolerance. As much of the normal requirement of one quart per day should be given as is possible while still satisfying the other dietary requirements. The same factors influence the amount of milk given adults, but the aim should be a pint a day.

Various substitutes for milk have been suggested. Janney has used soy-bean milk and almond milk for children, and with certain intestinal cases.

Sugar-free milks have been prepared that will keep from one to three weeks. As a rule they are concentrated one-half and should be diluted before using. Williamson recommends a preparation made from cream, egg white, salt and a little saccharin.

The formula is as follows: To one pint of water add 4 T of 20 per cent cream, mix thoroughly and allow to stand 12 hours. Remove the cream from the top and add the beaten white of one egg. Mix and dilute with water to the consistency of milk. If desired, a little salt and saccharin may be added.

Food value:

Carbohydrate, 0; Protein, 2; Fat, 4.

Egg and milk drinks are valuable when it is desirable to give concentrated foods.

EGGNOG—COLD

Egg..................	1	Flavoring extract
Milk.................	100 gms.	Saccharin

Beat the egg, add the flavoring and saccharin, then the milk.

Food value:

Carbohydrate, 5; Protein, 10; Fat, 9.

EGGNOG—HOT

Egg yolk.............	1	Flavoring extract or nutmeg
Hot milk.............	100 gms.	Saccharin

Beat the egg yolk, add the saccharin, then the hot milk. Strain and flavor as desired.

Food value:
Carbohydrate, 5; Protein, 6; Fat, 11.

ALBUMENIZED ORANGE-JUICE

Egg white	1	Saccharin
Orange-juice	150 gms.	

Place all the materials in a covered glass jar, and shake until blended. Strain and serve. If desired the egg white may be cut and strained into the orange-juice without the shaking or beating.

Food value:
Carbohydrate, 20; Protein, 5; Fat, 1.

EGG BROTH

Egg	1	Salt
Hot broth	1 C	

Beat the egg, add the salt, pour in hot broth and serve at once. Hot milk may be used instead of broth.

BROTHS AND SOUPS

CLEAR BROTH (practically no food value)

Very lean steak	1 lb.
Water	2 qts.

Cut steak into pieces, removing all fat. Cover with cold water and let stand ½ hour, or set in the ice box over night. In the morning simmer 1½ to 2 hours, adding water as it evaporates. Strain through a sieve lined with double cheese cloth or a piece of muslin. When this is cold the fat will form a cake on top of the broth and can be easily removed. Reheat, season with salt, pepper, onion or celery salt or bay leaf and serve. Broth may be thickened with Irish moss or egg yolk. The fat may be removed from hot broth by blotting the surface with small pieces of unglazed paper.

Bouillon cubes may also be used if it is not necessary to restrict the salt in the diet. They contain from 20 to 60 per cent of sodium chloride.

This clear broth may be used freely if there is no need to limit the fluid intake, or if it is advisable to force fluids. It is especially useful in forcing fluids in cold or cool weather, as it helps to keep the patient warm. It is appreciated between meals or at night when the diabetic is hungry and cannot go to sleep.

Chicken, clam, mutton or veal broth may be prepared in the same way as beef broth.

VEGETABLE SOUP

Clear meat broth.........	2 C
5 or 10% vegetables......	50 gms. to 100 gms.

Instead of using plain broth, a small part of the day's allowance of 5 per cent or 10 per cent vegetables may be puréed and added to the broth. The purée may be thickened by boiling with Irish moss that has been soaked for ten minutes in cold water. A combination of 5 per cent vegetables, such as tomato, celery and cabbage may be used to make up the total amount.

CREAM OF TOMATO SOUP

Cream or milk	100 gms.
Tomato	100 gms.
Salt and pepper to taste.	

Press cooked tomato through a sieve, add the salt and pepper and a pinch of soda. Just before serving, add this to the hot cream or milk.

The cream or milk and the 5 per cent vegetable must be taken out of the day's allowance of those foods. Any other 5 per cent vegetable may be substituted for the tomato.

CAKES AND COOKIES

ALMOND MACAROONS (with food value)

Ground almonds	4 T or 22 gms.
Egg whites	(2) or 56 gms.
Saccharin	¼ gr.

Beat egg whites very stiff, fold in powdered saccharin and blanched almonds ground or chopped fine. Drop on pan greased with mineral oil and bake 30 minutes in a moderate oven. Make into 10 cakes.

Food value of 10 cakes:

Carbohydrate, 3; Protein, 10; Fat, 12.

PEANUT BUTTER CELLU COOKIES

Peanut butter	60 gms.	Salt	¼ t
Cellu flour	½ C	Mineral oil	1 T
India gum	1 t	Hot water	
Baking powder	½ t		

Mix dry ingredients, add mineral oil and peanut butter. When well mixed, add enough hot water to make a soft dough. Spread on a baking sheet or in flat pans and cut into 10 cookies. Bake in a slow oven.

Food value of each cookie:
Carbohydrate, 1; Protein, 2; Fat, 3.

CELLU SPONGE CAKE (with food value)

Cellu flour.........	10 gms.	Saccharin...............	¼ gr.
Eggs...........(2)	100 gms.	Flavoring	

Beat eggs, white and yolk separately. Add cellu flour and flavoring. Drop from a teaspoon on a pan greased with mineral oil and bake in a moderate oven.

Food value for entire mixture (due to eggs):
Carbohydrate, 0; Protein, 13; Fat, 11.

CELLU FLOUR PIE CRUST (no food value)

Cellu flour.............	50 gms.	Hot water
India gum.............	10 gms.	Salt
Mineral oil	4 T	

Mix flour, salt and India gum thoroughly. Add oil and water to moisten. Toss on board dredged with cellu flour, pat and roll out. Bake in a moderate oven.

CHEESE DISHES

CHEESE SANDWICHES

Swiss cheese...........	40 gms.	Chicken...............	20 gms.
Butter................	3 gms.	Lettuce...............	10 gms.

Cut two very thin slices of Swiss cheese (20 gms. each). Butter lightly with 3 gms. of butter and spread one slice with finely chopped chicken moistened with cream or with mineral-oil mayonnaise dressing. Lay on lettuce leaf and cover with other slice of cheese.

Food value:

Carbohydrate, 1; Protein, 16; Fat, 17.

HALIBUT WITH CHEESE

Sprinkle with salt and pepper a small fillet of halibut which has been weighed and calculated in the diet; brush over with butter or bacon fat from the day's allowance; place in a pan and bake for 12 minutes. Remove to a serving dish and pour over it the following sauce:

Heat 2 T of cream, add ½ egg yolk slightly beaten, and when well mixed, add grated cheese; 10 to 30 gms. of cheese may be used in this way, and the cream and egg yolk may be taken from the day's allowance of these foods.

COTTAGE CHEESE

Methods of preparing cottage cheese:

1. Heat, but do not boil, one quart of thick sour milk (100° F.) and allow it to stand until the curd separates from the whey. Strain through cheese cloth. Press until dry. Add ¼ t salt and 2 T cream and mix well. This makes ½ cup cottage cheese.

2. 1 qt. thick sour milk   2 qts. boiling water

Pour boiling water into the sour milk and allow it to stand until the curd separates from the whey. Strain through cheese cloth and press until dry.

3. 1 qt. sweet milk ¼ rennet tablet

Heat milk to 80° F. or until it is lukewarm. Dissolve rennet tablet in 1 t cold water and add to the warm milk. Allow the mixture to stand at room temperature until firm—about ½ hour. Proceed as with ordinary cheese.

CREAMY EGG

Water	¼ C	Butter	(1 T) 15 gms.
Egg	(1) 50 gms.	Pepper	pinch
Cottage cheese	(¼ C) 70 gms.	Salt	¼ t
Soda	⅛ t		

Add soda to the cheese, then the seasoning, melted butter and beaten egg. Place in frying pan with a little butter, and as mixture sets, scrape from side of pan.

Food value:

Carbohydrate, 3; Protein, 22; Fat, 19.

COTTAGE CHEESE OMELET

Eggs	2	Salt	¼ t
Cottage cheese	(3 T) 50 gms.	Soda	⅛ t

Mix soda with cheese, add salt and beaten egg yolk. Fold in stiffly beaten egg white. Place it flat in a hot frying pan and cook slowly until eggs are set. Fold over. Serve at once.

Food value:

Carbohydrate, 2; Protein, 24; Fat, 12.

For other suggestions see Salads.

BAKED EGG WITH CHEESE

Egg	1	American cheese	20 gms.
Cream	15 gms.	Butter	5 gms.

Grease a small baking dish with the butter and add the egg, cream and grated cheese. Bake in a moderate oven until the cheese is melted.

These foods should be taken from the day's allowance, or their food value may be allowed for in calculating the diet. As little as 10 gms. of cheese may be used in this way.

Food value, if 20 per cent cream is used:

Carbohydrate, 1; Protein, 13; Fat, 19.

CHEESE CUSTARD

Egg	1	Water	2 T
Cream	50 gms.	Butter	5 gms.
American cheese	20 gms.	Salt and pepper	

Beat egg and cream slightly, add cold water, grated cheese and seasonings. Bake in a buttered baking dish, in a moderate oven, until firm.

These foods should be taken from the day's allowance or their food value may be allowed for in calculating the diet.

Food value, if 20 per cent cream is used.

Carbohydrate, 3; Protein, 14; Fat, 26.

DESSERTS

The dessert is a difficult problem for one on a restricted diet. The answer is fresh fruits, custards, junkets, gelatin or agar desserts. Even ice creams and ices and pies are possible if substitutes are used for sugar and flour. To some the omission of a dessert may not mean much. Others have an unsatisfied feeling after a meal which does not include a dessert. This failure to satisfy the appetite is often confused with real hunger and it is hard for the patient to think of anything except himself and his own discomfort.

A few suggestions are given here. Many of the favorite desserts may be served if the recipes are altered to suit the dietary requirements.

Agar-agar Jelly Desserts

AGAR-AGAR JELLY (no food value)

Water	1 quart
Agar-agar	1 level T
Color	To color faintly
Vinegar	2 t
Flavoring	to taste
(Use bottled extracts only; no fruit juices)	
Saccharin	1 gr.

Mix agar-agar and water. Boil 15 minutes. Strain through cheesecloth to remove scum. Add vinegar, coloring and flavoring, and mix. Lastly add saccharin and mix until dissolved. Pour into bowls or pans and allow to harden.

Agar-agar may be substituted for gelatin in any of the gelatin desserts such as Spanish creams, ice cream and Bavarian creams. It has no food value and it is laxative.

Following are a few suggestions:

SPANISH CREAM

Egg	50 gms.	Water	(½ C) 100 gms.
Cream (40%)	30 gms.	Salt and vanilla	
Agar-agar	2 gms.		

Boil agar-agar and water until agar-agar is dissolved. Strain and keep hot. To 10 c.c. of this add the cream. Bring to a boil, add the well-beaten egg yolk and cook as a custard. Fold in the stiffly beaten egg white and add flavoring. Pour into mold. If diet permits, surround with whipped cream to serve. Previously made agar-agar jelly may be heated to liquid and used.

Food value:

Carbohydrate, 1; Protein, 8; Fat, 17.

SHORTCAKE

Cream (40%)	50 gms.
Walnut meats—chopped	10 gms.
Bran wafers	2

Toast the bran wafers until crisp. Spread on one a layer of whipped cream and cover with cubes of agar-agar jelly. Cover with second wafer and garnish the top with whipped cream and chopped nuts.

Food value:

Carbohydrate, 4; Protein, 3; Fat, 26.

Twenty-five gms. of any 10 per cent or 15 per cent fruit may be substituted for the agar-agar jelly if taken from the day's allowance of fruit. The fruit may be sweetened with saccharin and crushed if desired.

