LONDON: PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET

THE SKIM-MILK TREATMENT OF DIABETES AND BRIGHT'S DISEASE.

WITH CLINICAL OBSERVATIONS ON THE

SYMPTOMS AND PATHOLOGY OF THESE AFFECTIONS.

BY

ARTHUR SCOTT DONKIN, M.D. EDIN. M.D. DURH.

LECTURER IN MEDICAL JURISPRUDENCE AND TOXICOLOGY IN THE UNIVERSITY OF DURHAM, LATE PHYSICIAN TO THE SUNDERLAND INFIRMARY AND DISPENSARY, ETC.

'Nam ne agricolam quidem aut gubernatorem disputatione, sed usu fieri.' CELSUS, *Medicinæ* lib. I. Præf.

LONDON:
LONGMANS, GREEN, AND CO.
1871.

TO

ROBERT CHRISTISON,

M.D. D.C.L. OXON., PROFESSOR OF MATERIA MEDICA IN THE UNIVERSITY OF EDINBURGH, AND ORDINARY PHYSICIAN TO THE QUEEN FOR SCOTLAND, ETC. ETC.

MY DEAR PROFESSOR CHRISTISON,

To you I am indebted for my first lessons in the science of Therapeutics, and the art of prescribing; therefore, in grateful acknowledgment of the lasting impression exercised on my mind by your teaching, and of many acts of kindness and courtesy, I venture to dedicate this volume to you, who, by a long and eminently successful career as a teacher, and scrupulous exactity as an author, have done more than any living Physician to improve and advance this most essential branch of medical knowledge; and, by painstaking and accurate observation and the advocacy of *simplicity*, to prune down the cumberous and often worse than useless exuberance which in times past deformed the Materia Medica. Accept, therefore, this simple expression of the fervent esteem of a former pupil, and his most earnest wish that you may long live to adorn the University which has the enviable fortune to secure your services, and continue to enjoy the distinguished position you have so justly earned.

Yours, ever faithfully,

ARTHUR SCOTT DONKIN.

September 7, 1871.

PREFACE.

During the past two years and the present, the Author has contributed to the *Lancet* a series of papers on the *Milk Treatment* of various diseased conditions, but more especially of *Diabetes* and *Bright's Disease*, with illustrative cases. The attention which these have attracted, and the interest they have excited, have induced him to publish the present volume on the subject. But in doing so he has not restricted himself to reproducing his original contributions in their previous form and scope; he has, instead, written an entirely new essay on a broader basis, which not only embraces the observations and facts they contained in relation to the two diseases just mentioned, but also much additional matter pertaining to their symptoms and pathology, together with two separate chapters on the physical, chemical, and therapeutic properties of milk and its relation to the process of nutrition.

In dealing with Diabetes the Author has given a somewhat historical and comprehensive, but by no means exhaustive, account of this formidable but highly interesting disease; embracing as it does, probably more than any other affection, important and intricate physiological questions. This course he has been induced to adopt, because it appeared to him, that there is not, in our own language, a work which, however valuable in other respects, presents a sufficiently full account of our present knowledge of the subject, and embraces the numerous and highly important observations concerning this disease made of late years, and scattered amongst a host of British and foreign medical journals and other publications. He has, moreover, introduced certain observations and opinions of his own which he believes to be warranted by the evidence he has adduced in support of them; of these he more particularly desires to refer to his observations on the mal-assimilation or saccharine transformation of fat in Diabetes, which is a subject of great practical importance.

In treating of the pathology and symptoms of Bright's Disease, the Author has restricted himself to a condensed description of the different morbid conditions embraced by this term, and which are now well understood. In this part of his undertaking he has confined himself to such points as appeared to him to be of importance, especially in a practical point of view, and has left less essential details to be studied from the valuable and exhaustive monographs which have been written on the subject.

PARK TERRACE, SUNDERLAND:

7th Sept., 1871.

Errata.

For Aræteus *read* Aretæus, *p.* 5, *l.* 23; *p.* 48, *l.* 21; *p.* 49, *l.* 3; and *p.* 69, *l.* 11.

For or *read* to, *p.* 59, *l.* 9.

For Griesenger *read* Griesinger, *p.* 70, *l.* 13.

For what *read* which, *p.* 85, *l.* 14.

For Pogiale *read* Poggiale, *p.* 105, *l.* 1.

For Dr. *read* Mr., *p.* 113, *l.* 21.

For transformed into sugar and taken up by the blood *read* taken up by the blood and transformed into sugar, *p.* 129, *l.* 15.

CONTENTS.

CHAPTER I.

THE HISTORY OF THE MILK TREATMENT OF DISEASE.

CHAPTER II.

ON THE PHYSICAL CHARACTERS, CHEMICAL COMPOSITION, AND PHYSIOLOGICAL RELATIONS OF MILK.

CHAPTER III.

THE THERAPEUTIC PROPERTIES OF MILK, AND MODE OF ADMINISTRATION.

CHAPTER IV.

DIABETES—ITS EARLY HISTORY AND SYMPTOMS.

CHAPTER V.

PATHOLOGY OF DIABETES.

CHAPTER VI.

PATHOLOGY OF DIABETES.

CHAPTER VII.

PATHOLOGY OF DIABETES.

CHAPTER VIII.

PATHOLOGY OF DIABETES.

CHAPTER IX.

THE TREATMENT OF DIABETES.

CHAPTER X.

THE SKIM-MILK TREATMENT OF DIABETES.

CHAPTER XI.

THE SKIM-MILK TREATMENT OF DIABETES.

CHAPTER XII.

BRIGHT'S DISEASE.

CHAPTER XIII.

THE SKIM-MILK TREATMENT OF BRIGHT'S DISEASE.

DIABETES

AND

BRIGHT'S DISEASE.

CHAPTER I.

HISTORY OF THE MILK TREATMENT OF DISEASE.

MILK is an animal secretion closely resembling blood, both histologically and chemically: it contains all the proximate alimentary principles—the *nitrogenous*, the *saccharine*, and the *oleaginous*, as well as the saline compounds which have been recognised by science as essential for nutrition and growth. The *only* function of milk, in the animal economy, is to serve as food, and, as such, it is perfect in itself, being deficient in nothing. It is employed *exclusively* as the food of *all* young mammals, however varied their ultimate food and habits may be, at the very dawn of animal life, when the digestive organs are so imperfectly developed, and their functions so feebly performed, that an existence independent of the mother cannot be maintained; but when, nevertheless, the processes of nutrition and growth are most active. Consequently, as food, milk is much more easily digested and assimilated than any other alimentary substance with which we are acquainted; in other words, it is much more easily and rapidly converted into healthy blood and tissue. As food milk requires no cooking; in short, it may justly be regarded as a natural device for the transference of a portion of the blood of the adult mother into the vascular system of the young mammalian—a kind of natural transfusion.

The milk of several of the herbivoræ,[1] especially of the cow and goat, has been highly prized, from remote antiquity, as an article of human food; and when we refer to the records of medicine we find that it has been employed from the earliest times by physicians in the treatment of disease.

As a remedy, milk seems to have been employed in consequence of supposed medicinal virtues imparted to it by the herbs on which the animals yielding it have fed. That it is capable of becoming

[1] In Sweden and Denmark sheep's milk is used; in Lapland reindeer's milk; while in Tartary the milk of the mare is largely consumed.

so impregnated, is a popular belief as old as the Christian era, as appears from the statement of Pliny the elder, who says:[1] 'Arcades quidem non medicaminibus uti, sed lacte circa ver, quoniam tunc maxime succis herbæ turgeant, medicenturque ubera pascuis. Bibunt autem vaccinum, quoniam boves omnivoræ sunt in herbas.' 'The Arcadians, indeed, employ no medicines, except milk about the spring time, since at that season plants are most distended with juices, and the udders are medicated with the pasturage. But they drink cows' milk, since oxen browse on all kinds of herbs.'

Galen[2] countenanced this ancient popular belief, and recommended that cows should be fed on certain plants, which he names, so that their milk may be medicated, and thus rendered fitter for the uses of the physician. Indeed, this doctrine seems to have survived to comparatively recent times, as Baccius, physician to Pope Sextus V. and Professor of Botany in Rome in the latter part of the fifteenth century, informs us in his writings[3] that in Italy, especially at Naples, meadows were specially cultivated and applied to medical purposes; certain plants were cultivated in them, according to the directions of

[1] Hist. Natur. lib. xxv. cap. 53.
[2] Method. Medic. lib. v. cap. 12.
[3] Opera, tom. iv.

physicians, and these served as pasturage for animals kept to yield milk for invalids. Each sick person was allowed a cow, a goat, or an ass; this he led to graze on the particular spot on which grew the plants best suited for his malady.

The extent to which milk can become impregnated with substances extraneous or foreign to its composition, through the food of the female secreting it, so that it may act either medicinally or toxically, as the case may be, on those partaking of it, young or old, is a subject certainly deserving of far more attentive and careful investigation than it has hitherto received. At the present day the influence of medicines, and of deleterious substances, or poisons, on milk, is a subject, though a most important one, almost entirely neglected. We know, as a general rule, that most soluble saline compounds, although there are certain exceptions, pass into it out of the blood, as into other secretions. Thus common salt, the sesquicarbonate of soda, sulphate of soda, iodide of potassium, oxide of zinc, trisnitrate of bismuth, and sesquioxide of iron, have been detected without difficulty in the milk of the ass to which these substances have been administered experimentally.[1] Besides, medical experience has

[1] See Carpenter's Principles of Human Physiology, 6th ed. p. 845.

shown that mercurial compounds, taken by the mother for the cure of constitutional syphilis, have been known to heal the infant at her breast of this affection as well as herself.

It is a familiar fact that many vegetables, such as ramsons, or garlic (*Allium ursinum*), and the turnip, when eaten by the cow, impart their characteristic flavour to milk; this fact may have first led to the apparently rational supposition that the medicinal properties of many plants are likewise communicated to it.

But independently of any medicinal qualities supposed to be imparted to it by the food of animals, milk has been largely employed as a dietetic remedy, even in the most formidable diseases, from the earliest ages of medicine. Indeed, it is only in recent years that it appears to have fallen, in this country, into comparative neglect.

Hippocrates [1] first recommended the milk of the ass, and then that of the cow, in phthisis, and as an excellent remedy in gouty affections of the joints, and certain other diseases.

Aræteus [2] remarks, that if a phthisical patient drinks much milk he will need no further aliment.

[1] De Affect. Intern. cap. 4.

[2] De Morb. Chronic. lib. iii. cap. 7.

Alexander Trallianus[1] also extolled milk as a remedy in phthisis.

Celsus[2] recommends milk as a proper remedy in phthisis and all chronic febrile affections: 'in phthisi tamen, sicut in omnibus longis difficilibusque febriculis, recte dari potest.'

Galen[3] strenuously advocates the employment of milk in consumption, and for the cure of this and other chronic maladies, was in the habit of sending his patients to reside at Stabiæ, a town in Campania, on the sea-coast, now Castelamare di Stabia, two miles below the river Sarno; and if we are to believe the testimony of a later physician, Patinus,[4] they returned cured: 'Galenus quidem ad Stabiam montem ægrotos suos ablegabat, unde sani redibant.' This locality was celebrated for its fountains, and such was the richness of its pastures that its milk was considered more wholesome and nutritious than that of any other country;[5] and in consequence of the benefits derived from it by invalids, the inhabitants of Stabiæ obtained from the Emperor Geta a medal representing a cow.

In short, to whatever authority we turn for infor-

[1] Lib. vii. cap. 1, 2.

[2] Medicin. lib. iii. cap. 22.

[3] Opus cit.

[4] Patini Epistolæ, tom. ii.

[5] Columella, Res Rust. 10.

mation, we find evidence of the extensive employment of milk as a therapeutic agent by the ancient physicians, and, as might be expected, by their more modern successors, with whom their authority held undisputed sway. In this country, more than three hundred years ago, physicians prescribed milk profusely—occasionally from the human breast—and as would appear, sometimes with remarkable success. Thomas Cogen, M.B., in his 'Haven of Health'—a quaint old work, well worthy of perusal, on regimen and diet, published in 1588, in the reign of Elizabeth, for the benefit of Oxford students—relates the following remarkable case of one of the Earls of Cumberland: 'Yet common experience prooveth that woman's mylke, sucked from the breast, is, without comparison, the best of all in a consumption. Whereof a notable example was shewed of late yeares in the olde Earle of Cumberland, who, being brought to utter weakneshe by a consuming fever, by means of a woman's sucke, together with the good counsayle of learned physicians, so recovered his strength that, before being destitute of heires male of his own body, he gatte that most worthy gentilman that now is inheritor both of his father's vertues and honour.'

This same author makes the following judicious remarks concerning the use of milk as an article of food, which at the present day, with our complex dietary, are well worthy of attention: 'And how naturall and nourishing a meate mylke is, may be perceived not only by children, who lyve and like better with that than with any other thing: but also men and women, who being used from their childhood, for the most part to mylke, and to eate none or little other meate but mylke and butter, appeare to be of good complexion and fashion of bodie. And no marvaile: for where mylke is well digested it engendreth good bloud, and giveth good nourishment; yea, it is a restorative for them that bee wasted or in a consumption or bee leane.'

More recently, amongst the writings of the great pioneers of modern medical science we discover evidence that they, too, fully appreciated the benefits to be derived from the use of milk. Van Swieten[1] observes, that gouty patients are much benefited by the use of it, and that they continue free from attacks of the disease so long as they live *solely* on milk. Indeed, milk is so much extolled as a remedy for gout by ancient and mediæval writers,

[1] Commentaria in H. Boerhavii Aphorismos, tom. iv.

that it seems strange that modern physicians have not by experiment determined its degree of efficacy in this malady.

The celebrated Hoffman[1] was a strenuous advocate of the milk treatment of disease; he says that milk is a sovereign remedy, and seems to have ascertained by experimental research that, in order to obtain its curative action, the patient should live on it *solely*, to the exclusion of all other kinds of food, and that a long perseverance under this rule is necessary. He complains that his contemporaries, pretending to be disgusted with the treatment, generally lose courage at the commencement and give it up, not being able to reconcile themselves to the prolonged use of milk and a spare diet. Under such circumstances, he asks whether any astonishment should be felt at the disappointment experienced, or if the result should even be injurious. The difficulty which he experienced in enforcing perseverance is that which will be encountered at the present day by practitioners desiring to have recourse to the remedy.

During the seventeenth and eighteenth centuries several works were written specially on the therapeutic employment of milk. I may cite those of

[1] Opera Omnia, tom. i. lec. 2, cap. 2.

Costeus,[1] Stephens,[2] Short,[3] Colombier,[4] Ferris,[5] and Petit-Radel.[6]

In the present century, Daehne[7] in Germany, Dr. Chretian[8] of Montpellier, and Serre D'Alais[9] in France; in Russia Inozemtseff,[10] and lastly Dr. Karell of St. Petersburgh, physician to the Emperor of Russia, have been the principal advocates of milk as a powerful therapeutic agent in the cure of disease. But besides these, numerous other writers of less note have contributed their experience to various continental journals.

With reference to the writings of these authors it is necessary to state the following particulars:—

Dr. Chretian published important details of his experience with milk in the treatment of dropsy with the history of several cases; his successor in France, Serre D'Alais, was the first to prescribe

[1] De Facile Medicina per Seri et Lactis Usum, libri tres. Pap. 1604.

[2] Dœlus on the Cure of Gout by Milk Diet, to which is prefixed an Essay on Diet. Lond. 1732.

[3] Discourse on Tea, Sugar, and Milk. Lond. 1750.

[4] Du Lait, considéré dans tous ses rapports. Paris, 1782.

[5] A Dissertation on Milk. Lond. 1785.

[6] Essai sur le Lait, considéré médicinalement. Paris, 1787.

[7] Die Milch- und Molken-Kur. Leipsic, 1817.

[8] Archives générales de Médecine, tom. xxvii. 1831.

[9] Bulletin général de Thérapeutique, tom. xiv.

[10] The Milk Cure, Moscow, 1857, quoted by Dr. Karell.

definite rules for the administration of milk; he recommended it to be taken thrice daily. He gives the details of sixty cases, treated methodically in the course of five years; unfortunately, details are wanting as to the exact pathological condition to which in each individual instance the dropsy was due. In most of the cases he avers that a complete cure was effected, and that only in five no improvement was effected. But, considering the grave structural changes to which dropsy is generally due, we cannot but receive with great reservation the announcement of so many recoveries. Nevertheless, his experience seems to have been confirmed by several contemporary observers in France.[1]

Dr. Inozemtseff, as would appear from the references made to his work by Dr. Karell, resorted, during his long professional career, with the help of assistants, to the milk treatment in nearly a thousand cases; he testifies to the indisputable efficacy of the remedy and the excellent results obtained; he does not define the dose to be taken, but points to the

[1] See contributions by Claudot, Ossilur, Dieudonné, Guignier, and D'Artigues: Bulletin général de Thérapeutique, tom. xiv. p. 363, 514, 515; Jour. de Médecine et de Chirurg. militaire; Bulletin général de Thérapeutique, tom. liii. p. 337; Journal de Bordeaux, 2me sér. tom. vii. p. 459.

distinction to be made between the *milk cure* and a *milk diet*; on the latter he places a patient for several years. He attributes the good results obtained to the *moderate* doses in which the milk is administered. Dr. Karell quotes from Dr. Inozemtseff's work the case of a lady suffering from enormous obesity; he says: 'She grew so large that she had to let out her chemises, and at last was almost suffocated in her own fat. All cures for obesity were tried, but in vain. Dr. Inozemtseff had seen many emaciated persons grow stout from the use of milk, but he was not aware that milk also had the power of producing a contrary effect. All remedies having failed, he employed the milk cure, and to his great satisfaction, his treatment was crowned with success.'

Dr. Karell's contribution [1] to the literature of the milk cure, is by far the most important which has appeared on the subject; yet notwithstanding the eminent position of its author, it has not received, in this country, the serious attention to which it is so justly entitled. He insists on the importance of

[1] 'On the Milk Cure,' read before the Medical Society of St. Petersburgh, March 1865, translated by Dr. Carrick, Physician to the British Embassy at St. Petersburgh, and published in the Edin. Medical Journal, Aug. 1866.

administering milk *judiciously* and of *strict attention to method* in its employment, without which he considers it impossible to obtain good results. He has been one of the most zealous propagators of this treatment in Russia and in other countries; in consequence he says: 'After effecting a number of cures which have multiplied by hundreds, and which have of late years increased to such an extent that I have been unable to note their histories as fully as I did at the commencement—my perseverance would be fully rewarded were I to see this mode of treatment generally recognised and adopted by medical men, and raised to that rank in therapeutics which, in my opinion, it so justly deserves.'

It is necessary here to mention the class of cases in which Dr. Karell considers the treatment to be indicated; he says: 'I arrive at the firm conviction that, in the use of this fluid, we possess one of the strongest weapons against that obstinate enemy of practitioners which, in spite of being disguised under various forms of chronic ailment, is, finally, almost always recognised as a *perverted or deficient nutrition.*' He gives the histories in detail of fifteen out of upwards of two hundred cases in which the treatment was scrupulously carried out, and in which the most excellent results were obtained;

even in apparently hopeless cases, in which all other remedies had previously failed. In summing up, he enumerates the following morbid conditions as those which have been cured or benefited by the treatment. 'An intractable state of the blood, impoverished to the utmost extent, and general dropsy; disordered inervation, assuming the form of hysteria, or hypochondriasis; obstinate dyspepsia, neither the result of congestion of the stomach nor of ulceration, nor of cancer of that organ; in fact, catarrhal, rheumatic, and gouty affections, as also nervous maladies not the result of a local disease, but of quantitative and qualitative defects in the fluids, or, to speak more clearly, a constitutional disease. If the cause of the disease was apparently situated in the organs of digestion, the more strongly was I tempted to try this cure. I have thus cured, or very much relieved, chronic irritations of the pharynx and of the œsophagus, ulcers of the stomach, and similar diseases of the digestive tract. The *gastric cases* formed the greater portion of the two hundred. Among these satisfactory results were obtained in a very short time. The desponding patients became lively, the gloomy countenance brightened up, the big belly decreased in size, and, as a consequence, many other unpleasant circumstances disappeared; in a word, the patient felt quite a new man. And even where the seat of the malady was not always as clear as in the cases above cited, but where the disease of any organ seemed to be connected with some derangement of the digestive tract, I have invariably tried the milk cure. For I thus produce a good result, simply by regulating the diet, and by excluding indigestible articles of food. And I have thus frequently had the satisfaction to see a complete cure effected, by such simple means, in cases where deep-seated organic disease was suspected. My own experience and that of other physicians has shown that great improvement, and even almost a complete feeling of health, have attended this treatment when employed in cases of organic disease of the heart, of advanced degeneration of the kidney, &c. Taking into consideration the fact that hypertrophy of the heart and the central congestion, as well as increased bronchial secretion which results therefrom, are frequently occasioned by disorder of the abdominal circulation, I think I have found an exact indication for the milk. I have modified the milk cure according to circumstances in treating plethoric persons. The fatty degeneration of the arteries, and the consequent friability being so frequently one of the determining causes of apoplexy, I think we shall find an exact indication in that disease for the use of milk. Neither can I say that constitutional debility was common to all patients whom I placed under the milk cure; on the contrary, I have made persons of florid complexion undergo the treatment —persons of a muscular build and a full pulse— who are generally ordered a temperate regimen and who, to prevent congestion and apoplexy, take bitter and saline solutions with benefit.' Dr. Karell concludes by strongly expressing himself against the practice of extolling the milk cure as a panacea.

During the last four years I have put the milk treatment to the test of direct experiment, both in hospital and private practice, in a variety of chronic maladies, especially in the chronic nephritic form of Bright's Disease and Diabetes mellitus. I have already laid a portion of my experience in these diseases before the profession in a series of papers contributed to the 'Lancet.'[1] I may justly claim to have been the first to apply the remedy systematically and successfully to the treatment of Diabetes. I can find no mention of anyone else having previously attempted to treat this formidable malady exclusively with milk.

[1] Oct. 16 and 23, Nov. 27 and Dec. 4, 1869, April 23 and 30, 1870, and May 6, 1871, &c.

CHAPTER II.

MILK: ITS PHYSICAL CHARACTERS, CHEMICAL COMPOSITION, AND PHYSIOLOGICAL RELATIONS.

It is not within the scope of the present work to give a complete account of the chemistry and general physiology of milk—human or comparative —or of the organs and processes by which it is formed. It is the intention of the author rather to consider its physical and chemical properties, simply as an alimentary substance; its relation as such to the blood and tissues; the changes it undergoes by the process of digestion; and, lastly, its therapeutic action as a remedy in disease, together with the method of its administration as such.

Milk is a fluid secretion formed from and closely resembling blood, for the *exclusive* purpose of being again converted into blood. Its *only function is to constitute the food of the young of all mammalia* immediately after the period of their birth, and until they shall have attained such a degree of maturity as to render them capable of maintaining an existence independent of the maternal parent, by subsisting on the particular kinds of crude aliment for which each species is fitted by organisation and habits. And it is a remarkable and, I may add, a highly instructive fact, that however varied the size, conformation, habits, and food of adult mammals may be, yet nature has prepared for them in their earliest infancy this *one universal food*, whether they are cetaceans, like the whale, inhabiting the deeps of polar seas, or the herbivorous or carnivorous denizens of tropical forests and plains. The contemplation of this fact alone leads to the inference, based on a knowledge of the perfect adaptations of an unerring design displayed in the economy of nature, that milk *must* possess, not only *all* the ingredients of a *perfect food*, but also that as such it must be endowed with *special qualities* which confer on it the power of regulating and insuring a healthy nutrition and growth of the tissues at a period of animal life when these processes are most active, and thus prevent the occurrence of abnormal deviations ending in abnormal and extraneous formations, or, in other words, disease.

Milk is a white, opaque, thickish fluid; when a drop of it is examined under the microscope it is observed to be a somewhat turbid fluid, in which are suspended a large number of irregularly-shaped particles, varying in size from about the 1· 12·700 to the 1· 3·040 of an inch. These are commonly called *milk globules*; they consist of an albuminoid envelope enclosing the oleaginous matter of the milk, or butter. In addition to these globules, numerous molecular granules, very much smaller in size, are observed in the milk; they exhibit the peculiar movement witnessed in molecules generally, and appear to consist simply of oily matter, and are readily dissolved by the action of ether. The large milk globules, however, are not soluble in this reagent alone, a fact clearly demonstrating that they are not composed simply of fatty matter. Hence, when milk is mixed with ether it still retains its whiteness and opacity, no transparency being produced; but if it is mixed with a sufficient quantity of caustic potash, or acetic acid, the envelopes of the milk globules are dissolved, and the contained oily matter, or butter, is set free, and is then readily capable of solution by the application of ether. This fact shows that the envelopes containing the butter are composed of albumen. When, after the application of potash, the liberated butter has been dissolved by the addition of ether, the whiteness and opacity of the milk are removed and a clear fluid is produced.

All the ingredients of milk, except the butter globules and granules suspended in it, are in a state of solution. The butter globules and the greater portion of the granules arise to the surface after milk has stood a certain length of time, forming a thick stratum of cream on the surface. The cream, then, consists of the butter globules having a coating of albumen, and of oleaginous molecules. In the process of churning the albuminoid coats of the globules are ruptured by the violent agitation to which they are subjected; the particles of fatty matter escape, and butter is formed by their aggregation and coalescence.

The object attained by the oleaginous matter, or butter, being enclosed in albuminoid envelopes in the form of milk globules, is, undoubtedly, *to insure the perfect mechanical admixture of all the ingredients of milk*, so that a single drop may contain the whole of them. Were it not for this exceedingly admirable contrivance the butter would form an oleaginous stratum, which, floating on the surface, would render the proper feeding of the infant or young mammalian, during lactation, simply impossible.

The larger milk or butter globules, just described, can all be removed from the milk by repeated filtration; the filtered fluid being nearly transparent, and scarcely any casein adhering to the filter. This is the simplest and most efficient method of separating the oleaginous matter from the other constituents of milk, all of which are in a state of solution; the transparent fluid which has passed through the filter contains almost the whole of the casein and milk sugar, together with the saline ingredients. But of course a portion of the minuter molecules pass through the filter, so that the fluid still contains a very small amount of fatty matter.

Such, then, is the physical constitution of healthy milk as it is secreted after the lapse of the first few days after parturition, when it becomes fit for consumption as food for the adult. But during the first ten days or so, subsequent to the process just mentioned, it is termed *colostrum*, and contains, in addition to the butter globules and molecules already described, *colostric corpuscles*; these are large, granulated, yellow corpuscles, apparently composed of an aggregation of numerous small granules of a fatty character, and are soluble in ether. This colostrum milk has a purgative effect, beneficial, no doubt, to the newly-born infant or mammalian, but it is quite unfit for food.

In its chemical composition milk contains every substance of which the human body is composed; its constituent proximate principles and other ingredients are very closely allied to, and indeed may be said to be identical with, those existing in the body generally. Thus it contains the four classes of substances of which the body is composed, namely: the nitrogenous and the carbonaceous proximate organic substances, the saline or mineral matter, and water.

The nitrogenous proximate principle of milk is *casein*.

The carbonaceous (non-nitrogenous) principles are *butter* and *milk sugar* (*lactin*).

The mineral matter consists of certain fixed salts in a state of solution in the water.

It will be necessary to consider these various substances in detail.