COFFEE MOUSSE

Cream (40%)	100 gms.
Coffee agar jelly	¼ C

Press agar jelly through a coarse sieve and fold it lightly into the whipped cream. Pack in a mold and chill.

Food value:

Carbohydrate, 3; Protein, 2; Fat, 40.

Twenty-five gms. of fruit, crushed or shredded and sweetened with saccharin, may be taken from the day's allowance and used in place of the jelly.

Gelatin Desserts

If the diet is sufficiently high in protein, gelatin may be used in the preparation of desserts. It may be substituted for agar-agar in any of the recipes given above; 3 or 5 gms. will be needed to give the desired consistency. Any of the standard gelatin desserts may be modified for use in diabetic diets by omitting the sugar and sweetening with saccharin and by using for flavoring only such fruits or fruit juices as are calculated in the diet. A few suggestive recipes are given here:

LEMON JELLY

Gelatin	3 gms.	Lemon-juice	5 gms.
Cold water	2 T	Saccharin	½ gr.
Boiling water	½ C		

Soak the gelatin in cold water. Add the boiling water and saccharin. Stir the mixture until the gelatin is dissolved. Mold and chill. This makes one serving. Any other 10 per cent fruit juice may be substituted for the lemon-juice.

Food value:

Carbohydrate, 1; Protein, 3; Fat, 0.

STRAWBERRY ORANGE JELLY

Strawberries	(6) 25 gms.	Cold water	3 T
Orange gelatin	(1 t) 3 gms.	Hot water	6 T
Saccharin	¼ gr.	Lemon-juice	(1 t) 5 gms.

Dissolve gelatin in cold water, add boiling water, saccharin, lemon-juice and orange-juice. When partly congealed, add crushed strawberries.

Food value:

Carbohydrate, 1; Protein, 3; Fat, 0.

SNOW PUDDING

When lemon jelly, as above described, begins to thicken, beat into it ½ a stiffly beaten egg white. Chill and serve with or without cream. The half egg white adds 2 gms. of protein to the food value.

BAVARIAN CREAM

Fold 25 gms. of whipped cream into any of the plain jellies when just beginning to thicken. This gives an added food value of carbohydrate 1 gm., protein 1 gm., fat 10 gms.

Frozen Desserts

FRUIT ICES

Fruit juice or pulp with water and sweetened with saccharin may be frozen and served as an ice.

ICE CREAM

Cream (40%)	100 gms.	Egg	(1) 50 gms.
Water	1 T	Saccharin	
Flavoring			

Beat the yolk of the egg until lemon-colored, add the cream slowly and fold in the stiffly beaten egg white. Flavor with extracts and the saccharin dissolved in water. Freeze.

Food value:

Carbohydrate, 3; Protein, 9; Fat, 45.

MOUSSE

A palatable frozen dessert may be made if the diet contains the heavy whipping cream. Weigh into a mold that may be tightly covered 75 or 100 gms. whipped cream. Flavor this by folding into it flavoring extract, minced fruit, or chopped nuts that have been calculated in the diet. Cover and pack in a freezing mixture of salt and ice for two hours. This may be turned out on a serving dish or served in the mold.

COFFEE PARFAIT (6 servings)

Egg yolks	2	Coffee flavor	3 T
Cream (40%)	(1 C) 210 gms.	Saccharin	½ gr.

Place beaten egg yolks, coffee extract and dissolved saccharin in a double boiler. Stir until it begins to thicken. Beat until foamy. Fold stiffly beaten cream into mixture. Pour into freezer from which dasher is removed. Pack with ice and salt. Let stand three to four hours.

Food value of one serving:

Carbohydrate, 1; Protein, 2; Fat, 16.

COFFEE FLAVOR

Take 3 T coffee and 8 T water and allow it to simmer until a dark golden-brown color and a strong flavor are produced.

JUNKET

Milk	100 gms.	Cold water	1 t
Junket	¼ tablet	Flavoring	

Heat milk until lukewarm or 100° F. Dissolve the junket tablet in cold water and add a few drops of extract. If this is done in the serving dish it may now be placed upon the scales and the milk weighed into it. Stir quickly, then let stand in a warm place without disturbing until it sets. Chill to prevent the separation of the curd and whey.

Food value:

Carbohydrate, 5; Protein, 3; Fat, 4.

Custards

PLAIN CUSTARD

Egg	50 gms.
Milk	100 gms.
Flavoring	

Weigh the egg and cream into a custard cup, add flavoring and beat slightly. Bake in a pan of hot water in a moderate oven until firm. If it is impossible or undesirable to use milk, cream may be used in the same amount, or a lesser amount may be diluted with water. This custard mixture may be varied by using different flavoring extracts, and it is very good if frozen.

Food value:

Carbohydrate, 5; Protein, 10; Fat, 9.

WHITE CUSTARD

Egg white	1
Milk	100 gms.
Flavoring	

Beat egg white, add extract and milk. Mix and bake as directed in above recipe. This is usuable in low fat diets and if skim milk is used instead of whole milk the dessert is practically fat-free.

Food value:

Carbohydrate, 5; Protein, 6; Fat, 4.

CHARLOTTE RUSSE

Line mold with orange sections and fill with soft custard or agar-agar jelly and whipped cream beaten together. Add chopped nuts and garnish with whipped cream.

This may be made with fruit, cream, egg, milk, or nuts in any proportion, depending upon the diet of the individual.

Pies

PUMPKIN PIE

If the diet contains a 10 per cent vegetable and 40 per cent cream, a palatable pie may be made using the cellu-flour pie crust or the bran-wafer mixture. Weigh out 100–150 gms. of canned pumpkin, season and flavor with salt, cinnamon, nutmeg and powdered saccharin. Fold into this 50 gms. of whipped cream, spread into the pie shell and garnish with 25–50 gms. of whipped cream. This is more palatable if served at once, as the crust becomes water-soaked upon standing. The pumpkin may be thickened by cooking with egg from the diet.

CRANBERRY PIE

Cook 100 gms. of cranberries in water until tender, with 3 gms. of agar-agar. Remove from the flame and sweeten with saccharin. When cool, pour the cranberries into a pie crust made with cellu flour or the bran-wafer mixture and garnish with whipped cream.

These foods may be taken from the day's allowance of 10 per cent fruit and 40 per cent cream. It is possible to make a filling with as little as 25 gms. of cranberries, using more water and agar-agar to thicken it.

EGG DISHES

Eggs may be poached, fried, baked, scrambled, soft-cooked and hard-cooked, shirred, or made into omelets, if the butter or bacon fat and milk or cream used are taken from the day's allowance of those foods. Mineral oil and water may be used on low diets.

BAKED EGG IN TOMATO

Cut a slice from the stem end of a tomato and with a spoon remove a small amount of the pulp. It should now weigh 100 gms. Break an egg and slip it into the tomato. Season and bake until the egg is firm.

Food value:

Carbohydrate, 4; Protein, 8; Fat, 5.

ASPARAGUS OMELET

Egg	1	Asparagus	100 gms.
Cream	15 gms.	Salt and pepper	
Butter	5 gms.		

Beat the egg slightly, add cream and seasonings. Put butter in small omelet pan; when hot, turn in the egg mixture. Brown on the bottom, then place in a moderate oven for a minute or two. Crease with the back of a knife and fold, enclosing the asparagus that has been heated. Serve on a hot plate.

Food value, if 40 per cent cream is used:

Carbohydrate, 4; Protein, 8; Fat, 15.

FISH

BAKED FISH

Fish, uncooked	100 gms.	Bacon	20 gms.
Tomato	50 gms.	Salt	

Put the fish in a small baking dish, sprinkle with salt and cover with the cooked tomato. Lay strips of bacon on top and bake in a moderate oven until the fish is tender.

Food value:

Carbohydrate, 2; Protein, 21; Fat, 16.

SALMON LOAF

Salmon, canned	100 gms.	Butter	5 gms.
Egg yolk	1	Vinegar and salt	
Cream (20% or milk)	50 gms.		

Add the beaten egg yolk, cream, vinegar and salt to the flaked salmon. Pack in a baking dish, dot with the butter and bake in a moderate oven for 15 minutes. This mixture may be cooked over the flame until it thickens, stirring constantly. Mold, chill and serve with some sauce such as Hollandaise, butter, or cucumber sauce.

MEAT

BROILED BACON

Place bacon on a wire rack over a baking dish. Cook in a moderately hot oven until crisp. If the bacon is weighed out raw, all of this fat should be used during the day with eggs or with vegetables or for broiling meats.

BROILED STEAK BALLS

Form 100 gms. of seasoned, ground, round steak into small balls and roll about in a very hot frying pan greased with mineral oil or fat from the diet. When cooked, sprinkle with salt and serve on a hot plate.

HAMBURG BAKED WITH TOMATO

Pack 100 gms. of ground round steak seasoned with salt and pepper into a small baking dish greased with mineral oil or butter from the diet. Cover with 100 gms. of tomatoes and bake in a moderate oven until the meat is cooked. This is very good with onions substituted for the tomato.

BEEF STEW

A stew may be made by cooking, in the usual way, meat and vegetables allowed in the diet. As little as 25 gms. of cubed meat and 100 gms. of mixed 5 per cent vegetables may be used and the flavor improved by adding half a bouillon cube to the broth. If larger amounts of vegetables are available, a regular New England boiled dinner is possible.

CREAMED DRIED BEEF

Dried beef............	25 gms.	Cream (20%)..........	50 gms.

Cover beef with hot water, let stand 10 minutes and drain. Cover with the cream, heat and serve.

Food value:

Carbohydrate, 3; Protein, 9; Fat, 11.

BAKED HAM WITH CREAM

Ham	50 gms.
Cream (20%)	50 gms.

Place ham in shallow baking dish, stick into it 1 to 2 cloves and cover with the cream. Bake in a moderate oven until tender. This is good with 25 to 50 gms. of sliced raw potato baked on top of the ham, if the diet can provide for the vegetable.

Food value (without potato):

Carbohydrate, 3; Protein, 13; Fat, 22,

CREAMED SWEETBREADS

Sweetbreads	100 gms. (one half a small pair)
Cream (20%)	50 gms.
Butter	5 gms.

Parboil the sweetbreads cut in small pieces. Heat the cream, add the sweetbreads and butter, garnish with parsley. Serve on toasted bran wafers. Five gms. of chopped nut meats make a pleasing addition.

Food value (without nuts):

Carbohydrate, 3; Protein, 19; Fat, 26.

SALADS

Salads are valuable in the dietary because of their attractiveness and the many ways in which they can be made to lend variety. They furnish salts and vitamines that have not been affected by cooking processes, essentials that must be definitely provided, especially for one on a limited diet. Salads are also bulky dishes, a fact appreciated by the diabetic patient. Possible combinations are unlimited, even on a comparatively low tolerance. Choice may be made from all of the 5 per cent vegetables, 10 per cent vegetables and 10 per cent fruits, besides fish, eggs and cheese in the usual combinations.

Fifty or seventy-five gms. of head lettuce is not too much to serve alone with a French, Russian or mayonnaise dressing made from the recipes given below.

A few suggestive salad combinations are given here:

VEGETABLE SALAD

Five per cent vegetable 100 gms.

Balance the salad plate on the scales and arrange a bed of lettuce on the plate, then make up the rest of the 100 gms. with any other 5 per cent vegetable, such as sliced tomato, or any combination of vegetables from that group that are on hand at the time.

CABBAGE SALAD

Cabbage	50 gms.
Lettuce	25 gms.

Select a firm green cabbage. Cut into quarters, core and slice very thin. Mix with mayonnaise dressing made with mineral oil or salad oil according to the amount of fat in the diet, and serve on a bed of lettuce.