Casein approximates very closely to albumen in its composition and characters; it contains carbon, hydrogen, oxygen, nitrogen, and sulphur. Casein is held in a perfect state of solution in milk, and is precipitated by acetic acid and by rennet, obtained from the stomach of the calf; the precipitate forms a firm coagulum and is the principal constituent of cheese; it is distinguished from albumen by being coagulated by acetic acid and by rennet; the latter is the best test for distinguishing it. An infusion of the stomach of the calf, or rennet prepared from it, mixed with skim milk and gradually heated to a temperature of about 122°, produces the complete coagulation of the casein and converts it into a firm curd. The action of rennet on casein has not been fully explained, but of course there exists an obvious physiological relation between the two substances. Acetic acid is a simple test for casein, but is not so reliable as rennet. Milk is prevented from coagulating by boiling in consequence of the union of its alkali with the casein. The addition of acetic acid causes the casein to be precipitated by holding the alkali in solution, but the same action is produced on albumen when in conjunction with an alkali.

The casein of human milk does not coagulate so readily as that of other milk; it is not coagulated by rennet, unless an acid is present also, and in some specimens it is not coagulated by acetic acid until the milk is boiled. This difference is most probably due to the presence of a larger quantity of alkali in human milk than in the milk of domestic animals, such as the cow. The albuminous envelope of the milk globule seems to be a distinct substance from casein.

Butter is an oleaginous substance found in milk in large quantities, and, as already stated, is held in *suspension* in the form of milk globules and granules. It is chiefly composed of the ordinary constituents of fat, but contains, in addition, another substance peculiar to it, namely, *butyrin*, and which imparts to butter its peculiar taste and odour. Butyrin yields on saponification with alkalies at least three volatile acids emitting a powerful animal odour; these, by Chevreul, have been named *butyric*, *caproic* and *capric* acids; they are also produced by the ordinary decomposition of butter: a process greatly accelerated by a warm temperature, especially if a little casein is present, which acts as a ferment. Hence the liability of imperfectly washed butter to become rancid. The quantity of butter present in milk is greatly modified by the nature of the food consumed, and by a variety of other well-known conditions.

Lactin or *Milk Sugar* exists in considerable quantity in milk, and may be obtained by the evaporation of whey to the consistence of syrup, in which, on standing, it crystallises in four-sided prisms; it is composed of carbon, hydrogen, oxygen, and water in the proportions shown in the following formula, $C_{12} H_{22} O_{11} H O_2$. It closely resembles glucose or grape sugar in several of its properties. The relative amount of lactin present in milk is subject to variation from the same causes which affect the quantity of butter, the quality of the food consumed being the most powerful regulating influence. Consequently the milk of dogs contains a much larger quantity of milk sugar when fed on vegetables than when subsisting on animal food. It is a remarkable fact, however, that it is still present in the milk of these animals when they are fed exclusively on an animal diet, even after the lapse of several months.

The *Saline* or *Inorganic* ingredients of milk are obtained by evaporating and then burning it, when they are found as ashes; they constitute, according to the analysis of Simon, from 1·6 to 2·7 parts in 1,000 of human milk.

The following table represents the relative proportion of the saline ingredients of milk:

Inorganic Constituents in 1,000 *parts of Milk.*

Phosphate of Lime . . .	2·31 to	3·44
Magnesia . . .	0·42	0·64
Iron	0·07	0·07
Chloride of Potassium . . .	1·44	1·83
Sodium . . .	0·24	0·34
Soda	0·42	0·45
	4·90	6·77

It will be observed that the ashes, or saline constituents of milk, are nearly identical with those of flesh and blood, differing chiefly in the larger proportion of phosphates of lime and magnesia, which amount to 2 or 3 parts in 1,000. This excess of phosphates is requisite for the growth and consolidation of the bones of the young animal. The phosphates are held in solution by the casein, which appears to possess the power of combining with them, their solutions being assisted by the presence of a minute quantity of alkali.

The whole of the phosphorus, which is an essential constituent of the brain and other nervous centres, must be derived from the phosphates of the milk, and so also must the iron entering into the composition of the red corpuscles of the blood. It is evident, therefore, that any kind of food deficient in these ingredients so essential to healthy nutrition is totally unfitted for the food of infants, and that the substitution of such for milk is totally incompatible with healthy development.

Milk has been found to contain about 3 per cent. of its volume of gas, namely — 55·15 of carbonic acid, 40·56 of nitrogen, and 4·29 of oxygen.

Water is present in considerable quantity in milk, and holds the other ingredients (except the milk globules and granules) in solution. The quantity of water varies from 860 to 914 parts in 1,000 parts of milk; it can be separated by evaporation. The relative quantity of water determines the specific gravity of milk, which varies from 1,018 to 1,040.

The relative proportion of the various ingredients of the milks of different animals is subject to considerable variation, as is shown in the following tabular comparison of human milk with the milks of the domestic herbivoræ. The differences thus presented are exceedingly instructive in a practical point of view.

<table>
<tr><th></th><th>HUMAN (Simon)</th><th>COW (Simon)</th><th>SHEEP (Chevallier)</th><th>GOAT (Chevallier)</th><th>ASS (Simon)</th><th>MARE (Luiscius)</th></tr>
<tr><td>Casein . .</td><td>35</td><td>68</td><td>45</td><td>40</td><td>16</td><td>16</td></tr>
<tr><td>Butter . .</td><td>25</td><td>38</td><td>42</td><td>33</td><td>12</td><td>8</td></tr>
<tr><td>Sugar and Extractive</td><td>48</td><td>30</td><td>50</td><td>53</td><td rowspan="2">65</td><td rowspan="2">88</td></tr>
<tr><td>Fixed Salts .</td><td>2</td><td>6</td><td>7</td><td>6</td></tr>
<tr><td>Water . .</td><td>890</td><td>860</td><td>856</td><td>868</td><td>907</td><td>888</td></tr>
<tr><td>Solids . .</td><td>110</td><td>140</td><td>144</td><td>132</td><td>93</td><td>112</td></tr>
</table>

From this table it is evident, that the milks of the domestic ruminants (the cow, the sheep and the goat) very closely correspond with each other, but are quite dissimilar to the milks of the ass and the mare, which possess a very close resemblance, both being very poor in casein and butter, but exceedingly rich in sugar or lactin.

It will also be observed that the milks of the ruminants are very rich in casein and butter, especially that of the cow, which contains no less than 68 parts in 1,000 of the former and 38 parts of the latter. It is this much greater richness in casein, or *flesh-forming material*, which gives to the milk of the cow a great superiority over the milks of other domestic animals as an article of diet, and more especially as a remedy in disease. This superiority is further enhanced by the moderate quantity of sugar it contains rendering it less liable to undergo fermentation than other kinds of milk.

From a study of the chemistry of milk, we perceive that not only does this substance contain *all* the constituents of healthy blood, and of the tissues of the body nourished by it, but also that these constituents are combined in the form of the same organic proximate principles (in union with certain fixed salts), which, mixed in proper proportions, constitute every variety of food capable of maintaining the healthy and vigorous nutrition of the human body. These organic principles are the *albuminous*, the *oleaginous* and the *saccharine*. In ordinary mixed food the saccharine or amylaceous principles are derived from the vegetable kingdom. The presence of lactin in milk for the food of the infant may justly be considered as the equivalent of starch or sugar entering into the composition of the food of the adult. Milk, therefore, may be regarded as a judicious admixture of animal and vegetable food, which experience has clearly demonstrated to be essential for the healthy nourishment of the human body.

In the process of digestion milk undergoes certain changes which it is necessary to consider. The lactin, or milk sugar, becomes converted into lactic acid, a fact of great practical importance, as I shall afterwards point out. The casein is first coagulated and then redissolved. The albuminoid envelopes of the milk globules undergo solution, and the enclosed butter is liberated and is afterwards liquefied and reduced to a state of fine subdivision and suspension, like other kinds of fatty matter by the process of digestion.

The solution of the capsules of the milk globules has been attributed by some to the action of lactic acid, into which the milk sugar is changed in the stomach. But as this process is capable of being effected by the gastric juice alone, it appears unquestionable that the lactic acid becomes subservient to ulterior nutritive purposes. It is certainly a remarkable circumstance, and at present unexplained, that during the digestion of milk, casein is at first precipitated or coagulated from a condition of perfect solution and is afterwards redissolved. But undoubtedly these alternations are connected with some important changes in its molecular constitution, if not in its chemical composition, intimately connected with its subsequent conversion into blood.

CHAPTER III.

MILK, AS A THERAPEUTIC AGENT, IN THE TREATMENT OF DISEASE—MODE OF ADMINISTRATION.

MILK in its natural condition, just as it is drawn from the udder of the cow, is extremely valuable when administered as food during the period of convalescence from acute diseases attended with emaciation and an impoverished condition of the blood, and also in debilitated conditions of the body generally. In the present work, however, it is not intended to discuss the value of milk as an article of food either in health or in disease, but rather to consider its therapeutic power as a remedy in certain diseases, especially those of a *chronic nature*, whether of *mal-assimilation*, or of perverted or deficient nutrition, or of a chronic inflammatory character. A distinction must therefore be drawn at the outset between a '*milk diet*' and the '*milk treatment*' of disease, the two being essentially different.

Milk in its ordinary condition does not appear to be endowed with any *special* therapeutic properties, or to exercise any important influence over the progress of chronic diseases, more especially over those which are the subject of this treatise. In such diseases, as I shall endeavour to show from experimental observation, when I come to treat of them individually, the *butter* or *fatty matter* of milk exercises a decidedly injurious influence.

Butter, in the shape of *cream*, is extremely prone, especially in invalids, to produce serious indigestion, when they are compelled for a long period to subsist exclusively on milk and to take a quantity sufficiently large to support life, namely: from 4 to 8 pints daily, according to the special conditions of individual cases.

Indigestion, however, is not by any means the most serious evil produced by the butter or cream; it unquestionably exercises a most pernicious influence over the progress of those particular diseases in which the milk treatment is most beneficial, and this, most probably, by supplying a food or *pabulum* for the activity of the morbid processes and the formation of their abnormal products. This injurious influence, in certain diseases at least, seems capable of explanation on well-known physiological and pathological laws.

In the healthy body we know that the organs of secretion either separate from the blood their secretions already formed, or select from it the special materials or elements out of which they are elaborated; so that without the existence in the blood of the *pabulum* or materials for their secretions, the functional activity of these organs would be entirely suspended. The same law equally applies to the nutrition of the healthy tissues of the body. Each tissue is endowed with a special power of selection—an elective affinity—for certain particular constituents of the blood, by the exercise of which it abstracts them from this fluid and appropriates them to its own nutrition and development.[1] The same process is in operation in several instances of disease, especially those associated with diseased tissues, and morbid growths or formations. In such diseases, certain morbid materials or substances are present in the blood and *determine* and *originate* the formation of the diseased tissues and growths, which afterwards, by a *special affinity*, select and appropriate them as pabulum essential

[1] See Carpenter's Principles of Human Physiology, 6th ed. p. 318.

for their existence and growth. No more notable example of this process could be given than the diseased condition to which the term *fatty degeneration* of the tissues has been given. Cancer may be cited as another example. The localised development of such morbid structures appears to be the result simply of the local manifestation of the presence in the blood of certain materials which become the essential nutriment of the tissues composing them. Each diseased structure or morbid growth then becomes, to use the words of Mr. Simon,[1] 'a new excretory organ which tends essentially to acts of eliminative secretion, just as distinctly as a healthy liver or a healthy kidney.'

In the second stage of the inflammatory form of Bright's Disease, distinguished by the pale fatty kidney, the diseased glandular epithelial cells, lining the uriniferous tubules of the organ, undergo fatty transformation, and following the law of nutrition of all fatty structures, healthy or diseased, eliminate and appropriate fatty matter from the blood. Consequently the administration of milk, rich in cream, in this form of the disease must have the effect of supplying the nutrient materials

[1] Lectures on General Pathology, pp. 87, 152.

required for the growth of the diseased epithelium constituting the essential character of the malady.

In *Diabetes*, as I shall endeavour to show further on, butter or cream is highly injurious, and productive of an increase of sugar in the urine, an effect clearly demonstrating that it supplies a material for the formation of the latter substance, whatever the ultimate cause of the disease may be.

But whether this explanation should prove to be correct or not, the fact still remains unaffected, that the cream of milk is injurious and therefore inadmissible in the treatment of the diseases under consideration. *Consequently the cream must be as carefully separated from the milk as possible, after it has stood a sufficient length of time, and the skim milk only must be administered.* For this very important reason the treatment itself must with strict propriety be termed, not the 'milk' but the 'skim milk treatment.'

In order to separate the cream from the milk as far as practicable, and sufficiently for ordinary practical purposes, without filtering, the milk when new must be put into a clean, shallow dish, or vessel, such as a milk-bowl, and placed in a cool dry situation, and allowed to remain there eighteen or twenty-four hours, according to the temperature of the atmosphere and the season of the year; in winter a period of twenty-four hours is decidedly preferable. At the end of this period the cream will all have risen to the surface and must be carefully skimmed off, after which operation the *skim milk* will remain fit for use. In close sultry weather in summer, unsuitable for keeping milk for any length of time, without fermentation and coagulation taking place, unless placed in a very cold situation and surrounded by ice, it may be allowed to stand eight or twelve hours. But if this brief period should be too short to separate a sufficient quantity of cream, on account of the milk being very rich in the latter, it will be necessary to pass it through a filter, by which, as already stated, the fatty matter is almost entirely removed.

In the manner just indicated, the milk globules and a very large proportion of the minuter butter particles are removed; but unless filtered there still remains some fatty matter in a molecular condition suspended in the skim milk and imparting an opacity to it; but when proper care and attention have been bestowed in its preparation, the amount is so very small as not to affect in an appreciable degree the favourable progress of the treatment in the great majority of cases.

Skim milk thus obtained is a simple solution of casein, of milk-sugar, and of certain fixed salts, in water, with the addition of a very small quantity of fatty matter, or butter, in a state of mechanical suspension; its specific gravity, which can be readily ascertained by the urinometer, should, in good cow's milk, range between 1030 and 1040; when below the former figure it has been diluted with water.

The quantity of casein, or *flesh-forming material*, capable of being absorbed and converted into blood immediately after digestion in a pint of skim milk of good quality and undiluted with water, in round numbers exceeds half an ounce, and in good specimens approximates to near three-quarters of an ounce, and to this is added all the salts necessary for the nutrition of the body, and milk-sugar as a heat-forming substance. It is therefore quite obvious that starvation, or any approach to it, on an *exclusively* skim milk diet is altogether impossible, when a quantity varying from five to eight pints is taken daily by an adult, especially by an invalid not subjected to much exertion. On the contrary, experience demonstrates, as I shall have occasion to point out further on by means of illustrative cases, that such a diet is not only capable of supporting life, but also, that individuals previously incapacitated for exertion by disease, have, after living on it exclusively for a period of several weeks, become strong and vigorous, and capable of great exertion without suffering fatigue. I feel desirous of directing particular attention to this fact, because of the opposition to the treatment too frequently encountered in practice, from the ignorance and prejudice of certain persons who regard it with suspicion and cannot believe it possible that life can be supported on what appears to them to be such slender fare. On such individuals, ignorant alike of the rudiments of physiological science and the chemistry of food, argument is lost; it is in vain to endeavour to enlighten their understandings by pointing out that the richest and most nutritious kinds of solid food, served up after the most approved methods of cookery, must first, by the process of digestion, be reduced to a condition quite as liquid as milk, before they can possibly be absorbed into the blood and contribute to the nourishment of the body, and that even then, they too frequently import into the blood the elements of disease and future death. Skim milk is free from this latter vice, it simply conveys what the tissues of the body require and appropriate by a healthy nutrition, and nothing more.

These observations on skim milk lead to a consideration of its therapeutic action, and as it contains no *special* therapeutic agent, the question at once presents itself, to what are we to attribute its curative power over certain diseases? In endeavouring to answer this question, it is of course necessary to take into consideration the pathology of the particular diseases over which it has been ascertained to exercise so powerful a control. Now of these diseases, when taken in the aggregate, it may be predicated, that they are intimately associated with a depraved or morbid condition of the blood; with deficient or perverted nutrition, or with mal-assimilation. Of the various diseased conditions to which I refer as belonging to this category, I may specially mention *fatty degeneration* of various organs, *Bright's disease*, and other affections associated with a poor watery condition of the blood, and *diabetes*; this last affection, in the present deficient state of our knowledge of its pathology, may with strict propriety be termed one of mal-assimilation.

The curative influence of skim milk over these various, and in many respects dissimilar, forms of disease may, with great probability of correctness, be referred to two causes:—

First, to the facility with which, by the processes of digestion and sanguification, it is transformed into healthy blood, which seems to have the power of regulating or controlling a healthy and of preventing a diseased nutrition, in accordance with physiological laws.

Secondly, to the absence of all substances *foreign* to healthy nutrition, and which, when imported into the blood with the food, become *materies morbi*, or the appropriate sustenance of morbid action or disease.

This appears to be the only explanation it is possible to give.

In addition to these effects on the blood, skim milk has the special property of acting as a powerful diuretic when taken in sufficient quantity (partly on account of the water it contains), which makes it a valuable remedy in general dropsy; but this action, as I shall show when considering the treatment of Bright's disease, is intimately connected with and in a great measure the result of its action on the blood serum, by restoring its lost albumen and its natural specific gravity.

Although it is not intended in this work to treat of all the special applications of the skim milk treatment, yet it is important to mention that it is invaluable in functional derangements and diseases of the gastric and intestinal organs, especially in certain forms of dyspepsia, hypochondriasis and diarrhœa;

also in cases of catarrh and ulceration of the stomach. By this treatment all indigestible articles of food are excluded from the stomach, and a carefully-regulated and easily-digested diet is given and the greatest possible amount of repose is afforded to the affected organs.

Mode of Administration.

I have never met with a single instance in which a patient could not be brought under the influence of the skim milk treatment, when sufficient care was taken at the outset in the administration of the remedy. But if the patient is permitted to take the milk at irregular intervals and in large quantities, at his own discretion and without restriction, indigestion is almost certain to be produced, and, moreover, little or no beneficial action will be produced on the disease. It is easily digested, however, when *systematically given in small quantities and at regular intervals.* The treatment must therefore be commenced and persevered with in the most careful and methodical manner. For this purpose the two following rules must be *scrupulously* observed, as well as the minor details pertaining to them.

1. *The skim milk must be prescribed in carefully-measured quantities and at definite periods.*

If the patient has an aversion for milk, or if there is indigestion or feebleness of the digestive organs, we must begin with small and well-regulated doses. During the first day of the treatment, half a tea cupful of skim milk may be given every two or three hours, and on the second day, double the quantity at the same intervals ; on the third day half-a-pint may be allowed for each dose and the intervals increased to three or four hours, so that, in all, three pints are consumed. On the fourth day four pints may be given, on the fifth or sixth five pints, and should this augmented quantity produce no inconvenience and the patient's appetite is good, as it generally is under the treatment, the quantity may be raised to six or seven pints daily ; but after this no further increase should be permitted, except in certain cases of diabetes in patients of large frame and keen appetites, to whom eight or even nine pints may be allowed daily. I have never permitted this allowance to be exceeded except, as I shall afterwards state, by giving curd in addition.

A limitation of the daily allowance of skim milk to the quantity just stated, is of paramount importance in obtaining a successful issue of the case under treatment, therefore six or seven pints should never be exceeded without a very important reason for the exception. I have known great mischief done by a violation of this rule.

Fortunately in a large proportion of cases, especially of diabetes, there is no necessity whatever for such extreme care at the commencement of the treatment; so that it can be begun by giving four or five pints of skim milk on the first day and raising it to the full quantity on the second, third, or fourth. And I may here add, that such a beginning is highly beneficial in the treatment of certain cases of Bright's disease, in which it is exceedingly desirable to produce at once a profuse flow of urine; it is equally salutary in diabetes in allaying the immoderate thirst of the patient, and in supplying to the blood a large quantity of water to combine with the sugar, its endosmotic equivalent, and assist the speedy elimination of the latter by the kidneys.

So soon as the patient can digest the full daily allowance of skim milk without inconvenience, it may be given at four meals with an interval of four hours between each, or at shorter periods and in smaller quantity at a time.

The milk may be given cold or warm according to the inclination of the patient, but it must never be boiled, as a temperature of 212, I feel assured, either seriously impairs or altogether destroys its therapeutic energy; possibly by altering the molecular constitution of the casein, or by destroying some vital property with which it is endowed.

The skim milk treatment generally produces constipation, a symptom which, though frequently requiring to be remedied by a mild laxative, I now regard as a sure indication that the milk is agreeing with the patient, and producing the beneficial effect for which it has been prescribed.

Diarrhœa, with judicious management and careful attention to the digestive organs of the patient, is not of frequent occurrence, but when it does appear it can generally be remedied by reducing the quantity of milk, for the time being, and by administering the 'essence of rennet,'[1] in half drachm or drachm doses in a little water after each meal of milk. When the diarrhœa, and the indigestion producing it, have disappeared, the daily allowance of milk may be gradually increased to the full quantity, and the rennet discontinued, or not, according to the circumstances of the case; but whenever there is a constant tendency to indigestion its continued administration is generally productive of a highly beneficial effect.

[1] The essence of rennet which I am in the habit of prescribing for this purpose and for the preparation of curd, is that manufactured by Procter of Penzance.

2. *The skim milk must be given alone and every other article of food must be strictly prohibited.*

This rule is even more important than the first, and if not *rigidly* observed a satisfactory result in any case need not be anticipated. Of this I am fully convinced by extended observation, and in some instances by a very painful experience. To this portion of the subject I shall refer more fully when considering the treatment of diabetes and Bright's disease, in both of which affections the rule just referred to must be made *absolute.*

When I come to the treatment of diabetes and Bright's disease, I shall fully explain at what period of convalescence a modification of the diet of the patient may first be made, and of what it should consist. I shall merely mention here, that, as a *middle course* between the absolute skim milk diet and the first administration of animal and vegetable food, I give curd in addition to the skim milk, which is still continued. In this way the coagulated casein of two, three, or four additional pints of skim milk, can be given without the water, and but little of the fatty matter; so that the flesh-forming material of from ten to twelve pints of good milk can be given daily with only a portion of the water, and but little of the fatty matter, both of which are greatly too much in excess in this quantity of ordinary milk. Dr. Parkes[1] has calculated that rather more than eleven pints of milk, with a specific gravity of 1026 (not skim milk) are equivalent to the 23 ounces of water-free food required as the daily allowance of an adult; but he justly remarks that the water and fat would be greatly in excess. By giving skim milk and curd, however, this inconvenience is completely avoided.

I shall mention further on that occasionally I allow tea and coffee once or twice daily, but not by any means as a general rule.

In conclusion I may state that the treatment does not exclude the employment of other remedies, which, in certain instances, can be prescribed with advantage, according to the special requirements of individual cases.

[1] Manual of Practical Hygiene, 2nd ed. p. 215.

CHAPTER IV.

DIABETES. ITS EARLY HISTORY AND SYMPTOMS.

THE term *Diabetes* is now properly restricted to that particular disease, of which a *persistent* saccharine condition of the urine, originating in a similar condition of the blood, is the distinguishing feature. The adjective *mellitus*, first used by Cullen in his 'Nosological Synopsis' to distinguish this affection from others, attended with a profuse flow of urine, or *polyuria*, has fallen into disuse. From the time of Willis, in the seventeenth century, until recently diabetes had a generic significance which has been abandoned in accordance with a more definite and accurate pathology. The excessive discharge of urine from various causes, unattended with saccharine impregnation, to which Cullen gave the specific appellative of diabetes *insipidus*, has been found by more correct observation to be merely symptomatic of affections totally dissimilar to each other, and in character essentially different from genuine diabetes.

The earlier Greek physicians appear to have been unacquainted with diabetes, as no mention is made of it in the writings of Hippocrates; the affection received its name from later Greek authors. The Roman physicians had no name for it, but nevertheless Celsus refers to it in terms which are unmistakable; he says[1]:—'At cum urina *super potionum modum* etiam sine dolore profluens maciem et periculum facit.' In this brief description we recognise not only some of the more salient features of the disease—the polyuria, emaciation, and danger—but also the supposition which has survived to the present day, that in this formidable malady the large quantity of urine voided by the patient exceeds the measure of the fluid ingesta. It appears to me that no other interpretation can be given of the words of Celsus which I have put in *italics*.

Aræteus has given a much fuller description of the disease, with which he seems to have been well acquainted, and has ventured to express an opinion of its nature; he defined it to be 'a colliquation of the flesh and limbs into urine, on account of which

[1] Medicinæ, lib. iv. cap. xx. sec. 2.

there is both extreme emaciation of the whole body, and the urine is more copious than the quantity of the drink taken.' From the time when Aræteus wrote—in the reign of Vespasian—until the seventeenth century, no new light appears to have been thrown on the subject. In 1674, however, our countryman, Willis, laid the foundation of our present knowledge of the disease, by discovering that the urine has a saccharine taste; he pointed out that, in all his patients it differed from every fluid of the animal body, and was as if it had been mixed with honey, or sugar, and had a powerfully sweet taste.[1] It was not, however, until a century after the researches of Willis, that Cawley,[2] in 1778, or ninety-three years ago, succeeded in isolating the sugar from the urine. During the period which has since elapsed, a host of investigators have laboured to unravel the pathology of the disease, and devise a successful method of treatment, so that now the literature of diabetes is almost more copious than that of any other disease. The more important investigations will be referred to in considering the pathology of the affection.

On a careful examination of the clinical history of

[1] Pharmaceut. Rat. sec. iv. cap. 3.
[2] In Lond. Med. Jour. vol. ix.

diabetes from its earliest manifestation to its fatal termination we discover that its progress is capable of being divided into two distinct stages, each of which is characterised by well-marked symptoms. When I come to the treatment of the disease I shall endeavour to show that it is curable in the first of these stages, and that the chances of recovery diminish in proportion as the disease advances, until a period arrives in its progress when it becomes incurable, even although it may then, for a time, be held in check. Consequently it is of the utmost practical importance to be able to detect the disease at an early period of its development in order at once to arrest its further progress.

Dr. Copland's definition of diabetes consists of an assemblage of symptoms which are those generally given in text-books as diagnostic of the disease ; his definition is as follows :—'Urine secreted of a sweet taste and violet smell, generally in large quantity, with great thirst, dryness of skin, debility and emaciation.'[1] Dr. Jaccoud, of Paris, in his recent elaborate monograph[2] on diabetes, states that its '*primitive*' or 'fundamental symptoms,' those which

[1] Dictionary of Practical Medicine, vol. i. p. 506.

[2] Nouveau Dict. de Méd. et de Chirurg. pratiq. tom. xi. 248, Paris, 1869.

he considers to be *essential* to the disease, are *five* in number:—namely, a saccharine impregnation of the urine, *glycosuria* or *melituria*; excess of urinary secretion, or *polyuria*; excess of thirst, or *polydipsia*; inordinate appetite, or *polyphagia*; and emaciation, or *autophagia*. The first four of these symptoms he considers to be contemporaneous in their origin, and the fifth to be later in its development and transitional, marking the commencement of the cachectic period.

Careful and extensive observation, however, has convinced me that the contemporaneous existence of all these symptoms, as a very general rule, indicates an advanced stage of the malady, and that in its earlier period only one of them (if we except the debility mentioned by Dr. Copland) can be detected, namely: *the saccharine condition of the urine which is always present and alone supplies unequivocal evidence of the existence of the disease.* This saccharine condition of the urine is, in the early stage, associated with a class of symptoms totally different in character from those just enumerated. They are chiefly referable to the nervous and muscular systems, and their existence should always lead to a suspicion of the presence of diabetes, and to a careful examination of the urine, inasmuch as they depend on the presence of sugar in the blood. The last four of the symptoms, which Dr. Jaccoud terms primitive and fundamental, are, on the contrary, when fully developed, indicative of a more or less advanced stage of the malady, to which, therefore, they bear the same relation as do copious expectoration, great dyspnœa, lung cavities and hectic, to advanced pulmonary phthisis. But as it would be culpable not to recognise, by percussion and auscultation, the existence of phthisis before the development of these advanced symptoms, so would it be equally inexcusable to fail to detect the presence of diabetes until the advent of its most formidable symptoms announces that it has already reached a period of its progress when irreparable mischief may have been done; more especially so, when the physical means of obtaining a correct diagnosis in the early stage are even more perfect and reliable than those for detecting incipient phthisis.