If 100 gms. of vegetable may be used for the salad, a combination of cabbage with green pepper, onion, cucumber or celery is good.

TOMATO JELLY SALAD

Tomato..............	100 gms.	Parsley
Gelatin...............	3 gms.	Salt
Cold water...........	2 T	Paprika

Simmer the tomato for 5 minutes, strain and season, and while hot add to it the gelatin that has been soaked in the cold water. Pour into a wet mold, chill until firm and serve with mayonnaise dressing on a bed of lettuce.

Food value of the jelly:

Carbohydrate, 4; Protein, 4; Fat, 0.

STUFFED PEPPER

Green pepper.......................	50 gms.
Cottage cheese......................	60 gms.
Salt and paprika	

Remove the seeds from the pepper. Fill with the seasoned cheese, chill, cut in slices and serve.

Ripe tomato may be substituted for the pepper.

Food value:

Carbohydrate, 4; Protein, 13; Fat, 1.

One-half these proportions may be used if desired.

STUFFED CELERY

Celery	25 gms.
Cheese	25 gms.

Wash, shake free of water, and weigh the celery. Fill in the curved side of the stalks with ground American cheese or cream cheese that has been moistened with cream, butter from the diet, or a mineral-oil mayonnaise dressing. This may be garnished with chopped parsley or paprika. Serve with lettuce in full-length stalks or cut into inch-long pieces.

Food value:

Carbohydrate, 1; Protein, 6; Fat, 9.

COTTAGE CHEESE WITH PEACHES

Cottage cheese	60 gms.
10% fruit	100 gms.

Pack the cottage cheese in a mold until shaped, then place on a bed of lettuce and arrange a border of finely sliced fresh peaches. Fifty gms. of peaches may be used this way if 100 cannot be calculated into the diet.

Food value:

Carbohydrate 11; Protein, 13; Fat, 1.

COTTAGE CHEESE BALLS

Cottage cheese	60 gms.
Nut meats	10 gms.

Form the cheese into balls and weigh, then roll in the nut meats that have been chopped or shredded, using all the nuts. Serve with lettuce and a dressing.

Food value:

Carbohydrate, 4; Protein, 15; Fat, 7.

CABBAGE AND APPLE SALAD

Cabbage, shredded	30 gms.
Apple, cut in cubes	30 gms.
Lettuce	20 gms.

Mix the prepared cabbage and apple together and serve on lettuce with a salad dressing.

Food value:

Carbohydrate, 6; Protein, 1; Fat, 0.

WALDORF SALAD

Apple	30 gms.
Celery	20 gms.
Walnuts	10 gms.
Lettuce	20 gms.

Cut apple, celery and walnuts into small pieces, mix and serve on lettuce with salad dressing.

Food value:

Carbohydrate, 8; Protein, 2; Fat, 6.

TUNNY FISH SALAD

Tunny fish	60 gms.
Celery, chopped	25 gms.

Mix the fish and chopped celery. Serve on lettuce with a salad dressing.

Salmon or crab meat may be used in this same way.

Food value:

Carbohydrate, 1; Protein, 14; Fat, 10.

SALAD DRESSINGS

MAYONNAISE

Oil	(1 C) 210 gms.	Salt	½ t
Egg yolk	1	Mustard	½ t
Vinegar or lemon-juice	(1 T) 15 gms.		

Mix dry ingredients. To this add egg and vinegar and beat into a homogeneous mixture. Add ½ t oil and beat, then 1 t, 3 t, 6 t; finally the remaining oil can be slowly poured in while dressing is being beaten.

Food value of 5 gms. dressing:

Carbohydrate, 0; Protein, 1; Fat, 4.

FRENCH DRESSING

Vinegar	2 T	Salt	½ t
Oil	(4 T) 52 gms.	Pepper	¼ t

Place ingredients in a jar or bottle and shake before using.

Food value of 1 tablespoon:

Carbohydrate, 0; Protein, 0; Fat, 9.

If mineral oil is substituted for the salad oil in the above mayonnaise and French dressings, the salad dressings resulting may be used in starvation diets as having no food value.

COTTAGE CHEESE DRESSING (makes 6 T)

Cottage cheese	(½ C) 135 gms.	Salt	½ t
Egg yolk	(1) 20 gms.	Mustard	½ t
Oil	(4 T) 52 gms.		
Vinegar or lemon-juice	2 t		

Mix ingredients until thoroughly blended.
Food value of 1 tablespoon:
Carbohydrate 1; Protein, 5; Fat, 10.

RUSSIAN DRESSING

Mayonnaise dressing	25 gms.
Tomato pulp (cooked)	25 gms.

Add the tomato pulp, chopped, to a mayonnaise dressing made with a salad oil or with mineral oil, and serve with a plain lettuce salad. The tomato adds 1 gm. of carbohydrate to the food value of the dressing.

SAUCES AND RELISHES

CUCUMBER SAUCE

Chopped cucumber	30 gms.
Vinegar	
Salt and pepper	

Food value: Carbohydrate, 1.

TOMATO SAUCE

Tomato	100 gms.	Irish moss	1 small piece
Chopped onion	10 gms.	Salt, pepper, vinegar to taste	

Strain the tomato and boil gently for 10 minutes with the other ingredients. Strain and serve hot or cold.

Food value:

Carbohydrate, 5; Protein, 1; Fat, 0.

HORSE-RADISH SAUCE

Horse-radish	10 gms.	Vinegar	½ t
Whipped cream	5 gms.	Salt and cayenne pepper	

Food value:

Carbohydrate, 1; Protein, 0; Fat, 2.

MINT SAUCE

Finely chopped mint leaves	2 T
Vinegar	4 T
Saccharin	

Pour vinegar over mint and let stand for 30 minutes. Add saccharin and serve.

HOLLANDAISE SAUCE

Egg yolk	1	Water	3 T
Butter	30 gms.	Salt and pepper	
Vinegar	½ T		

Put butter, vinegar and water in small saucepan and place over hot water. When butter has melted add a small amount of the hot mixture to the egg yolk, mixing well. Add the egg yolk slowly to the butter mixture, stirring constantly. Season and serve while hot.

Food value:

Carbohydrate, 0; Protein, 3; Fat, 33.

BUTTER SAUCE

Butter	15 gms.	Lemon-juice	1 t
Chopped parsley	1 t	Salt and pepper	

Cream butter, add lemon-juice, salt and pepper and chopped parsley. Serve with steak or fish. Food value:

Carbohydrate, 1; Protein, 1; Fat, 13.

SEASONINGS

The proper seasoning of the food is a great help to the diabetic patient. Because many articles are excluded from the diet, great variety in the preparation of the food may be secured by the help of seasoning. Sour pickles are allowable, and other pickles made from the group of 5 per cent vegetables, providing they are prepared without sugar. Mint, capers, curry, tarragon vinegar, bay leaf and cloves may all be used as seasonings. Tomatoes stewed, with bay leaf and cloves, thickened with agar-agar or Irish moss, may be served as a sauce.

Saccharin should be used for sweetening in place of sugar. It has no food value, but it is very sweet, having 500 times the sweetness of cane sugar. To get the best results, use as little as possible. If it is added to foods after cooking, the bitter taste that develops with heating will be avoided.

A very palatable pickle having no food value may be made by boiling thrice-cooked vegetables, such as string beans, beets, carrots and cauliflower, in vinegar seasoned with salt and spices. Saccharin is added after the pickle has been removed from the flame.

VEGETABLES

Because vegetables must form a large part of the diet it is important that fresh ones be available and that the methods of preparation and serving be varied so that the monotony incident to the restriction may be relieved. Many ordinary combinations are possible, and the diabetic may often be served the same kind of food as is eaten by other members of the family, the only difference being that his portion has been weighed, while the others have not.

If the vegetable is cooked in salted water, a portion may be weighed out, seasoned with a weighed allowance of cream or butter and served to him, while the rest of the vegetable is served to other members of the family with any seasoning they choose. This eliminates a great deal of work and worry often entailed by the preparation of a single serving.

Vinegar, salt, pepper and mineral oil may be added to the vegetables without increasing the food value; but all butter, milk and cream must be taken from the day's allowance of these foods.

BAKED STUFFED TOMATO

Tomato..............	150 gms.	Butter..................	5 gms.
Ground lean meat.....	25 gms.	Salt and pepper	

Cut a slice from the stem end of a medium-sized tomato and with a spoon remove a portion of the pulp. This shell should weigh 150 gms. Place in a baking dish, fill the shell with the ground meat, butter and seasoning. Bake until tender.

Food value:

Carbohydrate, 6; Protein, 9; Fat, 5.

Chopped ham makes a good filling for the tomato and, if desired, 75 gms. of onion may be substituted for the 150 gms. of tomato.

SCALLOPED CAULIFLOWER

Cauliflower	150 gms.	Cream (20%)	25 gms.
Grated cheese	25 gms.	Salt and pepper	
Butter	10 gms.		

Butter a small baking dish and put into it the cooked cauliflower. Add the cream, seasoning and grated cheese. Bake in a moderate oven. Crumbled bran wafer may be sprinkled over the top.

Tomato, cabbage, eggplant, or any of the other 5 per cent vegetables may be prepared in this same way.

Food value:

Carbohydrate, 7; Protein, 9; Fat, 23.

SUBSTITUTE BAKED POTATO

Mashed and creamed cauliflower makes a palatable substitute for potato, if served in a baked shell that has been scraped free of potato.

Cauliflower also may be used instead of potato, in making fish cakes or croquettes, if egg white is added as a binding agent.

WILTED LETTUCE

Lettuce................ 50 gms. Bacon................. 20 gms.
Vinegar, salt, pepper

Cut bacon into small pieces and cook until crisp. Add vinegar and seasonings, and pour over the prepared lettuce. Serve at once.

Food value:

Carbohydrate, 2; Protein, 3; Fat, 13.

SQUAW CORN

Bacon.. 20 gms.
Corn (canned)...................................... 100 gms.

Cut bacon into small pieces and cook until crisp. Add the corn and cook for 10 minutes. Serve at once.

Food value:

Carbohydrate, 19; Protein, 5; Fat, 14.

If the diet will not warrant the use of 100 gms. of corn, use 50 gms. combined with 100 gms. of chopped string beans.

Thrice-cooked Vegetables

By processing vegetables practically all the carbohydrate can be removed so that it is safe to use them rather freely on starvation days, or to pad out a low diet. They should be well seasoned. Discretion is necessary in their use however, for, though they add no appreciable amount of carbohydrate, protein or fat, an unlimited amount over a long period of time may cause diarrhea and distention, especially in children.

Canned vegetables may be used. Drain of water and place in a double cheese-cloth bag, or a square of cheese-cloth tied at the corners. A strainer that fits inside a pot may be used. Cover the vegetables with fresh cold water, bring to the boiling point and keep at this temperature for an hour. Pour off and replace by fresh water and boil for a half-hour. Repeat after another change of water. If desired, the iodine test for starch may be made in a clean white saucer or spoon. A blue color is evident if there is starch remaining.

Uncooked vegetables may be used for thrice cooking. Clean them thoroughly, cut into small pieces, soak in cold water and drain. They are then ready for the processing.

String beans, asparagus, cabbage, spinach, cauliflower, the outer stalks of celery and chard and the outer leaves of lettuce shredded and served like spinach, are all suitable vegetables for thrice cooking.

These thrice-cooked vegetables may be served in the same ways as other vegetables. They are rather tasteless and therefore need careful seasoning.

CHAPTER X

TABLES OF FOOD VALUES

Recalculated from Bulletin No. 28, U. S. Department of Agriculture

FOREWORD

These tables of food values are recalculated from Bulletin No. 28, U. S. Department of Agriculture. No decimals are used; when the fraction is less than 0.5 it is dropped; when it is 0.5 or above, a whole number is added. In calculating the fuel value 4 calories per gram of carbohydrate, 4 calories per gram of protein and 9 calories per gram of fat are used.