The symptoms of the first stage of the disease develop themselves insidiously, and it is but seldom that the exact period of its commencement can be correctly ascertained. Dr. Prout[1] has stated that in several instances he has traced attacks very nearly

[1] Stomach and Renal Diseases, 5th ed. p. 27.

to their origin by endeavouring to ascertain the period 'when the urine *was last observed to be turbid.*'

The patient begins to suffer from an indefinable general indisposition not usually associated with local suffering, except a dull aching pain in the lumbar region, which is of frequent occurrence. Occasionally there is dyspepsia, for which the disease is, at this period, frequently mistaken. There is generally great debility or prostration of muscular power as well as of nervous energy; the patient feels much fatigued or even exhausted after moderate exertion, and complains of listlessness and disinclination for either bodily or mental exertion. So great is this feeling of general debility that I have known men of large muscular build, and not suffering from emaciation, unable to walk farther than a quarter of a mile, or even less, without being obliged to take a rest. Consequently the usual amount of daily exercise cannot be taken, and the avocations of life are followed with great difficulty and suffering, or have to be altogether suspended. There is great restlessness and extreme and protracted suffering from loss of sleep at night; frequently there is dimness of vision and inability to read, and numbness and loss of sensation over the outer and anterior surfaces of the thighs. At this period there is not usually much thirst, but the mouth feels clammy and frothy, especially during conversation. The skin is not preternaturally dry at this period of the disease; in two instances I have seen it perspiring. The urine is not much augmented in quantity, being regulated in this respect by the diet and quantity of drink taken; it generally ranges from three to six pints daily, *is of a pale straw colour, transparent, and does not throw down a deposit on cooling.* Dr. Prout has also stated, as the result of his observation, that during the early stage of the disease, as a general rule, the increased flow of urine was not so great as to attract the attention of the patients for several weeks, and in some instances for several months, after its saccharine condition had most probably become confirmed.

To recapitulate: the symptoms which indicate the existence of diabetes in its early stage are as follows: *General debility not dependent on emaciation; great nervous and muscular prostration; disinclination for bodily or mental exertion; dimness of vision; loss of sensation, or anæsthesia, over the surfaces of the thighs; loss of sleep, and occasionally dull pain over the loins.* When in any case we meet with such an assemblage of symptoms, more or less complete, our suspicions should be aroused, and a careful examination of the urine made for the detection of sugar, the presence of which reveals the true character and import of the patient's sufferings and the existence of diabetes. That all the symptoms just described are produced by the contamination or poisoning of the blood with sugar is proved beyond doubt by the fact of their rapid disappearance when, by the application of the skim-milk treatment, the sugar is greatly diminished or altogether removed from the blood. I shall direct attention to cases illustrative of this further on.

It is of the utmost importance to direct special attention to the symptoms of the first or early stage, because every day's experience shows that their diagnostic importance is too frequently overlooked or undervalued, and that the malady remains undetected until it has reached its second stage, when its symptoms are unmistakable and it has become much less amenable to treatment.

The duration of the first stage is exceedingly indefinite, and varies according to a variety of circumstances; it is shorter in youth than in manhood and middle or more advanced life; it may extend over a lengthened period. Cases have come under my own observation in which it had lasted many months.

The symptoms of the second stage become gradually superadded to those of the first, and are developed out of the greater intensity acquired by the disease; not only do we observe the introduction of new symptoms, but those pre-existing in the first stage acquire a much greater intensity. Consequently the debility of the patient, the loss of nervous energy, and the muscular prostration are greatly increased. The vision grows dimmer, the local anæsthesia deepens, and the sleeplessness at night becomes more and more distressing.

The symptoms which now become engrafted on the preceding are: *intense thirst, a dry parched skin, a greatly increased appetite, increasing emaciation, which ultimately becomes extreme, and an excessive flow of urine of high specific gravity and strongly impregnated with sugar.* These are the symptoms of the disease when it is fully developed, and they gradually increase in intensity until near its fatal termination. It is necessary that they should be considered somewhat in detail.

Thirst, or *polydipsia*, is a symptom always present in this stage, in greater or less intensity according to the quality of the diet of the patient and the severity of the disease (two circumstances which chiefly determine the amount of sugar present in the blood), or, in other words, the intensity of the *glycæmia.* The existence of thirst at this period, and increasing in urgency as the malady advances, is not difficult of explanation. We know that in the process of *osmosis* through membranes very different quantities of water are attracted or absorbed by different substances. Water is the endosmotic equivalent of sugar by which it is attracted and absorbed in large quantities from the blood and extra-vascular fluids in diabetés, and afterwards carried out of the system with it by the kidneys; hence the excessive flow of saccharine urine. But the continuous unceasing withdrawal of such large quantities of water from the blood and tissues excites a proportionate degree of thirst, in accordance with a physiological law, to replace the deficiency thus produced. It follows, therefore, that the thirst and polyuria must necessarily bear a direct ratio to each other and that both originate from the same cause, namely: a peculiar physical property of sugar and a well-known physical law which it sets in operation in the blood.

It is the persistent thirst, accompanied by a persistently copious discharge of urine, which generally first excites in the minds of the patients and their relatives a suspicion of diabetes when the disease has not been detected before these symptoms become urgent. The thirst is generally most intense towards evening and at night, and, with the parched mouth and sleeplessness then present, renders the condition of the sufferer exceedingly wretched and distressing. The quantity of water consumed daily by diabetics is frequently enormous, and the thirst is never appeased; it varies in different individuals and in the same patient at different periods, so that no correct estimate of it can be formed. In my own experience I have known it exceed thirty-six pints or four and a half gallons in the twenty-four hours; but other observers have recorded the drinking of much larger quantities.

A dry, parched mouth is another distressing phenomenon associated with the intense thirst, and not assuaged by the frequent large draughts of water taken by the patient; the dry tongue cleaves to the mouth, and the lips are also dry and parched.

A dry and unperspiring skin is an almost constant symptom in this stage of the disease, and, like the thirst, is produced by the continual abstraction from the system of the large quantity of water which passes off by the kidneys as urine. Dr. Prout[1] records that he has seen cases in which this symptom was absent, and in which perspiration and even

[1] Op. cit. p. 29.

sweating was produced by slight exercise; but notwithstanding such exceptional cases, this symptom is very generally present and much complained of by the patient. The insensible perspiration is enormously diminished, so much so, that according to the experiments of Von Dursch[1] only 200 grammes of water passed off by the skin and lungs in the 24 hours, instead of the normal quantity escaping through these channels, namely: 1,000 or 2,000 grammes. Probably the whole of the small quantity stated by Von Dursch escaped by the lungs.

Polyphagia, or inordinate appetite, is not as a rule prominently developed until the second stage is considerably advanced and the period of emaciation has set in; it indicates the advent of the most serious phase of the disease, when a considerable portion of the albuminoid principles of the food is converted into sugar and eliminated by the urine. It follows, therefore, that the intensity of the polyphagia is an unerring index of the extent of the mal-assimilation and saccharine metamorphosis of the nitrogenous alimentary substances destined for the healthy nutrition of the tissues of the body. This *misappropriation* of the food of the tissues creates a corresponding want, which in its turn

[1] Quoted by Dr. Parkes, On the Urine, p. 339.

excites an inordinate appetite; hence the origin of the symptom. It is needless to observe that the polyphagia increases in intensity with the further progress and increased severity of the malady; so that even enormous quantities of food are consumed by the patient without the cravings of hunger being satisfied. Under these circumstances it is exceedingly fortunate that the function of digestion is generally vigorous and unimpaired, so that quantities of food are digested which in the healthy subject would produce serious gastric disorder.

Emaciation, gradually progressive and ultimately extreme, is a constant and exceedingly prominent symptom of the disease when it has reached the second stage, and it is one moreover which has attracted the attention of physicians from the earliest period of its history. Indeed, so extreme does the emaciation become when the malady runs its course uninterruptedly to a fatal termination and life is not cut short by the invasion of some other incidental affection, that the patient becomes ultimately reduced to a mere skeleton.

The exact period at which the emaciation begins is subject to considerable variation in individual cases, being regulated in this respect by the intensity of the disease and other conditions. The first stage of the emaciation is marked by the disappearance of the fat from the adipose tissues of the body until every particle of it becomes ultimately absorbed. The rapid absorption of fat, at this period of the disease, is well illustrated by a case recorded by Dr. Prout[1] of an unusually corpulent gentleman, who, before the commencement of an attack of diabetes, weighed 27 stones, but in a short time afterwards was reduced by it to 23 stones, having lost 4 stones at the expense of the fat; and two years afterwards, although he had in a great measure recovered, his weight was further reduced to 21 stones.

This loss of fat is a feature of the disease the importance of which, as I shall afterwards point out, has not been sufficiently appreciated by pathologists. Dr. Pavy[2] attributes it to the non-assimilation of starch and sugar; but this explanation, though partly accounting for the phenomenon, is certainly insufficient to give a full explanation of it, inasmuch as it omits one important element which ought to be explained, namely: the non-assimilation of fat when consumed in abundance in the food. It is a well-established physiological fact, that when more

[1] Op. cit. p. 30.

[2] Researches on the Nature and Treatment of Diabetes, 2nd ed. p. 219.

fatty matter is consumed by a healthy individual than is used by the system for the production of animal heat, it becomes stored up in the adipose tissues and obesity is the result; nay, further, if the quantity taken is excessive and the habits of the individual are inactive and sedentary, fatty degeneration of the muscular tissues will become developed sooner or later. The question therefore arises as to what becomes of the fatty portion of the food of diabetics if *none* of it is assimilated and deposited after undergoing digestion and absorption into the blood, even in quantities larger than required for maintaining the ordinary temperature of the body. It cannot be eliminated by the lungs, for as a rule there is no elevation of temperature indicating fever, but, on the contrary, a depression, and there is no evidence to show that it passes off by the intestines or skin. The only solution of which the problem seems capable is, that a large portion, at least, of the fat taken as food is transformed into sugar and removed from the blood by the kidneys. It is not therefore the *mal-assimilation of starch and sugar alone, but of fat in addition* which produces the earlier stage of emaciation in diabetes. That such a mal-assimilation of fat does take place in this disease, I shall endeavour to show further on, under the head of Pathology, when I shall have occasion to revert more particularly to the subject.

The primary stage of emaciation is followed sooner or later by its second or more advanced period, which attacks the muscular tissues; it indicates the advent of a phase of the disease when the albuminous principles of the food begin to suffer the same fate of mal-assimilation or saccharine transformation which had previously been confined to the starch, sugar, and fat; so that the general nutrition of the body, especially of the muscles, becomes thereby seriously impaired, and atrophy is the result. In other words, during the *earlier* period of emaciation the *carbonaceous* alimentary principles *only* are transformed into sugar, while in the *later* the *nitrogenous also* are converted into this substance.

The term *autophagia*, applied by Dr. Jaccoud to designate the emaciation produced by the disease, is certainly objectionable, inasmuch as he uses it to imply the operation of a cause of very doubtful existence, namely: the production of diabetic sugar out of the albuminous tissues of the body. That such a transformation actually takes place is simply an hypothesis founded on the experiments of Traube and Mr. Sidney Ringer, showing the excretion of sugar by the kidneys of diabetics after fasting for several hours. I shall, however, have occasion to show, when considering the sources of sugar in the urine, that a very different explanation can be given of this phenomenon. Besides, the term autophagia, to be strictly appropriate, should be applicable to the *whole* of the phenomenon instead of *only a part* of it; as employed by Dr. Jaccoud, however, it could only be applied to the advanced stage of emaciation, supposing the hypothesis on which it is founded to be an established fact.

It is evident that the gradual diminution, and at last the almost complete arrest, of the function of nutrition in the advanced stage of diabetes from the continual saturation of the blood and extra-vascular fluids of the tissues with sugar, and the misappropriation and transformation of so large a proportion of the food into this substance, is of itself a cause amply sufficient to account for the atrophy and emaciation. The muscular and other tissues of the body simply suffer *inanition* and consequent destructive metamorphosis, and are excreted by the kidneys in the form of urea, which is frequently found in great excess in the urine. I may further add that it is this almost complete arrest of nutrition and resulting destruction of the tissues which ultimately produce death by exhaustion when the disease runs its full course uninterruptedly.

Besides these constant and characteristic symptoms of diabetes, which, with the superabundance, and saccharine character of the urine, enable us to diagnose the existence of the disease, there are others of minor importance, or less constantly present, which it is necessary to consider before proceeding to the *pathology* of the affection, under which head it is most convenient to consider the morbid condition of the urine, in consequence of its intimate relation to important pathological questions. The following are the more prominent of the symptoms alluded to :—

A spongy bleeding condition of the gums and looseness of the teeth, especially of the incisors, is of frequent occurrence. I have witnessed it in two cases in which it disappeared when the disease was subdued by treatment; in one of these the teeth regained their firmness when the gums became consolidated; in the other, two of them remained loose, and were extracted.

In the early or middle period of the malady the tongue is frequently covered with a thick coating of fur, but in the more advanced stage, with much emaciation, it is generally red and devoid of epithelium, while the mouth is dry and parched, especially in the night-time. A sweet taste in the mouth is a frequent symptom, and the breath of the patient exhales a sweetish sickly odour, which is peculiarly characteristic of the malady, and by which it can frequently be recognised, especially in confirmed cases. In the advanced period the tongue and the lining membrane of the mouth and fauces generally present a dusky red hue, and become covered with apthæ.

There is, generally, constipation of the bowels throughout the course of the disease, and the fœces are dry and hardened. Occasionally, however, the patient suffers from attacks of diarrhœa.

When the disease is far advanced, and the emaciation considerable, the pulse becomes rapid and feeble, and œdema of the lower extremities is frequently developed.

During the course of the disease the power and function of reproduction are suspended, both in the male and female, and as it progresses more and more all the symptoms referable to the nervous system and developed in the early stage, become greatly aggravated in degree : such as the despondency of spirits, the feebleness and vacillation of mind, the dimness of vision, the feeling of chilliness, and the anæsthesia of the limbs. It is needless to add that, with gradually increasing emaciation, the muscular debility grows more painfully distressing.

Such, then, are the phenomena of a fully developed case of this formidable disease when it runs its course without interruption; it is frequently terminated by suppression of urine, ending in fatal coma.

CHAPTER V.

PATHOLOGY OF DIABETES.—CONDITION OF THE URINE: POLYURIA, QUANTITY OF UREA.—AZOTURIA, GLUCOSURIA OR MELLITURIA.

There is, sooner or later, in diabetes a great increase in the daily secretion of urine, or *polyuria*. The quantity voided in twenty-four hours is subject to considerable variation from a variety of causes, and ranges from four to forty pints. This excess is due to the presence in the blood of diabetic sugar, which has a strong attraction for water, and thus produces a powerfully diuretic effect. The larger the quantity of sugar elaborated by the disease and circulating in the blood in a given period the greater the polyuria; hence the quantity of urine voided is regulated by the nature of the diet and the severity and stage of the disease: conditions which determine the amount of diabetic sugar produced in any given case.

Nearly the whole of the water drunk by diabetics passes off by the kidneys, a small portion only being excreted by the lungs; and, as already stated, the excessive discharge of urine excites intense thirst, and is thus compensated for by the quantity of fluid drunk. In many instances, however, the discharge of urine is so enormous as to have given rise to the supposition that it is in excess of the quantity of fluid drunk. This opinion, although believed in by several recent authorities of distinction, is, as I have already pointed out, as ancient as the times of Celsus and Aræteus. To account for this phenomenon it has been supposed that, either water is absorbed by the skin and lungs or is formed in the body, or that the latter loses weight.

The belief in such a phenomenon, if it did not originate in, has most probably been perpetuated by, a source of fallacy, caused by the singular fact that water is often *retained* in the body in diabetes for a considerable period; so that if an observation is limited to a single day, more urine may be passed on that particular day than the drink consumed; this circumstance being due to a portion of the water drunk on the previous day being then discharged as urine. But if observations to determine this question extend over a sufficiently lengthened period—from eight to twelve days—so as to exclude this source of fallacy, very different results are obtained. Thus Dr. Parkes quotes the experiments of Nasse, Von Dursch, Rosenstein, and others, and refers to his own, in addition, to demonstrate that the quantity of fluid taken surpasses the amount of urine voided and the fluid excreted by the lungs included. 'We may therefore conclude,' he observes, 'that at present there is no reason to think either that water is absorbed or formed in the body. Occasionally, no doubt, the body may for a time lose more water than it receives; it will then lose weight.'[1]

It has been proved by the experiments of Falck,[2] confirmed by those of Griesenger and Neuschler, that the water drunk by diabetics is not passed so rapidly by the urine as in healthy persons. Thus if a certain quantity of drink is taken in the morning, there may be no increase of the urine until mid-day, but if an equal quantity is taken by a healthy person at the same period, the maximum discharge of urine will be shortly after. In other words, the elimination of water is *retarded* in diabetics, and for the same reason the excretion of urine is regular. Falck attempted to explain this fact by attributing it

[1] Op. cit. p. 34.

[2] Deutsche Klinik, 1853, and Vogel in Canstatt's Jahresb. 1853. Report on Chronic Diseases.

to a retarded absorption from the stomach. But Professor Vogel, of Halle, has offered an explanation which is certainly more satisfactory and more philosophical, being founded on certain physical conditions created by the presence of sugar in the blood, and the alteration in density to which the latter is thereby subjected. 'When,' says Professor Vogel,[1] 'a diabetic is deprived of drink for a certain period, his blood becomes more concentrated in consequence of the urinary secretion which continues. This concentrated blood, much richer in solid materials than normal blood, forcibly attracts the water of the parenchymatous fluids (extra-vascular) until the degree of concentration of the latter is in equilibrium with the serum. But when the healthy individual drinks a considerable quantity of fluid, the water absorbed rapidly augments the quantity of the blood, and consequently the intra-vascular pressure; diuresis immediately follows, and ceases as soon as the greater part of the water absorbed is thereby removed. But when a diabetic drinks the same quantity of liquid, the effect is quite different, even when the gastric absorption is as rapid in the one case as in the other. The blood is diluted by the water absorbed, but the

[1] Krankheiten der harnbereitenden Organe. (Virchow's Handbuch der Pathologie. Erlangen, 1863.)

parenchymatous liquids, rich in sugar, are much more concentrated in the diabetic than in the healthy subject; they by exosmotic attraction withdraw from the blood serum a part of the absorbed water, so that immediately after the ingestion of liquid the diuresis is less abundant than in a healthy person. But in proportion as the blood, in consequence of the urinary excretion, attains a higher degree of concentration, it takes back in its turn from the parenchymatous liquids the water it had given them, so that more slowly, when a considerable interval has passed since the ingestion of drink, the diuresis is relatively more abundant with diabetics than in healthy persons.'

There can be no doubt that the modified osmotic changes described in this explanation are, in diabetes, continually in operation between the blood serum and the extra-vascular tissue fluids, and are caused by the saccharine impregnation of the blood, which in its turn produces a similar saccharine condition of these tissue fluids. The augmented specific gravity of the blood serum, in the first instance, increases the activity of the endosmotic process, so that a large quantity of fluid at once passes from the tissues into the blood-vessels, and thirst is thus excited, to be allayed by drinking. By the combined operation of these causes there is a constant influx of water into the blood and a plethora of the vascular system produced, which in its turn excites diuresis and the polyuria observed in the disease.

Quantity of Urea.—Azoturia.

Our knowledge respecting the amount of urea excreted in the urine in diabetes is very indefinite and unsatisfactory, and the statements of authors on the subject are exceedingly contradictory. Some have asserted that it is absent; others that it is diminished, or even normal; while others again aver that it is greatly in excess.

These conflicting statements are apparently due to the fact that sufficient attention has not been paid to the exact condition of the patients at the time the analyses of their urine were made. If the clinical history of each case had been carefully recorded and care taken to ascertain the degree of severity and the stage of the disease in each case, also the absence or presence of emaciation, with the rapidity of its progress when present, and all other conditions capable of modifying the excretion of urea, results of a much less contradictory character would undoubtedly have been obtained.

According to the analyses of Dr. Parkes and others there is often a very great increase in the quantity of urea, even to the extent of double or treble the healthy amount. Now, we know that the quantity of urea, or of urates, excreted daily by the kidneys is an unerring index of the amount of tissue change or metamorphosis taking place either in health or in disease (due allowance being made for the effect of food on the urine), and that when the muscular and other nitrogenised tissues are oxidised and removed in fever there is a great excess of urea or of its salts in the urine. From these facts we are justified in inferring that during the progress of emaciation in diabetes, though unattended by febrile symptoms, the excretion of urea will likewise be greatly augmented; nay further, that the quantity present in the urine at any given period and in any given case, will bear a direct ratio to the rapidity or slowness of the emaciation—being greater when the wasting is rapid, smaller when slow, and not above, or even below the normal standard before the process of emaciation has set in. In this manner it appears to me the discrepancies of different observers will be found capable of reconciliation.

The healthy relation of the blood to the tissues is destroyed by the presence of so much sugar, and, moreover, in severe or advanced cases, a very large proportion of the food becomes converted into this substance. From the combined operation of these two causes the function of nutrition is most seriously impaired, and in the end almost entirely suspended. Consequently the tissues of the body, and the muscular system in particular, suffer *inanition* and undergo destructive metamorphosis, or, in other words, are rapidly disintegrated and converted into urea, to be cast out of the body in the urine; hence the atrophy and emaciation. We can scarcely imagine the absorption into the blood of the *colloid* albumen of the tissues in such a form as to be capable of being afterwards converted into sugar, and I shall point out further on that the supposed operation of such a cause in the production of emaciation is not founded on reliable evidence.

The influence of food on the quantity of urea excreted in diabetes has been found to be the same as in health; there is an increase of urea near the usual period after mixed and nitrogenous food. According to the experiments of Mr. Sidney Ringer, quoted by Dr. Parkes,[1] the excretion of urea after nitrogenous food (meat) begins to increase in the second and third hour, and reaches its maximum in the third and fifth hour, when it begins to decrease.

[1] On the Urine, pp. 343 and 351.

But it appears that the influence of food on the urine does not entirely disappear until from eight to fourteen hours. Dr. Parkes, however, has directed attention to the fact that an animal diet is not at all sufficient to account for the immense increase of urea found in the urine in several cases of diabetes.

Experimental researches, especially those of Ranke, and of Bischoff and Voit,[1] on the effect of *inanition* and of different kinds of ingesta on the urine and the elimination of nitrogen, throw considerable light on the phenomena of emaciation and the excessive excretion of urea observed in diabetes. It seems clearly established by these experiments that the quantity of nitrogen or of urea present in the urine is in *inverse* ratio to the amount of carbon consumed in the food, being most abundant when the carbonaceous constituents are absent from the food altogether, and *vice versâ*. Consequently, when fat and starchy matter are either absent from the food or in quantity insufficient for the maintenance of animal heat, the temperature of the body is maintained by the oxidation or combustion of its albuminous tissues (especially the muscular tissue)

[1] On this important subject see Dr. Carpenter's interesting chapter on the 'Balance of the Vital Economy,' Principles of Human Physiology, 6th ed. p. 324.

and the products of their retrograde metamorphosis. It appears, further, that when fat is taken in the food it is consumed by the oxygen, which is thus prevented from oxidising the albuminous tissues. Fat, therefore, exercises a powerfully protective influence on these tissues.

Now, in diabetes, as is well known, there is a *complete misappropriation* of the starch and sugar taken in the food, so that these substances neither contribute to the process of nutrition nor to the production of animal heat, but are rapidly cast out of the body by the urine as a foreign substance in the form of diabetic sugar. And, as I shall endeavour to show further on, there is a similar misappropriation of fat, though perhaps not so complete. It follows, therefore, that the temperature of the body must be dependent chiefly on the combustion or oxidation of the albuminous constituents of the food and tissues, and that this circumstance must be productive both of emaciation and of excessive elimination of urea in the urine.

None of the other normal constituents of the urine appear to be affected in diabetes in a manner requiring to be specially noticed. On account of its extreme dilution and the presence in it of sugar, the urine continues to be of a pale straw colour and perfectly transparent; it does not become turbid nor throw down deposits on cooling. There does not appear, however, to be any absolute diminution in the quantity of its colouring matter, which is simply so much diluted as to be scarcely recognisable. Diabetic urine has a very peculiar, faint, sickly, apple-like smell by which it can frequently be detected, and which is quite unlike the odour of the healthy secretion.

Glucosuria or Mellituria.

It has been stated already that a saccharine impregnation of the urine is *constant* in diabetes, and is unquestionably *the essential* symptom of the disease. The presence of a large quantity of sugar imparts to the urine a sweet taste and greatly increases its specific gravity, which, though variable in different individuals, and in the same individual at different periods of the disease, generally ranges between 1,030 and 1,045 when the quantity of fluid ingesta is considerable and the flow of urine copious. Dr. Prout[1] mentions having met with cases in which the urine had a specific gravity of 1,010 and 1,015; this, however, is exceptional. But when the quantity

[1] Op. cit. p. 25.

of fluid drunk is restricted and the urine consequently less abundant, its specific gravity may considerably exceed the range just given. Cases indeed have been recorded in which the specific gravity is said to have been as high as 1,050, 1,055, 1,060, 1,074, and 1,111;[1] such instances are certainly of rare occurrence. In my own experience I have never met with a case in which the density of the urine exceeded 1,046, which figure is frequently attained. As a very general rule, increase in quantity and high specific gravity are conditions associated together in the same case, and have an intimate relation to each other, both being determined by the quantity of sugar eliminated by the kidneys; their coexistence in any given case therefore supplies a very reliable index of the intensity of the disease.

The kind of sugar found in diabetic urine is *glucose*, or *grape sugar*; its chemical composition being $C_6 H_{12} O_6$; it is readily obtained from the urine by concentrating it, until it crystallises, then washing the crystals with cold alcohol, and afterwards dissolving them in water, and re-crystallising. Glucose is found abundantly in the vegetable kingdom, and in honey; it is readily obtained from

[1] Jaccoud, Op. cit. p. 253, and Prout, Op. cit.

starch by boiling with dilute sulphuric acid, and by the action of diastase, a peculiar ferment produced during the germination of barley.

The quantity of sugar found in the urine of diabetics is subject to great variation, according to the period and the severity of the disease, and various other conditions about to be noticed. It may vary from the fraction of an ounce to $2\frac{1}{2}$ pounds, or even 3 pounds, in the twenty-four hours; so that in severe cases uncontrolled by treatment, patients void a quantity of sugar equivalent to their own weight in the course of a very few months. Dr. Parkes states that the percentage of sugar may be as high as 15; and Dr. Pavy[1] has met with as much as 48 grains to the fluid ounce, but he considers that a greater degree of concentration than this is prevented by an increased flow of urine.

According to the observations of Dr. Bence Jones[2] the presence of sugar in the urine is frequently intermittent, and without obvious cause, in cases which seem to be genuine diabetes in elderly persons.

Great discrepancy of opinion prevails amongst

[1] Researches on the Nature and Treatment of Diabetes, 2d ed. p. 204.

[2] Med. Chirurg. Trans. vol. xxxvi. 1853, p. 420, and Med. Times and Gazette, Feb. 4, 1854.

authors as to the period of the day when the specific gravity of the urine, and the quantity of its contained sugar, is greatest in diabetes. Some have stated that it is heavier, and therefore more saccharine, in the morning ; others that its density is greatest, and that it is more saccharine, in the afternoon and evening.[1] To determine this question I have made some careful experiments on patients placed on an exclusively skim-milk diet, the quantity and quality of the skim-milk being exactly the same from day to day, and always taken at the same regular periods. The results obtained have been remarkably uniform. The subjoined table gives the result in a very severe case of diabetes. The patient was passing, at the commencement of the treatment, twenty-seven pints of urine daily, having a specific gravity of 1040 and containing an enormous quantity of sugar, which at first suddenly, and afterwards gradually, diminished until it disappeared altogether from the urine at the end of thirty-five days. Portions of the urine voided at the times specified were preserved separately by the patient, and afterwards examined by myself.