Average figures are included for groups of bread, cereals, fruits, vegetables, meats and fish having approximately the same composition of carbohydrate, protein and fat. The approximate measure of a customary serving of the various foods is also included. Unless otherwise stated, all teaspoon and tablespoon measures are level.

A.P. is used as an abbreviation for "as purchased."

E.P. is used as an abbreviation for "edible portion."

TABLE OF FOODS LISTED

Bread and Baked Foods
- Bread—Group
- Rolls—Group
- Crackers—Group

Cereals and Cereal Products
- Cereals—Group—Raw
- Cereal Meal
- Farina—Raw
- Macaroni—Raw
- Macaroni—Cooked
- Rice—Raw
- Rice—Cooked
- Rolled Oats—Raw
- Shredded Wheat

Dairy Products
- Butter
- Cheese—Group
- Cheese—Cottage
- Cream 20%
- Cream 32%
- Cream 40%
- Egg—Whole—E.P.
- Egg—Whites Boiled
- Egg—Yolk Boiled
- Milk—Butter
- Milk—Condensed
- Milk—Skimmed
- Milk—Whole

Fruits
- 10% Fruits—Group
- 15% Fruits—Group
- 20% Fruits—Group
- Dried Fruits—Group

Meats
- Bacon—E.P.—Raw
- Chicken Broiler—A.P.
- Meat—Lean
- Meat—Medium Fat—Cooked
- Sweetbreads
- Tongue

Miscellaneous
- Nuts—Group
- Nuts—Butter
- Nuts—Brazil
- Cocoanut—Prepared A.P.
- Gelatin
- Oil—Olive or Salad Oils—Lard—Cottolene

Fish
- Lean Fish
- Fat Fish
- Shell Fish
- Oysters

Vegetables
- 5% Vegetables—Cooked
- 10% Vegetables—Cooked
- Beans—Lima, Canned
- Corn—Canned
- Olives—Green A.P.
- Potatoes—Boiled A.P.
- Potatoes—Raw or Fresh A.P.
- Potatoes—Sweet—Raw A.P.
- Potatoes—Sweet—Raw E.P.
- Succotash—Canned A.P.

BREAD AND BAKED FOODS

BREAD Rye White Whole Wheat

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	3	1	0	16	
10	5	1	0	24	
20	10	2	0	48	
30	16	3	0	76	1 slice 3½ × 4 × ⅜ in.
40	21	4	0	100	
50	26	5	1	133	
60	31	5	1	153	
70	36	6	1	177	
80	42	7	1	205	
90	47	8	1	229	
100	52	9	1	253	

ROLLS—ALL ANALYSES—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	3	1	0	16	
10	6	1	0	28	
20	11	2	1	61	
30	17	3	1	89	1 roll
40	23	4	2	126	1 French roll
50	29	5	2	154	
60	34	5	2	174	
70	40	6	3	211	
80	46	7	3	239	
90	51	8	4	272	
100	57	9	4	300	

CRACKERS Graham Saltines Soda

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	1	1	29	7 gms. = 1 cracker
10	7	1	1	41	
20	14	2	2	82	
30	22	3	3	127	
40	29	4	4	168	
50	36	5	5	209	
60	43	6	6	250	
70	50	7	7	291	
80	58	8	8	336	
90	65	9	9	377	
100	72	10	10	418	

CEREAL AND CEREAL PRODUCTS

CEREALS

Corn Meal, Farina, Macaroni, Noodles, Pettijohn[1], Puffed Rice[1], Puffed Wheat[2], Rice, Rolled Oats, Shredded Wheat, Wheatena

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	1	0	20	
10	8	1	0	36	15 gms. = 3 T
20	15	2	0	68	
30	23	3	1	113	
40	30	4	1	145	
50	38	6	1	185	
60	45	7	1	217	
70	53	8	1	253	
80	60	9	2	294	
90	68	10	2	330	
100	75	11	2	362	

[1] Rose, Mary S. Laboratory Handbook for Dietetics.
[2] Joslin, E. P. Diabetic Manual.

CEREAL MEAL

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	3	1	0	16	
10	6	2	1	41	15 gms. = 3 T
20	12	3	1	69	
30	18	5	2	110	
40	24	6	2	138	
50	30	8	3	179	
60	35	9	4	212	
70	41	11	4	244	
80	47	12	5	281	
90	53	14	5	313	
100	59	15	6	350	

FARINA

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	1	0	20	
10	8	1	0	36	
20	15	2	0	68	2 T
30	23	3	0	104	
40	30	4	0	136	
50	38	6	1	185	
60	46	7	1	221	
70	53	8	1	253	
80	61	9	1	289	
90	68	10	1	321	
100	76	11	1	357	

NOTE.—Because the amount of water absorbed during the cooking of cereal varies with the type of utensil used and the length of the cooking period, it is advisable to weigh in the raw state any cereals that are to be cooked. It may be inconvenient to prepare a single serving, in which case 45 gms. may be weighed and cooked rather than 15 gms. and a third of the finished product served to the patient.

MACARONI

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	1	0	20	
10	7	1	0	32	15 gms. = 2 T
20	15	3	0	72	
30	22	4	0	104	
40	30	5	0	140	
50	37	7	1	185	
60	44	8	1	217	
70	52	9	1	253	
80	59	10	1	285	
90	67	12	1	325	
100	74	13	1	357	

MACARONI—COOKED

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	3	1	0	16	
30	5	1	1	33	
40	6	1	1	37	
50	8	2	1	49	
60	10	2	1	57	
70	11	2	1	61	
80	13	2	2	78	
90	14	3	2	86	3 rounded T
100	16	3	2	94	

Rice

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	0	0	16	
10	8	1	0	36	15 gms. = 1 T
20	16	2	0	72	
30	24	2	0	104	
40	32	3	0	140	
50	40	4	0	176	
60	47	5	0	208	
70	55	6	0	244	
80	63	6	0	288	
90	71	7	0	312	
100	79	8	0	348	

Rice—Boiled

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	5	1	0	24	
30	7	1	0	32	
40	10	1	0	44	
50	12	2	0	56	
60	14	2	0	64	¼ cup
70	17	2	0	76	
80	19	2	0	84	
90	22	3	0	100	
100	24	3	0	108	

Oats—Rolled

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	3	1	0	16	
10	7	2	1	45	15 gms. = 2 T
20	13	3	1	73	
30	20	5	2	118	
40	26	7	3	159	
50	33	9	4	204	
60	40	10	4	236	
70	46	12	5	277	
80	53	14	6	322	
90	59	15	6	350	
100	66	17	7	395	

Shredded Wheat[1]

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	4	1	0	20	
10	8	1	0	36	
20	15	2	0	68	
30	23	4	1	117	1
40	30	5	1	149	
50	38	6	1	185	
60	45	7	1	217	
70	53	8	1	253	
80	60	10	2	298	
90	68	11	2	334	
100	75	12	2	366	

[1] Rose, Mary S. Laboratory Handbook for Dietetics.

DAIRY PRODUCTS

BUTTER

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	4	36	
10	0	0	9	81	15 gms. = 1 × 1 × 1 in.
20	0	0	17	153	
30	0	0	26	234	
40	0	0	34	306	
50	0	1	43	391	
60	0	1	51	463	
70	0	1	60	544	
80	0	1	68	616	
90	0	1	77	697	
100	0	1	85	769	

CHEESE

American, pale Full Cream — Limberger — Roquefort Swiss

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	2	22	
10	0	3	3	39	
20	0	5	7	83	
30	0	8	10	122	1 × 1 × 1½ in.
40	0	10	13	157	
50	1	13	17	209	
60	1	16	20	248	
70	1	18	23	283	
80	1	21	26	322	
90	1	23	30	366	
100	1	26	33	405	

CHEESE—COTTAGE—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	0	4	
10	0	2	0	8	
20	1	4	0	20	
30	1	6	0	28	
40	2	8	0	40	
50	2	11	1	61	
60	2	13	1	69	
70	3	15	1	81	¼ cup
80	3	17	1	89	
90	4	19	1	101	⅓ cup
100	4	21	1	109	

CREAM—20%

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	1	9	
10	1	0	2	22	
20	1	1	4	44	
30	2	1	6	66	2 T
40	2	1	8	84	
50	3	2	10	110	
60	3	2	11	119	
70	4	2	13	141	
80	4	2	15	159	
90	5	3	17	185	
100	5	3	19	203	

Cream—32%

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	2	18	
10	0	0	3	27	
20	1	0	6	58	
30	1	1	10	98	2 T
40	2	1	13	129	
50	2	1	16	156	
60	2	1	19	183	
70	3	1	22	214	
80	3	2	26	254	
90	4	2	29	285	
100	4	2	32	312	

Cream—40%

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	2	18	
10	0	0	4	36	
20	1	0	8	76	
30	1	1	12	116	2 T
40	1	1	16	152	
50	2	1	20	192	
60	2	1	24	228	
70	2	1	28	264	
80	2	2	32	304	
90	3	2	36	344	
100	3	2	40	380	

EGGS—HEN'S—UNCOOKED—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	1	13	
10	0	1	1	13	
20	0	3	2	30	
30	0	4	3	43	
40	0	5	4	56	
50	0	7	6	82	1
60	0	8	7	95	
70	0	9	8	108	
80	0	10	9	121	
90	0	12	10	138	
100	0	13	11	151	2

EGGS—HEN'S—BOILED WHITES—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	0	4	
10	0	1	0	4	
20	0	2	0	8	
30	0	4	0	16	1
40	0	5	0	20	
50	0	6	0	24	
60	0	7	0	28	
70	0	8	0	32	
80	0	10	0	40	
90	0	11	0	44	
100	0	12	0	48	

Eggs—Hen's—Boiled Yolks—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	2	22	
10	0	2	3	35	
20	0	3	7	75	1
30	0	5	10	110	
40	0	6	13	141	
50	0	8	17	185	
60	0	10	20	220	
70	0	11	23	251	
80	0	13	26	286	
90	0	14	30	326	
100	0	16	33	361	

Buttermilk—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	0	0	
10	1	0	0	4	
20	1	1	0	8	
30	2	1	0	12	
40	2	1	0	12	
50	3	2	1	29	
60	3	2	1	29	
70	4	2	1	33	
80	4	2	1	33	
90	5	3	1	41	
100	5	3	1	41	240 gms. = 1 cup

Condensed Milk—Unsweetened

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	1	1	17	
10	1	1	1	17	
20	2	2	2	34	
30	3	3	3	51	2 T
40	4	4	4	68	
50	6	5	5	89	
60	7	6	5	97	
70	8	7	6	114	
80	9	8	7	131	
90	10	9	8	148	
100	11	10	9	165	

Milk—Skimmed—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	0	0	
10	1	0	0	4	
20	1	1	0	8	
30	2	1	0	12	
40	2	1	0	12	
50	3	2	0	20	
60	3	2	0	20	
70	4	2	0	24	
80	4	2	0	24	
90	5	3	0	32	
100	5	3	0	32	240 gms. = 1 cup

MILK—WHOLE—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	0	0	
10	1	0	0	4	
20	1	1	1	17	
30	2	1	1	21	
40	2	1	2	30	
50	3	2	2	38	
60	3	2	2	38	
70	4	2	3	51	
80	4	2	3	51	
90	5	3	4	68	
100	5	3	4	68	240 gms. = 1 cup

FRUITS

FRUIT—10%—FRESH
- Alligator Pear E.P.[1]
- Cranberries A.P.
- Grapefruit E.P.[1]
- Lemon-juice
- Peaches
- Pineapple E.P.
- Strawberries E.P.
- Muskmelon E.P.
- Watermelon E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	1	0	0	4	
20	2	0	0	8	
30	3	0	0	12	
40	4	0	0	16	
50	5	0	0	20	
60	5	0	0	20	
70	6	0	0	24	
80	7	0	0	28	
90	8	0	0	32	
100	9	0	0	36	½ small grapefruit, diameter 4 in.