The table gives the condition of the urine during the twenty-two days preceding the disappearance of the sugar.

[1] Oppolzer and Jordao, quoted by Jaccond, Op. cit. p. 253.

Table Showing the Daily Quantity of Urine and its Specific Gravity at Four Different Times of the Day during a Period of Thirty-One Days under an Exclusively Skim-Milk Diet.

	Spec. Grav.	Spec. Grav.	Spec. Grav.	Spec. Grav.	Spec. Grav.	Daily Quantity in Wine Pints	
	4 A.M.	11·30 A.M.	2 P.M.	10 P.M.	mean		
Dec. 2	1022·	1030·	1008·	1010·	1016·	4½	Urine containing sugar
3	1006·	1026·	1028·	1008·	1018·	6	,,
4	1018·	1024·	1012·	1002·	1014·	6	,,
5	1020·	1010·	1030·	1004·	1016·	5½	,,
6	1010·	1014·	1018·	1006·	1014·	5½	,,
7	1012·	1030·	1014·	1010·	1014·	6½	,,
8	1002·	1038·	1014·	1026·	1020·	7	,,
9	1022·	1022·	1016·	1011·	1024·	5½	,,
10	1006·	1008·	1022·	1006·	1014·	5	,,
11	1008·	1024·	1012·	1006·	1012·	5	,,
12	1016·	1024·	1010·	1010·	1015·	4½	,,
13	1008·	1016·	1016·	1011·	1013·	5	,,
14	1015·	1016·	1016·	1002·	1012·	6	,,
15	1011·	1016·	1012·	1004·	1012·	5	,,
16	1007·	1010·	1010·	1002·	1008·	6	,,
17	1016·	1010·	1006·	1008·	1010·	6	,,
18	1005·	1014·	1006·	1007·	1008·	6	,,
19	1009·	1010·	1002·	1016·	1010·	5½	,,
20	1007·	1006·	1007·	1008·	1007·	5	,,
21	1006·	1005·	1007·	1010·	1007·	5½	,,
22	1008·	1018·	1006·	1004·	1009·	5½	,,
23	1006·	1018·	1007·	1009·	1008·	6	,,
24	1004·	1014·	1007·	1009·	1008·	6	Urine free from sugar
25	1004·	1017·	1006·	1007·	1008·	6	,,
26	1012·	1012·	1006·	1001·	1008·	6	,,
27	1007·	1012·	1006·	1007·	1008·	6	,,
28	1005·	1018·	1007·	1001·	1008·	6	,,
29	1008·	1017·	1010·	1008·	1008·	6	,,
30	1010·	1012·	1007·	1004·	1008·	6	,,
31	1003·	1010·	1014·	1006·	1008·	6	,,
Jan. 1	1005·	1008·	1012·	1007·	1008·	6	,,

It will be observed from this table that as an almost absolute rule (there being only three consecutive and unimportant exceptions near the end, when the sugar had nearly disappeared) the urine secreted during the morning and forenoon and voided just before midday was very much heavier than that secreted during the evening and early part of the night and voided two hours before midnight, the difference in one instance being as high as twelve to one. It is necessary here to remark that the conditions as to food, drink, and exercise were alike from day to day.

The quantity of sugar was very much greater in the urine secreted in the morning and forenoon than in that secreted in the evening and early part of the night, notwithstanding that the quantity of skim-milk taken between midnight and midday, on the one hand, was exactly the same as that consumed between midday and midnight, on the other.

During the last eleven days of the observation preceding the complete disappearance of the sugar, the daily quantity being then small, *it was always present in the urine secreted before midday and occasionally up to 2 p.m.; and always absent, or nearly absent, in that secreted between 2 p.m. and midnight.*

The daily allowance of skim-milk in this case was from six to eight pints, seven being the usual quantity; free perspiration continued during the whole period, especially at night. No water was drunk nor other food taken. The patient had been twelve days under this treatment before the table was begun on the 2nd of December, when the disease had been greatly subdued. Prior to this date a record had been kept of the mean daily specific gravity and quantity only.

It is exceedingly interesting to observe in this case that for nine consecutive days (from the 24th of December to the 1st of January inclusive) after the sugar had left the urine, the daily quantity remained stationary at six pints and the mean specific gravity at 1008.

The following table is another illustration :—

	Spec. Grav.	Spec. Grav.	Spec. Grav.	Spec. Grav.	Spec. Grav.	Urine Voided Daily	Daily Allowance of Skim-Milk
	6 A.M.	noon	6 P.M.	10 P.M.	mean		
April 16	1020·	1017·	no exam.	1017·	1017·	5¼	7 pints
17	1020·	1017·	,,	1016·	1018·	5	7 ,,
18	1020·	1016·	1005·	1014·	1016·	5¼	7 ,,
19	1014·	1018·	1004·	1013·	1015·	5½	7 ,,
20	1012·	1014·	1005·	1011·	1013·	6	7 ,,
21	1011·	1010·	1005·	1011·	1011·	5¼	7 ,,
22	1015·	1015·	1005·	1011·	1012·	6	7 ,,
23	1015·	1007·	1004·	1007·	1010·	5¼	8 ,,
24	1013·	1009·	1006·	1015·	1010·	6½	8 ,,
25	1009·	1006·	1007·	1008·	1012·	5¼	8 ,,
26	1010·	1010·	1007·	1007·	1010·	6	8 ,,
27	1010·	1010·	1005·	1005·	1010·	6	8 ,,
28	1010·	1010·	no exam.	1009·	1010·	6½	8 ,,
29	1010·	1010·	1008·	1009·	1009·	6½	8 ,,
30	1008·	1010·	1006·	1015·	1010·	6¾	8 ,,
May 1	1010·	1010·	no exam.	1010·	1010·	5	8 ,,
2	1010·	1012·	,,	1010·	1010·	6	8 ,,
3	1014·	1016·	,,	1016·	1010·		8 ,,
4	1014·	1012·	,,	1010·	1012·	6¾	8 ,,
5	1012·	1012·	,,	1012·	1010·	6¾	8 ,,
6	1015·	1017·	,,	1013·			7 ,,
7	1014·	1013·	,,	1010·	1011·	5¾	7 ,,
8	1018·	1012·	,,	1010·	1012·	6½	7 ,,
9	1015·	1010·	,,	1008·	1010·	6½	7 ,,
10	1015·	1014·	,,	1006·	1010·	6	8 ,,
11	1014·	1010·	,,	1010·	1013·	6¼	8 ,,
12	1012·	1010·	,,	1010·	1012·	6¼	8 ,,
13	1018·	1020·	1004·	1006·	1014·	6½	8 ,,
14	1014·	1012·	1004·	1012·	1012·	6½	8 ,,
15	1012·	1012·	no exam.	1012·	1010·	7	8 ,,
16	1018·	1012·	,,	1008·	1012·	6	7 ,,

In this case the treatment was begun on the 7th of April, when the sugar was unusually abundant in the urine, which amounted to nearly nine pints daily and had a specific gravity of 1045, so that on the 16th of April, eight days afterwards, when the above table, recording the density of the urine at four separate periods of the day, began to be kept, in addition to the mean specific gravity previously taken, its density had fallen to 1017, and the quantity of sugar was very greatly reduced.

A glance at the table will show that the urine secreted between midnight and noon was very much heavier than that voided between noonday and 10 P.M., and that what was passed in the evening at 6 P.M. had an exceedingly low density.

An examination of the urine at each period noted in the table invariably revealed a much larger quantity of sugar in the morning and at noon than in the evening and at night. The sugar altogether disappeared on the 15th of May, and for a few days previously it could only be detected in the morning and not in the evening.

I will only add that in all the cases I have put on the skim-milk treatment I have obtained the same result as recorded in these two tables, and that the sugar has always been found most abundantly in the morning or forenoon. How far this condition may be modified under other methods of treatment or under different kinds of diet I am unable to decide from experience.

The fact has long been familiar to physicians that the invasion of certain acute febrile affections, both specific and non-specific in their nature, have generally the singular effect of greatly diminishing or completely removing the sugar from the urine in diabetes during the period of their continuance. In a case reported by Stokvis, and quoted by Dr. Parkes, the sugar fell from 388 grammes daily to 7·99 grammes during gastric fever, and again rose to more than 296 grammes after the subsidence of the fever, although the quantity of food was diminished. Some have considered that this effect of fever may be due to some cause which checks or lessens the formation of sugar, or produces its retention; it seems quite as probable, however, that it may undergo decomposition in the blood.

It is also well known that on the approach of death the sugar frequently disappears from the urine entirely; but we have no certain knowledge as to the cause of this phenomenon.

The Detection of Glucosuria.

When the urine voided exceeds in quantity four pints daily and has at the same time a specific gravity exceeding 1030, and is, moreover, pale straw-coloured, transparent, and without a deposit on cooling, the presence in it of diabetic sugar may, as a very general rule, be taken for granted. But when the daily quantity is much larger still and the density also higher, there can be no doubt whatever in the matter. But at the same time it must be remembered, that the urine may contain sugar even when its specific gravity is as low as 1015 or 1012, and below the normal standard. This, however, is exceptional, except under the influence of the skim-milk treatment, when it is generally observed after the sugar has been greatly diminished in quantity and before it entirely disappears.

But in every suspected case of diabetes the urine must always be subjected to a careful chemical examination for the detection of sugar. Fortunately the processes to be employed for this purpose are quite simple and perfectly reliable. The apparatus and reagents needed for the investigation consist simply of a few middle-sized test tubes, a spirit lamp, and two stoppered bottles, the one containing a solution of caustic potash (*liquor potassæ*): the other a solution of sulphate of copper of moderate strength. Both solutions must of course be ascertained to be chemically pure and not contaminated with the salts of lead or other impurities. By means of these reagents (*sulphate of copper* and *liquor potassæ*), we apply what are now familiarily known as *Moore's* and *Trommer's tests*, which may be briefly described.

Moore's test consists in putting a portion of the suspected urine in a test tube (one-third full), and adding to it half its bulk of *liquor potassæ*, and then boiling it over a spirit lamp for a few minutes. If sugar is present, the urine, thus treated, assumes a brownish colour, which increases in intensity as the boiling is continued. This change is caused by the formation of *glucic acid* which becomes transformed into *melassic acid*. The intensity of colour produced by this test depends on the quantity of sugar present in the urine: if the quantity is minute, the urine will become like pale sherry; but if large, the colour will resemble that of port wine or claret, or in some specimens it will become almost black. Between these two extremes, shades of varying intensity will be observed in different samples of urine.

Trommer's test is applied by adding to a portion of the urine, in a test tube, a drop or two of a solution of sulphate of copper so as to produce a pale blue colour, and then adding *liquor potassæ*, in excess, until the *hydrated oxide of copper*, first thrown down, is re-dissolved, as it always is when sugar is present, and a clear deep blue fluid is produced: this latter is next boiled over a spirit lamp, and if the quantity of urine sugar is minute, a yellowish-red opalescent tint will be produced; but if the amount of sugar is large, a copious opaque orange-coloured precipitate of the *sub-oxide of copper* is thrown down. If, however, sugar is altogether absent from the urine, a dark green precipitate is formed by the boiling.

These two tests for diabetic sugar are sufficient for ordinary clinical examinations, although there are others more delicate still. The old and familiar *fermentation* test has fallen, in a great measure, into disuse, in consequence of the length of time required for its completion, and the readiness with which the others can be applied.

As already stated, increase in quantity and elevation in density are conditions generally co-existent in the urine of diabetics, so that the *degree* to which they are developed supplies a very reliable practical guide as to the quantity of sugar voided in any particular case of the disease, and an index by which we can safely predicate whether the amount is *small* or *large*. But when it is considered necessary to determine the *exact* quantity of sugar in any given specimen of urine, we must have recourse to a more definite procedure. For this purpose various methods are employed. One of the simplest and most ingenious of these is the beautiful apparatus invented by Soleil and named the *polarising saccharimeter*, by which the quantity of sugar is accurately measured by the degree of polarisation produced. This instrument is made by some London philosophical instrument makers; it is much used in France, but is not generally known in this country.

CHAPTER VI.

PATHOLOGY OF DIABETES. SOURCE OF THE SUGAR. MAL-ASSIMILATION OF THE PROXIMATE PRINCIPLES OF FOOD; OF STARCH AND SUGAR; OF FAT; AND OF ALBUMEN.

Although the urine-sugar in diabetes is immediately derived from the blood, there can be no doubt whatever that the ultimate source is the food. In every case of the disease more or less of the food taken, according to the stage and severity of the affection, is converted into diabetic sugar in the system. The saccharine metamorphosis, or mal-assimilation, in fact constitutes the disease. But as food is composed of an admixture of carbonaceous and nitrogenous proximate principles, it is necessary to enquire into the influence exercised by each and all of these compounds, or principles, on the quantity of sugar formed and subsequently excreted in the urine, or, in other words, on the activity of the morbid process.

Experience has clearly demonstrated that in diabetes, as a general rule, all kinds of vegetable food containing amylaceous and saccharine substances increase the quantity of sugar in the urine: the augmentation commencing in less than two hours after such food has been taken, and generally continuing from four to six hours, and even much longer when the quantity of starch has been large.

A very important fact, throwing considerable light on the pathology of the disease, has been established by careful experiment and observation in several cases, namely: *that in the early period of the disease the whole of the sugar found in the urine is derived from the starch and sugar in the food.* This seems to be proved by the following observations. Mr. Graham[1] ascertained that in two cases of diabetes kept carefully under examination for a period of two months, the quantity of diabetic sugar voided never exceeded the amount of starch taken in the food, and that nearly the whole of the starch consumed was accounted for by the sugar in the urine. Traube has also recorded a case in which at first all the diabetic sugar detected in the urine was derived exclusively from the starch in the food. Dr. Parkes,[2] too, refers

[1] See article on Adventitious Products, by Dr. Walshe: Cyclop. of Anat. and Physiolog.