[1] Joslin, E.P. Diabetic Manual.

FRUIT—15%—FRESH

Apple A.P.	Blackberries A.P.	Oranges E.P.
Apple E.P.	Black Raspberries E.P.	Pears E.P.
Apricot E.P.	Gooseberries E.P.[1]	Red Raspberries A.P.
Banana A.P.	Grapes A.P.	

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	1	0	0	4	
20	3	0	0	12	
30	4	0	0	16	
40	5	0	0	20	
50	7	1	1	41	
60	8	1	1	45	
70	9	1	1	49	
80	10	1	1	53	
90	12	1	1	61	
100	13	1	1	65	
					1 small orange diameter 2 in.

[1] Joslin, E.P. Diabetic Manual.

FRUIT—20%—FRESH

Cherries A.P.	Huckleberries E.P.	Plums E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	4	0	0	16	
30	5	0	0	20	1 large plum
40	7	0	0	28	
50	9	1	1	49	
60	11	1	1	57	
70	13	1	1	65	
80	14	1	1	69	
90	16	1	1	77	
100	18	1	1	85	

Fruit—Dried

Apricots A.P. Figs. A.P. Raisins E.P.
Dates A.P. Prunes A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	3	0	0	12	
10	7	0	0	28	
20	14	1	0	60	
30	21	1	0	88	2 small prunes
40	28	1	0	116	
50	35	2	1	157	
60	41	2	1	181	
70	48	2	1	209	
80	55	2	1	237	
90	62	3	1	269	
100	69	3	1	297	

MEATS

Bacon—Smoked—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	3	31	
10	0	1	7	67	
20	0	2	13	125	
30	0	3	20	192	3 strips
40	0	4	26	250	
50	0	6	33	321	
60	0	7	39	379	
70	0	8	46	446	
80	0	9	52	504	
90	0	10	59	571	
100	0	11	65	629	

The fat in cooked bacon is so variable that in amount its value can only be approximately estimated. For this reason it is preferable to weigh the bacon uncooked; and the fat which escapes in the process of cooking can be utilized in the preparation of other foods.

Chicken Broiler—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	0	4	
10	0	1	0	4	
20	0	3	0	12	
30	0	4	0	16	
40	0	5	0	20	
50	0	7	1	32	
60	0	8	1	36	
70	0	9	1	40	
80	0	10	1	44	
90	0	12	1	52	
100	0	13	1	56	
					180 gms. = 1 small chicken

Lean Meat—Cooked
Beef Round—Fat Removed
Beef Dried—Canned
Chicken Breast

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A. serving in approx. measure
5	0	1	0	4	
10	0	3	1	21	
20	0	6	1	33	
30	0	8	2	50	
40	0	11	3	71	
50	0	14	4	92	1 slice 4 × 3 × ¼ in.
60	0	17	4	104	
70	0	20	5	125	
80	0	22	6	142	
90	0	25	6	154	
100	0	28	7	175	

Medium Fat Meat—Cooked

Beef—corned E.P.
Beef roast A.P.
Tenderloin E.P.
Ham—smoked—boiled A.P.
Lamb—Roast leg
Lamb chop
Mutton—Roast leg E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	1	13	
10	0	2	2	26	
20	0	4	5	61	
30	0	6	7	87	
40	0	8	9	113	
50	0	11	12	152	1 slice 4 × 4 × ¼ in.
60	0	13	14	178	
70	0	15	16	204	
80	0	17	18	230	
90	0	19	21	265	
100	0	21	23	291	

Sweetbreads—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	1	13	
10	0	2	1	17	
20	0	3	2	30	
30	0	5	4	56	
40	0	7	5	73	
50	0	9	6	90	
60	0	10	7	103	
70	0	12	8	120	
80	0	14	10	146	
90	0	15	11	159	
100	0	17	12	176	
					240 gms. = 1 pair

TONGUE—PICKLED—E.P.

Amount, grams	Carbohydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	1	13	
10	0	1	2	22	
20	0	3	4	48	
30	0	4	6	70	3 slices
40	0	5	8	92	
50	0	7	11	127	
60	0	8	13	149	
70	0	9	15	171	
80	0	10	16	193	
90	0	12	19	219	
100	0	13	21	241	

MISCELLANEOUS

NUTS

Almonds E.P.
Filberts E.P.
Peanut butter
Pecans E.P.
Walnuts—Calif. E.P.

Amount, grams	Carbohydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	1	3	35	2 almonds
10	2	2	6	70	10 filberts
20	3	4	12	136	2½ t peanut butter
30	5	6	18	206	
40	6	8	24	272	
50	8	10	30	342	
60	9	11	36	404	
70	11	13	42	474	
80	12	15	48	540	
90	14	17	54	610	
100	15	19	61	676	

Butternut—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	3	31	
10	0	3	6	66	15 gms. = 4 to 5 nuts
20	1	6	12	136	
30	1	8	18	198	
40	2	11	24	268	
50	2	14	31	343	
60	2	17	37	409	
70	3	20	43	479	
80	3	22	49	541	
90	4	25	55	611	
100	4	28	61	677	

Brazil Nut—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	3	31	
10	1	2	7	75	15 gms. = 2 nuts
20	1	3	13	133	
30	2	5	20	208	
40	3	7	27	283	
50	4	9	34	358	
60	4	10	40	416	
70	5	12	47	491	
80	6	14	54	566	
90	6	15	60	624	
100	7	17	67	699	

Cocoanut—Prepared—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	2	0	3	35	1 T
10	3	1	6	70	
20	6	1	11	127	
30	10	2	17	201	
40	13	2	23	267	
50	16	3	29	337	
60	19	4	34	398	
70	22	4	40	464	
80	26	5	46	538	
90	29	5	51	595	
100	32	6	57	665	

Gelatin—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	5	0	20	
10	0	9	0	36	1 T
20	0	18	0	72	
30	0	27	0	108	
40	0	36	0	144	
50	0	46	0	184	
60	0	55	0	220	
70	0	64	0	256	
80	0	73	0	292	
90	0	82	0	328	
100	0	91	0	364	

OIL—OLIVE OR SALAD—LARD—COTTOLENE

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	5	45	
10	0	0	10	90	
20	0	0	20	180	15 gms. = 1 T
30	0	0	30	270	
40	0	0	40	360	
50	0	0	50	450	
60	0	0	60	540	
70	0	0	70	630	
80	0	0	80	720	
90	0	0	90	810	
100	0	0	100	900	

FISH

LEAN FISH—FRESH

Cod sections E.P.
Flounder—Whole E.P.
Haddock—Entrails removed E.P.
Halibut steak E.P.
Mackerel—Whole E.P.
Perch—White—Whole E.P.
Trout—Brook—Whole E.P.
Weakfish—Whole E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	0	4	
10	0	2	0	8	
20	0	4	1	25	
30	0	5	1	29	
40	0	7	1	37	
50	0	9	2	54	
60	0	11	2	62	
70	0	13	2	70	
80	0	14	2	74	
90	0	16	3	91	Slice 3 × 2¼ ×
100	0	18	3	99	1 in.

Fat Fish—Canned

Salmon E.P. Sardines E.P. Tunny—in oil E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	1	13	
10	0	2	2	26	
20	0	5	3	47	
30	0	7	5	73	
40	0	9	7	99	
50	0	12	9	129	
60	0	14	10	146	½ cup
70	0	16	12	172	
80	0	18	14	198	
90	0	21	15	219	
100	0	23	17	245	

Shell Fish—Fresh

Clams—Long E.P. Crabs—Hard—E.P. Lobster—Whole E.P

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	1	0	4	
10	0	1	0	4	
20	0	3	0	12	
30	0	4	1	25	
40	0	6	1	33	
50	1	7	1	41	
60	1	8	1	45	6 clams
70	1	10	1	53	
80	1	11	2	66	
90	1	13	2	74	
100	1	14	2	78	

OYSTERS—SOLIDS—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	0	0	
10	0	1	0	4	
20	1	1	0	8	
30	1	2	0	12	
40	1	2	0	12	
50	2	3	1	29	
60	2	4	1	33	
70	2	4	1	33	
80	2	5	1	37	
90	3	5	1	41	
100	3	6	1	45	⅓ cup

VEGETABLES

VEGETABLES—5%

- Artichokes—Canned
- Asparagus—raw and canned
- Brussels sprouts—Canned
- Cabbage
- Cauliflower
- Celery
- Cucumber
- Egg Plant
- Endive[1]
- Haricot-vert beans—Canned
- Lettuce
- Okra—Canned
- Radishes
- Rhubarb
- Sauerkraut
- String beans—Canned
- Tomato—raw and canned
- Wax beans—Canned

[1] Joslin, E. P. Diabetic Manual.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	0	0	
10	0	0	0	0	
20	1	0	0	4	
30	1	0	0	4	
40	2	0	0	8	
50	2	1	0	12	
60	2	1	0	12	
70	3	1	0	16	
80	3	1	0	16	
90	4	1	0	20	
100	4	1	0	20	½ cup

VEGETABLES—10%

Beets E.P. | Peas—Green—Canned | Squash—Canned
Carrots E.P. | Pumpkin—Canned | String beans—Fresh
Onions E.P. | Rutabagas E.P. | Turnip E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	1	0	0	4	
20	2	0	0	8	
30	3	1	0	16	
40	4	1	0	20	
50	5	1	0	24	
60	5	1	0	24	
70	6	1	0	28	
80	7	2	0	36	
90	8	2	0	40	
100	9	2	0	44	½ cup

Baked Beans—Canned

Amount, grams	Carbohydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	1	0	12	
20	4	1	1	29	
30	6	2	1	41	
40	8	3	1	53	
50	10	4	2	74	
60	12	4	2	82	
70	14	5	2	94	
80	16	6	2	106	
90	18	6	3	123	
100	20	7	3	135	½ cup

Beans—Lima—Canned—A.P.

Amount, grams	Carbohydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	3	1	0	16	
30	5	1	0	24	
40	6	2	0	32	
50	8	2	0	40	
60	9	2	0	44	
70	11	3	0	56	
80	12	3	0	60	
90	14	4	0	72	
100	15	4	0	76	½ cup

Corn—Green—Canned—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	4	1	0	20	
30	6	1	0	28	
40	8	1	0	36	
50	10	2	1	57	
60	11	2	1	61	
70	13	2	1	69	
80	15	2	1	77	
90	17	3	1	89	
100	19	3	1	97	½ cup

Olives—Green—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	0	0	1	9	1 medium-sized
10	1	0	2	22	
20	2	0	4	44	
30	3	0	6	66	
40	4	0	8	88	
50	5	1	10	114	
60	5	1	12	132	
70	6	1	14	154	
80	7	1	16	176	
90	8	1	18	198	
100	9	1	20	220	

POTATOES—BOILED—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	4	1	0	20	
30	6	1	0	28	
40	8	1	0	36	
50	11	2	0	52	
60	13	2	0	60	
70	15	2	0	68	
80	17	2	0	76	
90	19	3	0	88	
100	21	3	0	96	
					150 gms. = 1 medium-sized

POTATOES—RAW OR FRESH—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	3	0	0	12	
30	5	1	0	24	
40	6	1	0	28	
50	8	1	0	36	
60	9	1	0	40	
70	11	1	0	48	
80	12	2	0	56	
90	14	2	0	64	
100	15	2	0	68	
					150 gms. = 1 medium-sized

POTATOES—SWEET—RAW OR FRESH—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	4	0	0	16	
30	7	0	0	28	
40	9	0	0	36	
50	11	1	1	57	
60	13	1	1	65	
70	15	1	1	73	
80	18	1	1	85	
90	20	1	1	93	
100	22	1	1	101	1 small-sized

POTATOES—SWEET—RAW OR FRESH—E.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	3	0	0	12	
20	5	0	0	20	
30	8	1	0	36	
40	11	1	0	48	
50	14	1	1	69	
60	16	1	1	77	
70	19	1	1	89	
80	22	2	1	105	
90	24	2	1	113	
100	27	2	1	125	1 small-sized

SUCCOTASH—A.P.

Amount, grams	Carbo-hydrate, grams	Protein, grams	Fat, grams	Calories	A serving in approx. measure
5	1	0	0	4	
10	2	0	0	8	
20	4	1	0	20	
30	6	1	0	28	
40	8	2	0	40	
50	10	2	1	57	
60	11	2	1	61	
70	13	3	1	73	
80	15	3	1	81	
90	17	4	1	93	
100	19	4	1	101	½ cup

NOTE.—The diabetic diet form given on pages 148 and 149 presents a selection of articles of food for use in diabetic diets given in arbitrary portions, the quantities of which are stated in grams, ounces and household measure, together with their carbohydrate, protein and fat content, and their caloric value. In prescribing one or more portions or a fraction of a portion, the proper number is written in the column for the total number of portions opposite the name of the particular article. The meal at which the food is to be used is designated by use of the blank spaces at the right of the list of articles (B for breakfast, D for dinner, and L or S for luncheon or supper).

The food value of the daily diet thus made out is obtained by multiplying the number of portions of each article of food prescribed by the grams of carbohydrate, protein and fat and the calories of one portion, as found opposite each article; the sum of these products gives the food value of the diet. If these figures fall short of the prescription, additions may be easily made.

The diet thus made out is copied in menu form in the blank space provided for this, and the quantities given in each serving stated in grams, ounces or household measure. This menu and the explanatory lists are given to the patient with instructions as to how he may use the latter to vary his diet from day to day.

Diet Form*

Name J. Smith
Date Sept. 24, 1923.
Diet 70-70-150

In each portion				No. of portions	Grams	Ounces	Approx. measure	Food	No. in each meal		
Carbohydrate	Protein	Fat	Calories						B	D	L or S
6	2	0	32	4	150	5	¾ cup	5% vegetables	..	2	2
11	2	0	52	...	120	4	⅔ cup	10% vegetables			
19	3	0	88	...	90	3	½ cup	potato—boiled			
12	2	0	56	1	15	½	3 T	cereal—raw	1		
16	3	0	76	...	30	1	¼ in. slice	bread—bakers			
11	2	2	70	...	15	½	2	crackers			
11	0	0	44	1½	120	4	½ grape-fruit	10% fruit—fresh	1	½	
16	1	1	77	...	120	4	1 orange	15% fruit—fresh			
16	1	1	77	...	90	3	3 plums	20% fruit—fresh			
0	8	10	122	...	30	1	1 × 1 × 1½ in.	cheese			
4	19	1	101	...	90	3	⅓ cup	cottage cheese			
0	13	11	151	1	100	3⅓	2	egg—whole	1		
6	4	5	85	2	120	4	½ cup	milk—whole	1	...	1
6	4	0	40	...	120	4	½ cup	skim milk			
6	4	1	49	...	120	4	½ cup	buttermilk			
0	25	6	154	...	90	3	5 × 4½ × ¼ in.	lean meat—cooked			
0	19	21	264	1	90	3	5 × 5½ × ¼ in.	medium fat meat—cooked	...	1	
0	22	4	124	...	120	4	3×3×1 in.	lean fish			
0	14	10	146	1	60	2	½ cup	fat fish—canned			1
1	13	2	74	...	90	3	9 clams	shell fish			
0	3	20	192	1	30	1	3 strips	bacon—raw	1		
0	0	13	117	4	15	½	1 in. cube	butter	1	2	1
2	1	6	66	2	30	1	2 T	cream—20%	1	½	½
1	1	10	98	...	30	1	2 T	cream 32%			
1	1	12	116	...	30	1	2 T	cream 40%			
0	0	15	135	1	15	½	1 T	oil			1
1	0	3	31	...	15	½	3	olives A.P.			
3	3	9	105	...	15	½	3	nuts E.P.			
				3	...	...	....	coffee, tea cocoa shells broth	1	1	1
69	69	151	1911	...	...	...	....	whiskey			

* Modification of Cornwall Universal Diabetic Diet List (See p. 71).

Diet Form

Name J. Smith
Date Sept. 24, 1923.
Diet 70-70-150

Explanatory

5% vegetables—Edible Portion

Artichokes	Egg plant
Asparagus	Endive
String beans, canned	Lettuce
Brussels sprouts	Okra, canned
Cabbage	Radishes
Cauliflower	Rhubarb
Celery	Sauerkraut
Cucumber	Tomato

10% vegetables—Edible Portion

Beets	Rutabagas
Carrots	Squash
Onions	Turnip
Green peas canned	
Pumpkin canned	

Cereals—Raw

Corn meal	Rice
Farina	Rolled oats
Macaroni	Shredded wheat
Noodles	Wheatena
Pettijohn	

Bread—Bakers

Rye	White	Whole wheat

Crackers—

Graham	Saltines	Soda

10% fruit—fresh—Edible portion

Alligator pear	Pineapple
Cranberries	Strawberries
Grapefruit	Watermelon
Lemon	Muskmelon
Peaches	

15% fruit—fresh—Edible Portion

Gooseberries	Oranges
Apple	Pears
Apricot	Bananas A.P.
Black and red raspberries	
Grapes	Blackberries

20% fruit—fresh—Edible Portion

Cherries	Huckleberries	Plums

Cheese

American pale	Roquefort
Full cream	Swiss
Limburger	

Lean Meat—cooked
- Beef round—fat removed
- Beef dried—canned
- Chicken breast

Medium fat meat

Beef corned	Lamb chop
Beef roast	Lamb roast
Beef tenderloin	
Ham smoked and cooked	

Lean fish—fresh—Edible Portion

Cod steak	Mackerel
Flounder	Perch
Haddock	Trout
Halibut	Weakfish

Fat fish—canned

Salmon	Tunny—in oil
Sardines	

Shell fish—fresh
- Clams, crabs, lobster

Menu

Breakfast

Bacon	30
Eggs	100
Cereal—raw	15
10% fruit	120
Cream	30
Milk	120
Butter	15
Coffee	

Lunch or Supper

Fat fish	60
5% vegetable	300
Cream	15
Milk	120
Butter	15
Oil	15
Tea	

Dinner

Medium fat meat	90
5% vegetable	300
10% fruit	60
Cream	15
Butter	30
Tea	

CHAPTER XI

METHODS OF BLOOD AND URINE ANALYSIS OF IMPORTANCE IN THE MANAGEMENT OF DIABETES

In the following pages are given directions for only those methods of blood and urine analysis which are of direct practical importance in the management of diabetes. All of them can be done without great difficulty and there is no reason why they should not be widely used by practitioners.

DETERMINATION OF THE ALKALINE RESERVE OF THE BLOOD PLASMA UNDER CONSTANT CARBON DIOXIDE TENSION[1]

The most practical clinical method for the measurement of acidosis is the determination of the alkaline reserve. The procedure, which is not difficult, is described below.

Drawing Blood Specimen. The blood (about 6 c.c.) is drawn from an arm vein into a Luer syringe. It is then immediately transferred to a centrifuge tube containing a few crystals of potassium oxalate and centrifuged within a half hour after drawing. After the removal of the clear plasma, it may be kept unchanged for a week on

[1] Van Slyke and Cullen.

ice, in case it is not convenient to determine the carbon dioxide capacity immediately.

Saturation with Carbon Dioxide at Alveolar Tension. In order to correct for loss of carbon dioxide, the plasma is resaturated with carbon dioxide at normal alveolar tension immediately before analysis. The plasma is placed in a separatory funnel of about 300 c.c. capacity and the funnel is completely filled with alveolar air from the lungs of the operator, using a forced, quick expiration. The stopper should be inserted before the stream of expired air ceases, in order that outside air may not be drawn in. Before it enters the funnel the air should be passed through a bottle of glass beads to bring the moisture content down to saturation at room temperature, and so not dilute the plasma. The funnel is now rotated for two minutes, the plasma being distributed over the surface of the walls in as thin a layer as possible.

Determination. Immediately before beginning the analysis the apparatus is tested to be certain that it is air tight. To do this, raise the mercury leveling bulb (Position 1) allowing mercury to flow in through the lower cock until the mercury completely fills the apparatus and both capillaries (*a* and lower *b*) above the upper stop cock (*e*). Close the upper cock and lower the leveling bulb (Position 3) until the vacuum extends to the 50 c.c. mark. Now raise the leveling bulb gently. If the vacuum remains and no air has leaked in, the mercury will rise and strike the cock with a sharp click.

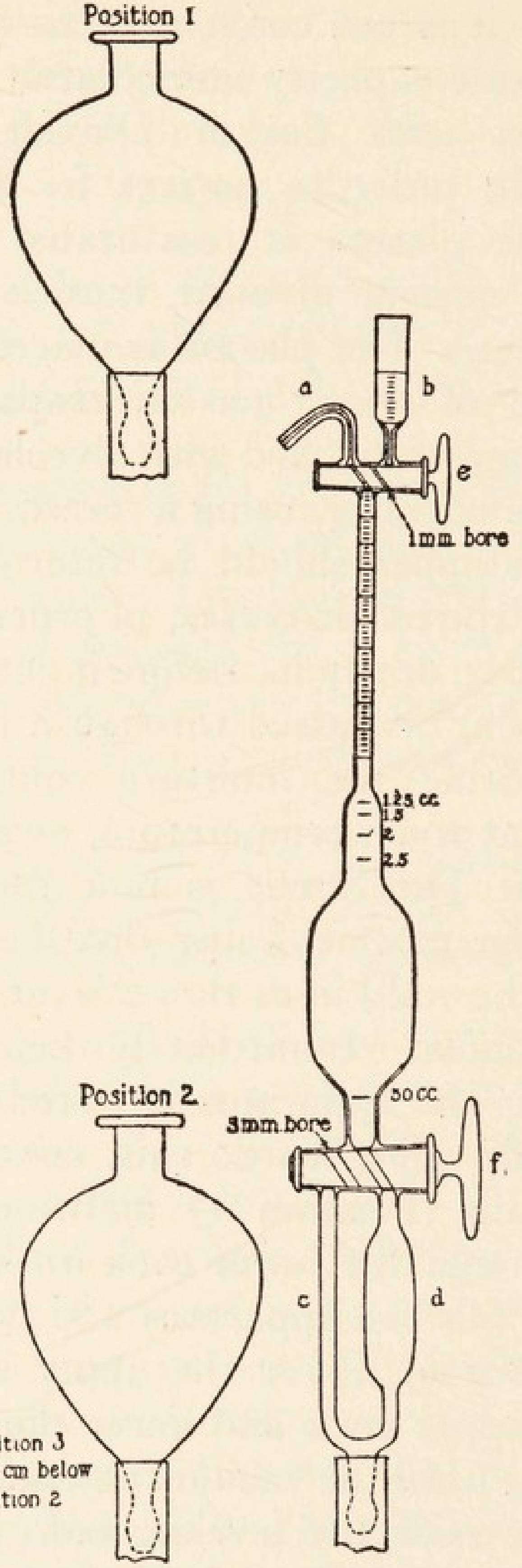

FIG. 1.—Van Slyke and Cullen Apparatus. Courtesy of Journal of Biological Chemistry.

If air has leaked in, the characteristic sharp click is dulled by an air cushion. If there is air, force out through the capillary and repeat the test.

When air-free, the apparatus, including the capillaries above the cock, is left filled with mercury, and about 1 c.c. of distilled water is placed in the cup (*b*). One c.c. of the saturated plasma in the separatory funnel is then quickly drawn up into an Ostwald pipette, calibrated to deliver 1 c.c. between two marks, and introduced into the cup beneath the surface of the water to avoid loss of CO_2 during the transfer. The plasma is then slowly run into the apparatus allowing the water to follow after and wash down the sides of the cup. Care should be taken not to admit any air. One or two drops of caprylic alcohol, to prevent foaming, are then admitted, then ¼ to ½ c.c. of 5 per cent sulphuric acid, and finally enough water to bring the total volume in the apparatus up to 2.5 c.c. (This is because the table for calculation of CO_2 per 100 c.c. of plasma is corrected for the physically dissolved carbon dioxide and air in 2.5 c.c. of fluid.) The capillary in the upper cock is then sealed with a drop of mercury to prevent air from being drawn in during the analysis.

The lower cock (*f*) having remained open since the beginning of these manipulations, the leveling bulb is now lowered, allowing the mercury to fall to the 50 c.c. mark. The cock is then closed. In order to extract the carbon dioxide as completely as possible the apparatus is removed and shaken vigorously ½ minute. It is then replaced. The leveling bulb is lowered and the lower cock opened, allowing the solution in the large chamber to flow almost completely into the lower chamber (*d*) below the cock, without, however, permitting any of the gas to follow it. The cock is then closed and opened again to the opposite side, (*c*) allowing mercury to flow into the upper chamber by raising the bulb. The leveling bulb is now placed beside the apparatus so that the mercury level in it is even with that in the apparatus, and the lower cock closed. The gas is now under atmospheric pressure. A few hundredths of a cubic centimeter of water will float on the mercury in the apparatus, but this may be disregarded in leveling. The volume of gas above the short column of water referred to is at once read off.

Calculation. Take temperature at the time of the determination. Then by means of the table the corrected gas volume may be directly transposed into cubic centimeters of CO_2 chemically bound by 100 c.c. of plasma.

Interpretation. Normal values for carbon dioxide range from 50 to 65 volumes per cent, 40 to 50 indicate mild acidosis, 30 to 40, moderate, below 30, severe, and below 20, extremely severe.

NOTE.—The method as described here will be found sufficiently accurate for clinical observations but may not be reliable within 5 volumes per cent as barometric corrections and certain precautions, preventing changes in the reaction of the blood, have been omitted. For procedure necessary for scientific accuracy the reader is referred to the original articles by D. D. Van Slyke in the *Journal of Biological Chemistry*.

Table for Calculation of Carbon Dioxide Combining Power of Plasma

Observed vol. gas	C.c. of CO_2 reduced to 0° 760 mm., bound as bicarbonate by 100 c.c. of plasma				Observed vol. gas	C.c. of CO_2 reduced to 0°, 760 mm., bound as bicarbonate by 100 c.c. of plasma			
	15°	20°	25°	30°		15°	20°	25°	30°
0.20	9.1	9.9	10.7	11.8	0.60	47.7	48.1	48.5	48.6
1	10.1	10.9	11.7	12.6	1	48.7	49.0	49.4	49.5
2	11.0	11.8	12.6	13.5	2	49.7	50.0	50.4	50.4
3	12.0	12.8	13.6	14.3	3	50.7	51.0	51.3	51.4
4	13.0	13.7	14.5	15.2	4	51.6	51.9	52.2	52.3
5	13.9	14.7	15.5	16.1	5	52.6	52.8	53.2	53.2
6	14.9	15.7	16.4	17.0	6	53.6	53.8	54.1	54.1
7	15.9	16.6	17.4	18.0	7	54.5	54.8	55.1	55.1
8	16.8	17.6	18.3	18.9	8	55.5	55.7	56.0	56.0
9	17.8	18.5	19.2	19.8	9	56.5	56.7	57.0	56.9
0.30	18.8	19.5	20.2	20.8	0.70	57.4	57.6	57.9	57.9
1	19.7	20.4	21.1	21.7	1	58.4	58.6	58.9	58.8
2	20.7	21.4	22.1	22.6	2	59.4	59.5	59.8	59.7
3	21.7	22.3	23.0	23.5	3	60.3	60.5	60.7	60.6
4	22.6	23.3	24.0	24.5	4	61.3	61.4	61.7	61.6
5	23.6	24.2	24.9	25.4	5	62.3	62.4	62.6	62.5
6	24.6	25.2	25.8	26.3	6	63.2	63.3	63.6	63.4
7	25.5	26.2	26.8	27.3	7	64.2	64.3	64.5	64.3
8	26.5	27.1	27.7	28.2	8	65.2	65.3	65.5	65.3
9	27.5	28.1	28.7	29.1	9	66.1	66.2	66.4	66.2
0.40	28.4	29.0	29.6	30.0	0.80	67.1	67.2	67.3	67.1
1	29.4	30.0	30.5	31.0	1	68.1	68.1	68.3	68.0
2	30.3	30.9	31.5	31.9	2	69.0	69.1	69.2	69.0
3	31.3	31.9	32.4	32.8	3	70.0	70.0	70.2	69.9
4	32.3	32.8	33.4	33.8	4	71.0	71.0	71.1	70.8
5	33.2	33.8	34.3	34.7	5	71.9	72.0	72.1	71.8
6	34.2	34.7	35.3	35.6	6	72.9	72.9	73.0	72.7
7	35.2	35.7	36.2	36.5	7	73.9	73.9	74.0	73.6
8	36.1	36.6	37.2	37.4	8	74.8	74.8	74.9	74.5
9	37.1	37.6	38.1	38.4	9	75.8	75.8	75.8	75.4
0.50	38.1	38.5	39.0	39.3	0.90	76.8	76.7	76.8	76.4
0.51	39.1	39.5	40.0	40.3	0.91	77.8	77.7	77.7	77.3
2	40.0	40.4	40.9	41.2	2	78.7	78.6	78.7	78.2
3	41.0	41.4	41.9	42.1	3	79.7	79.6	79.6	79.2
4	42.0	42.4	42.8	43.0	4	80.7	80.5	80.6	80.1
5	42.9	43.3	43.8	43.9	5	81.6	81.5	81.5	81.0
6	43.9	44.3	44.7	44.9	6	82.6	82.5	82.4	82.0
7	44.9	45.3	45.7	45.8	7	83.6	83.4	83.4	82.9
8	45.8	46.2	46.6	46.7	8	84.5	84.4	84.3	83.8
9	46.8	47.1	47.5	47.6	9	85.5	85.3	85.2	84.8
0.60	47.7	48.1	48.5	48.6	1.00	86.5	86.2	86.2	85.7

List of Apparatus Used in Determination of the Alkaline Reserve. A 300 c.c. separatory funnel.

A one c.c. pear-shaped Ostwald pipette accurately calibrated to deliver 1 c.c. between two marks (Emil Greiner Co., New York).

A Van Slyke CO_2 apparatus attached to a board, having a clamp on the back that may be simply unhooked to remove apparatus for shaking (Emil Greiner Co.)

A 200 c.c. leveling bulb.

Four feet of rubber tubing. The most durable tubing is the nitrometer tubing obtainable from A. H. Thomas and Co. This tubing is free from sulphur.

Mercury, 150 c.c.; about 2 kg.

A small bottle half filled with glass beads and containing a two-holed rubber stopper with inlet tube reaching to bottom of bottle, and outlet tube just extending below stopper.

Reagents: (*a*) 5 per cent sulphuric acid
(*b*) caprylic alcohol

Hints on Cleaning Apparatus. Between analyses the apparatus may be conveniently washed as follows: Close the upper cock and lower leveling bulb. While the mercury in the apparatus is falling, fill the 6 c.c. cup with water. As soon as the apparatus is partly evacuated let in the water, which rushes down the sides washing the entire chamber. Eject the water and rinse once more, leaving 1 c.c. water in the cup to start the next analysis.

BLOOD SUGAR DETERMINATION[1]

The Folin and Wu blood-sugar method, like all the available methods for the determination of

[1] Method of Folin and Wu.

blood sugar, is based upon a chemical reduction reaction. The protein is precipitated with tungstic acid and the determination is then made on the water-clear filtrate, using alkaline copper tartrate as the oxidizing agent. The method is simple, quick and reliable.

Blood for sugar determinations on patients not receiving insulin should be drawn at least four hours after a meal, preferably just before breakfast. In patients receiving insulin, the interpretation of the blood sugar with regard to meal time and injections is discussed in Chapter V.

As is well known, the sugar content of blood rapidly decreases on standing, even at a low temperature. Because of this rapid glycolysis the sugar determination should be made within an hour after drawing the sample. If this is impossible, the protein may be precipitated or a preservative added. One drop of formalin (40 per cent formaldehyde) added to 5 c.c. of oxalated blood will prevent glycolysis for at least ninety-six hours at ordinary temperatures. The protein-free filtrate prepared as described below will also keep for at least seventy-two hours, or for a longer period if preserved with thymol, toluol or xylene.

Technique of Determination. Transfer 1 c.c. of oxalated blood to a small flask or bottle, add 7 c.c. of water, then 1 c.c. of 10 per cent sodium tungstate and mix. Finally, add 1 c.c. ⅔ normal sulphuric acid and shake vigorously. If precipitation is complete the color of the coagulum gradually changes from old rose to brown. In case the color does not change the precipitation is incomplete, usually because too much oxalate has been used. The addition of 1 or 2 drops of 10 per cent sulphuric acid with shaking will generally clear up such a sample. Pour the mixture through a filter paper just large enough to hold the entire 10 c.c. in order to obtain the maximum amount of filtrate. The latter should be absolutely water-clear.

To 2 c.c. of the tungstic acid filtrate in a Folin-Wu blood-sugar tube add 2 c.c. alkaline copper solution. At the same time prepare two standards. Take two Folin-Wu blood-sugar tubes: into one measure with an accurate pipette 2 c.c. of .01 per cent standard dextrose solution; into the other 2 c.c. of the .02 per cent dextrose. To each tube then add 2 c.c. of the alkaline copper solution. Place the tubes in a boiling-water bath and heat for six minutes, then transfer to a cold-water bath and let cool without shaking for two or three minutes. After cooling add to each tube 2 c.c. of the molybdic acid reagent. When the cuprous oxide is dissolved, dilute the blue solution to the 25 c.c. mark, stopper and mix thoroughly. Compare in the colorimeter, using the standard which better matches the unknown.

Calculation: $\frac{\text{Reading of the Standard}}{\text{Reading of the Unknown}} \times$ per cent glucose in standard $\times$ 10 = per cent of sugar.

Normal blood sugar range = 0.08 to 0.13 per cent.

Preparation of Solutions

1. STANDARD SUGAR SOLUTIONS.

(*a*) Stock solution: Dissolve 1 gm. of pure anhydrous dextrose[1] in distilled water and dilute to 100 c.c. in volumetric flask.

(*b*) Dilute 5 c.c. of (*a*) to 500 c.c. giving a .01 per cent solution.

(*c*) Dilute 10 c.c. of (*a*) to 500 c.c. giving a .02 per cent solution.

2. ALKALINE COPPER SOLUTION.

Dissolve 40 gms. of pure anhydrous sodium carbonate in about 400 c.c. of water and transfer to a liter flask. Add 7.5 gms. tartaric acid and when the latter has dissolved add 4.5 gms. of crystallized copper sulphate, mix and make up to a volume of 1 liter.

3. MOLYBDIC ACID REAGENT.

Transfer to a liter beaker 35 gms. of molybdic acid (J. T. Baker) and 5 gms. of sodium tungstate. Add 200 c.c. of 10 per cent sodium hydroxide and 200 c.c. of water. Boil vigorously twenty to forty minutes, so as to remove nearly the whole of the ammonia present in the molybdic acid. Cool, dilute to about 350 c.c., and add 125 c.c. of concentrated (85 per cent) phosphoric acid. Dilute to 500 c.c.

[1] (Kahlbaum or Pfanstiehl from Special Chemicals Company, Highland Park, Ill.)

4. TWO-THIRDS NORMAL SULPHURIC ACID.

Dilute exactly 18.7 c.c. of concentrated (95 per cent) c. p. sulphuric acid to a liter.

5. TEN PER CENT SODIUM TUNGSTATE.

Dissolve 100 gms. of sodium tungstate in water and make up to a volume of 1 liter.

Notes on the Method

Preservation of Sugar Solutions. The standard sugar solutions may be preserved almost indefinitely by the addition of a small crystal of thymol. This in no way interferes with the blood-sugar determination by this method. Toluene or xylene may also be used, but these preservatives are difficult to keep out of pipettes, which drain very poorly when filmed with toluol.

Folin and Berglund advocate the making up of the 1 per cent glucose in 0.3 per cent benzoic acid. The same benzoic acid solution is used instead of water for the preparation of the dilute standards. The dilute as well as the 1 per cent solution then keeps perfectly well.

Potassium Oxalate to Prevent Clotting. Much oxalate or citrate interferes with the precipitation of the protein. We add 0.1 c.c. of 20 per cent potassium oxalate (= 20 mg.) to our specimen bottles and then dry in the oven. This amount of oxalate is ample for 10 c.c. of blood, but in case only 1 or 2 c.c. of blood are taken, the precipitation is not affected.

Alkaline Copper Solution. Two c.c. of alkaline copper solution are sufficient for blood containing sugar up to 0.4 per cent. For bloods higher than this only 1 c.c. of filtrate should be used.

Folin Sugar Tube. The special blood-sugar tube is shown in Figure 2. It is designed to prevent reoxidation of cuprous compounds by reducing to a minimum the surface area of the mixture of blood filtrate and copper solution in contact with the air during heating. It is essential, therefore, that the 4 c.c. mark should lie along the constriction. These tubes may be obtained with or without graduation from the Emil Greiner Company, New York, or Arthur H. Thomas Company, Philadelphia.

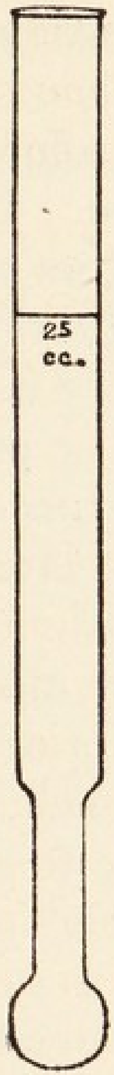

FIG. 2.—Folin Blood-Sugar Tube.

LABORATORY ANALYSES OF THE URINE WHICH ARE IMPORTANT IN THE MANAGEMENT OF DIABETES

Collection of a Twenty-four-hour Specimen. For determining the total excretion of sugar a complete twenty-four hour specimen must be collected, beginning after the 7 or 8 a. m. voiding and continuing up to and including the 7 or 8 a. m. voiding on the following day. To prevent decomposition, collection should be made in a well-cleaned 2-liter bottle containing 3 or 4 c.c. of toluol or a few c.c. of chloroform as a preservative. If possible keep the bottle on ice. Mix well before removing specimen for analysis.

Ferric Chloride Test for Ketone Bodies. To 2 or 3 c.c. of urine in a test-tube add an equal amount of 15 per cent ferric chloride. In the presence of acetoacetic acid a Bordeaux-red color is produced, the intensity depending on the amount of acetoacetic acid in the specimen. Compare the color of the mixture with that of equal parts of ferric chloride and distilled water or normal urine, contained in a tube of the same size. If the color is due to acetoacetic acid it will disappear spontaneously in twenty-four to forty-eight hours; if due to a substance such as antipyrin, phenacetin, a salicylate, sodium acetate, a thiocyanate, or thallin, all of which give a similar reaction, the color may remain permanent for days. This test cannot be positive with a negative nitroprusside test, because the nitroprusside is more delicate for acetoacetic acid than the ferric chloride test. Acetone does not give a Bordeaux-red color.

Nitroprusside Test for Ketone Bodies. This test detects both acetoacetic acid and acetone, but is more delicate for acetoacetic acid. To 5 c.c. of urine in a test-tube add 3 drops of freshly prepared 5 per cent aqueous sodium nitroprusside and a drop of glacial acetic acid. Mix, and layer with 26 per cent ammonia. In the presence of acetoacetic acid or acetone a ruby red to purple ring forms between the layers.

Benedict's Qualitative Reduction Test for Glucose: Solution

Copper sulphate	17.3 gms.
Sodium citrate	173.0 gms.
Sodium carbonate (anhydrous)	100.0 gms.
Distilled water to	1000.0 c.c.

With the aid of heat dissolve the sodium citrate in about 800 c.c. of water. Pour (through a folded filter if necessary) into a glass graduate and make up to 850 c.c. Dissolve the copper sulphate in about 100 c.c. of distilled water. Pour the carbonate-citrate solution into a large beaker or casserole and add the copper sulphate solution slowly, with constant stirring, and make up to 1 liter. The mixed solution is ready for use, and does not deteriorate upon long standing.

Test. Boil 8 (not more) drops of urine with 5 c.c. of the reagent in a test-tube one to two minutes, shaking to prevent boiling over; or immerse the test-tube in boiling water three to five minutes, and allow to cool spontaneously. In the presence of glucose the entire body of the solution will be filled with a precipitate which may be orange (high percentage) yellow or green (low percentage) in color, depending upon the amount of sugar present. If no glucose beyond the normal is present, the solution will, on standing five to ten minutes, either remain perfectly clear or show a very faint turbidity due to precipitated urates.

Notes on the Method

Chloroform and toluol do not interfere with this test, nor do uric acid nor creatinine interfere to such an extent as with Fehling's solution. Benedict's solution is much more specific for glucose than Fehling's and has the advantage that only one solution is necessary, and that it keeps indefinitely.

Haine's solution is about as delicate as Fehling's. The Bismuth Reduction Test (Nylander) will easily detect glucose present to the extent of 0.08 per cent. Uric acid, creatinine and homogentesic acid which interfere with Fehling's, do not interfere with Haine's, but solutions containing mercuric chloride or chloroform give a negative reaction.

Benedict's Quantitative Reduction Test for Glucose: Principle. Benedict's reagent for the estimation of reducing sugars contains potassium thiocyanate, and therefore a white precipitate of cuprous thiocyanate is formed on reduction, instead of the usual red cuprous oxide. As the precipitate is white, the loss of all blue color, indicating complete reduction of the copper, is easily observed. The solution contains sodium carbonate, a weak alkali, which is much less likely to destroy small amounts of sugar than a strong alkali. The solution keeps indefinitely.

Solution.

Copper sulphate (crystallized)........ 18.0 gms.
Sodium carbonate (crystallized, or ½ the weight of the anhydrous salt)... 200.0 gms.

Sodium or potassium citrate.........	200.0 gms.
Potassium thiocyanate..............	125.0 gms.
Potassium ferrocyanide (5% solution)	5 c.c.
Distilled water to make.............	1000.0 c.c.

The copper sulphate is the only substance which need be weighed out accurately. The remaining substances can be weighed on the rough balance. With the aid of heat, dissolve the carbonate, citrate and thiocyanate in enough water to make about 800 c.c. of the mixture, and filter. Dissolve the copper sulphate separately in about 100 c.c. water. Have both solutions boiling vigorously, and pour the copper sulphate solution slowly into the other liquid, with constant stirring. Add the ferrocyanide, cool and dilute to exactly 1 liter. Standardize with a glucose solution.

Standardization. To standardize follow directions (Macro Method) given below for determining sugar in urine, using instead of urine a 0.50 per cent solution of pure glucose. Twenty-five c.c. of the reagent will be reduced by 10 c.c. (=0.050 gm.) of this glucose solution if the reagent has been accurately prepared from pure chemicals. In case more or less than 10 c.c. of the standard glucose is required, calculate the weight of glucose in the number of c.c. used and employ this weight in the formula for calculation of sugar per cent in the urine. An example will illustrate. Suppose 10.8 c.c. of 0.50 per cent glucose are required to reduce 25 c.c. of reagent. Then $10.8 \times 0.0050 = 0.054$ gm.

glucose and we would use 0.054 instead of 0.050 in the formula.

Macro Method. Twenty-five c.c. of the reagent are measured with a pipette into a porcelain casserole (about 10 cm. in diameter); 5 to 10 gms. of crystallized sodium carbonate (or ½ the weight of the anhydrous salt) are added, together with a small quantity of powdered pumice stone or talcum, and the mixture heated to boiling over a free flame until the carbonate has dissolved. The urine is now run in slowly from a 25 c.c. burette until a chalk-white precipitate forms, and the blue color of the mixture begins to lessen perceptibly. The sides of the dish are washed down, and the urine is now run in very slowly, a few drops at a time, allowing the solution to boil vigorously after each addition, until the disappearance of the last trace of blue color, which marks the endpoint.

Calculation:

x = c.c. urine used in the titration.

0.050 = gms. glucose which reduce 25 c.c. of reagent.

Therefore $\frac{0.050}{x} \times 100$ or $\frac{5}{x}$ = per cent of glucose.

Knowing the twenty-four-hour volume, the number of grams excreted per day can be calculated.

Micro Method. This method does not require a burette, and less material is used than with the macro method, but it is less accurate. Into a 75 c.c. pyrex test-tube (25 × 200 mm.) measure 5 c.c. Benedict's quantitative solution, about a gram of sodium carbonate and a pinch of talcum. Place the tube in a test-tube holder and heat to boiling over a free flame, shaking constantly to prevent spattering. From a 2 c.c. pipette graduated in hundredths, add the urine, a few drops at a time, boiling vigorously after each addition. Continue this until the last trace of blue disappears.

$$\text{Calculation: } \frac{1}{\text{c.c. of urine used}} = \text{per cent glucose.}$$

Fermentation Test for Glucose. This test is of value in cases of a doubtful reduction, and if carefully checked, the experiment shows whether the reduction is actually due to glucose, or whether it is due to some other substance present in the urine, which is capable of reducing copper solutions.

Control I. Grind up some yeast with distilled water and fill a saccharometer, to prove that nothing in the yeast gives off carbon dioxide.

Control II. Grind up some yeast with a pure glucose solution and fill a saccharometer, to prove that the yeast is active.

Procedure: Place about 15 c.c. of urine in a mortar; add about 1 gm. of yeast (1/16 ordinary cake of compressed yeast) and carefully crush the latter by means of a pestle. Transfer the mixture to a saccharometer, being careful that the tube is completely filled. Place all three tubes in an incubator at 37.5° C. for twelve hours.

If gas is formed in the tube containing urine plus yeast and if it is present in Control II also, it may be assumed that the reducing substance in the urine is glucose. If gas forms in Control I, the test should be repeated with another cake of yeast.

Acid Heat Test for Albumin. Half fill a test-tube with urine and carefully heat the upper part of the tube to boiling. If a precipitate forms, it may be due either to albumin or to phosphates. Acidify the urine by adding dilute acetic acid drop by drop to the hot solution. If the precipitate is due to phosphates, it will disappear under these conditions; whereas if due to albumin, it will not only fail to disappear, but may become more pronounced.

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