[2] Op. cit. p. 347.

to an instance which occurred in his own practice, in which abstinence from starchy food completely removed the sugar from the urine, and in which the saccharine metamorphosis of starch was so complete that the smallest quantity taken in the food soon presented itself in the urine as diabetic sugar. These and other cases which might be quoted, quite in accordance with common experience, afford unequivocal evidence of the fact that in most cases of diabetes, if not in all, the mal-assimilation of starch and sugar, only, constitutes the earliest stage of the disease. At this early period complete abstinence from starch or sugar alone for twelve hours or so will cause a complete disappearance of the sugar from the blood and urine, and the restoration of the latter to its normal density.

When the mal-assimilation of starch and sugar has once begun, it continues in operation during the whole period of the disease, and it would appear that ultimately the *whole* of these substances taken as food undergo transformation into diabetic sugar. It follows as a consequence of this complete and continuous mal-assimilation and misappropriation, that no portion of these substances can be available for the purposes of nutrition or the production of animal heat, and that the supply of one of the three essential principles of food is cut off from the system.

The *oleaginous* or *fatty* principles of food are not at present recognised by pathologists as a source of sugar in diabetes, notwithstanding the circumstance, already stated, that sooner or later in the progress of the malady the whole of the fat disappears from the tissues of the body. But when we take into consideration the fact that the disease is not attended by pyrexia or any abnormal elevation of temperature, denoting increased destruction of carbonaceous and other compounds for the production of animal heat, there being, on the contrary, often a diminution of the heat of the body, we have strong presumptive evidence that there is also, after the disease has continued for some time, a saccharine transformation of fat, of which large quantities are sometimes consumed by diabetics without being appropriated by the processes of assimilation and nutrition.

It is of great practical importance to determine with some degree of precision the rôle played by fat in the pathology of diabetes, and to ascertain whether it exercises any important influence in the production of sugar; because if it can be established beyond reasonable doubt that it supplies a *pabulum* for the formation of sugar, the knowledge of such a fact must necessarily introduce important modifications into our future treatment of the disease.

The following observations have an important bearing on this question :—

A gentleman, aged 45 years, suffering from confirmed diabetes of three years' standing, for which he had been subjected to various methods of treatment, chanced to read in the 'Lancet' of the 23rd of October 1869, the details of two cases of the disease which I then published as illustrations of the success attending the skim-milk treatment. Shortly afterwards he left London to reside for a while in the country, with a near relation, for the express purpose of trying the milk treatment according to the method I had described in my paper. When he began to subject himself to the treatment he had for a long period been living on a restricted animal diet containing a certain amount of fat, and from which starch was not entirely excluded; he also drank a bottle of claret, and sometimes more, in the day; his urine varied in quantity from four to six pints daily, having a specific gravity varying from 1032 to 1042, and being loaded with sugar, for the detection of which he had long used the ordinary tests.

On the 29th of November this gentleman placed himself on an exclusively milk diet, and pursued it most rigidly for a week, during which period he abstained even from his accustomed beverage, claret. The milk which he took, however, was not skim-milk—from which he was dissuaded by his lady friends as too poor to support life—but *new milk*, exceedingly rich in cream—'nearly as good,' he said, 'as most London cream'—yielded by a particular cow in the dairy, and specially set apart for his use on account of its richness. Of this milk, in the condition yielded by the cow, he took from six to eight pints daily. The following table shows the state of his urine—first, on the day before beginning the milk diet; secondly, under the influence of this diet; and, thirdly, for some days after its abandonment and the resumption of his previous diet:—

Restricted animal diet and claret.

Nov. 28	4	pints of urine . . .	1041	specific gravity

Exclusive new-milk diet.

Nov. 29	5	pints of urine . . .	1043	specific gravity
30	4	,, . . .	1042	,,
Dec. 1	4	,, . . .	1040	,,
2	4	,, . . .	1046	,,
3	$6\frac{1}{4}$	,, . . .	1040	,,
4	$4\frac{1}{2}$	,, . . .	1042	,,
5	6	,, . . .	1040	,,
6	8	,, . . .	1044	,,
7	$6\frac{1}{2}$	,, . . .	1044	,,

Left off milk diet.

Dec. 11	6	pints of urine . . .	1038	specific gravity
19	6	,, . . .	1035	,,
22	6	,, . . .	1035	,,
26	6	,, . . .	1032	,,

It will be observed from this table that the immediate effect of this exclusive diet of milk, rich in cream, and therefore in butter or fatty matter, was greatly to raise the specific gravity and quantity of the urine and greatly increase the amount of diabetic sugar contained in it. It will also be observed that the specific gravity of the urine again fell very considerably after the milk diet was abandoned and the previous restricted diet resumed. That the increase of sugar in the urine in this case was caused entirely by the butter or fatty matter of the milk was proved most conclusively by the effect of an exclusive skim-milk diet on the same gentleman four months after the date of the above experiment, as I shall now show.

On the 7th of April following the above date, this case came under my own observation and treatment. On this day the patient voided nine pints of urine having a specific gravity of 1045, and containing $14\frac{3}{4}$ ounces of sugar ; for some time the disease had been gaining ground. I placed him at once under the skim-milk treatment; at first he took, daily, six pints, and afterwards seven pints, of skim-milk, from which the cream had been most carefully removed after the milk had remained in a cold situation twenty-four hours. All other food was strictly prohibited, and neither claret nor other drink was taken. Under this treatment the quantity of fatty matter taken in the milk must have been extremely small. The following table shows the effect produced on the urine :—

Restricted animal diet.

April	7	9	pints of urine . . .	1045 specific gravity

Skim-milk diet.

April	8	4	pints of urine . . .	1030 specific gravity
	9	5	,, . . .	1026 ,,
	10	6	,, . . .	1025 ,,
	11	5	,, . . .	1020 ,,
	12	$4\frac{3}{4}$	,, . . .	1020 ,,
	13	4	,, . . .	1015 ,,
	14	$4\frac{1}{4}$	,, . . .	1016 ,,
	15	$5\frac{1}{2}$	,, . . .	1018 ,,
	16	$5\frac{1}{4}$	,, . . .	1017 ,,
	17	5	,, . . .	1018 ,,
	18	$5\frac{1}{4}$	,, . . .	1016 ,,
	19	$5\frac{1}{2}$	,, . . .	1015 ,,
	20	6	,, . . .	1013 ,,
	21	$5\frac{1}{4}$	,, . . .	1011 ,,

On the 21st of April the quantity of sugar in the urine was reduced to a mere trace.

The results obtained by these two experiments on the same individual are to my mind perfectly conclusive, that fatty matter taken as food increases the amount of diabetic sugar in the urine after the disease has continued some length of time. I have met with other instances corroborative of this opinion.

Thus, in a case of long-standing diabetes placed under the skim-milk treatment, the specific gravity of the urine never fell below 1025, and very seldom so low, as long as the milk stood only eight or twelve hours before the cream was separated; but no sooner was the milk allowed to stand twenty-four hours before it was skimmed and used, than under its influence the specific gravity of the urine fell to 1019 and the sugar to one-half the previous amount.

In another instance, to be referred to further on, the administration of *new milk*, rich in cream, caused a return of sugar in the urine about a fortnight after its removal by the skim-milk treatment.

If further evidence was necessary to prove that fat contributes to the formation of sugar in diabetes, it is supplied by the experiments of Dr. Pavy on the administration of *glycerine* and of a diet composed of milk (containing the cream) and suet. To these experiments I must now refer.

As glycerine does not belong to the carbo-hydrate group, its composition being: C_6 H_8 O_6, Dr. Pavy considered it would not be expected to produce an increased elimination of sugar. On making a trial with it, however, the result was exactly opposite to what he anticipated. I shall here, in his own words, give his account of the experiment:[1] 'To a patient who was being restricted to an animal diet, and who was passing from three to three and a half pints of urine, and from 900 to a little over 1,100 grains of sugar in the twenty-four hours, I ordered glycerine to be administered. Upon the first day he took six ounces; upon the second, eight ounces; and upon the third, ten ounces. The urine rose in quantity to between five and six pints, and the sugar to from upwards of 2,000 to upwards of 3,000 grains *per diem*. The glycerine being omitted, the urine immediately fell in quantity and averaged for several days about three pints, and the sugar about 1,500 grains. Glycerine was then given again to the extent of ten ounces a day for two days consecutively. The urine rose, and upon the third day reached eight pints, and the fourth day seven and three quarter pints in quantity. The sugar upon the first day amounted to 3,744 grains; the second, 4,032 grains; the third, 4,608 grains; and the fourth, 4,850 grains.

'The glycerine being now discontinued, the urine on the following day stood at three pints, and the sugar at 2,540 grains. The next day the urine

[1] Op. cit. p. 258.

amounted only to two and a quarter pints, and the sugar to 1,199 grains. The glycerine employed was that supplied to Guy's Hospital dispensary.' Dr. Pavy adds that, whatever the explanation may be, the fact is indisputable that glycerine produced a material aggravation of the symptoms under which the patient laboured, in addition to the great increase of sugar in the urine.

Dr. Pavy made a series of experiments on a diabetic patient named North, extending over a period of nearly two months, with the view of determining the effect of various kinds of food on the quantity of sugar excreted in the urine. During the course of these experiments, when (on the 15th of February) the patient was on a diet composed exclusively of meat, jelly, and beef tea, and was passing 569 grains of sugar in the twenty-four hours, milk to the extent of three pints daily was given with the meat, instead of the jelly and beef tea, for two consecutive days (16th and 17th of February): the result was that the quantity of sugar gradually rose, and at the end of the second day amounted to 1,258 grains in the twenty-four hours. During the next three days (18th, 19th, and 20th of February) *suet was added* to the meat and milk diet—half a pound on the first day, three-quarters of a pound on the second, and a quarter of a pound on the third—and the effect of this addition of fatty matter was to increase the quantity of urine sugar gradually until it amounted to 2,225 grains, in the twenty-four hours, at the end of this period. On the following day (21st February) eggs and beef tea were substituted for the milk and suet, which were withdrawn, and the quantity of urine sugar fell to 927 grains.

In this experiment it is obvious: first, that the addition of milk to the patient's diet greatly increased the quantity of sugar eliminated; and secondly, *that the increase was greatly augmented, or nearly doubled, by the further addition of suet.*

That the special ingredient of milk which in this instance increased the amount of sugar was butter, is abundantly proved by my own numerous experiments, which have most fully established the fact that an exclusive diet of skim milk (from which the butter has been almost completely removed) *rapidly* and *invariably* diminishes the sugar in the urine, and, in a large proportion of cases, ultimately removes it altogether.

It appears to me that the only legitimate interpretation of the result obtained in Dr. Pavy's case is, that the butter of the milk raised the quantity of sugar to a certain extent, and that the further addition of suet, or of *more* fatty matter, raised it still higher.

Dr. Pavy, however, has given an entirely different explanation, and attributes the increase to the action of milk sugar on the disease. 'It would be an unintelligible exception,' he observes, 'if the presence of lactin did not render milk an objectionable article of food in diabetes.'[1] I feel convinced, nevertheless, for the reason just stated, that lactin, *as a constituent of milk*, is not converted into diabetic sugar. Indeed such a transformation seems to be effectually prevented by the conversion of the former into lactic acid in the stomach during digestion. Dr. Bence Jones[2] has advanced the opinion that one of the most important physiological uses of lactin is to become converted into lactic acid during digestion, for the purpose of dissolving the albuminous capsules of the milk globules. It is therefore not quite so unintelligible as might be supposed that this substance is *not* converted into diabetic sugar.

It has yet to be determined at what period of the disease the conversion of fat into sugar begins. I am, however, inclined to believe that in its origin it is

[1] Op. cit. p. 260.

[2] Lectures on Digestion, Respiration, and Secretion: Med. Times and Gazette, April 19, 1851.

intermediate between the *initial* stage characterised by the mal-assimilation of starch and sugar only, and the *advanced* phase in which albumen also undergoes saccharine transformation. We can thus understand how it is that cod-liver oil has been found to act beneficially, instead of injuriously, when administered sufficiently early in the malady, as in a case recorded by Dr. Bence Jones[1] and similar instances.

At the present time our physiological knowledge relating to the production of sugar from fatty matter is exceedingly limited and unsatisfactory. It is, however, admitted that such a production does take place. Thus Dr. Carpenter[2] observes, that 'it seems also to be established, that compounds presenting a close analogy to sugar may be obtained by the metamorphosis of the oleaginous as well as the albuminous substances within the body.'

Some light is undoubtedly thrown on the subject by the researches of certain German physiologists on the fatty origin of glycogen, of which Dr. Carpenter has given the following brief summary:[3]—'In addition to the two hypotheses above stated as to the origin of glycogen, a third has recently been put

[1] Med. Times and Gazette, Feb. 4, 1854.

[2] Principles of Human Physiology, 6th ed. p. 34.

[3] Op. cit. p. 390, *foot-note.*

forward by V. Deen,[1] Pogiale, and others, that it is the result of the metamorphosis of fatty substances consumed as food or generated in the liver itself. Küthe and Heynsius[2] especially adopt the latter view, maintaining that the glycogen proceeds from the decomposition of the conjugated biliary acids re-absorbed in the intestine; for in dogs with biliary fistulæ, Küthe found that the liver contained no glycogen and a very small portion (0·2 per cent.) of sugar, whether they had or had not been previously fed with meat; whilst if healthy dogs, after many days' fasting, and in which there should normally have been but a small proportion of glycogen present, were fed with 1 oz. of *taurine*, and were killed after two or three hours, an abundant supply of glycogen could be obtained from the liver. And again, theoretically, urea and glycogen may very easily be derived from the decomposition of glycine, thus:—

$$\begin{array}{ll} \text{2 Eq. of urea } 2\ (C_2\,H_4\,N_2\,O_2) & = C_4\,H_8\,N_4\,O_4 \\ \text{2 Eq. of glycogen } (C_{12}\,H_{12}\,O_{12}) & = C_{12}\,H_{12}\,O_{12} \\ \hline \text{4 Eq. of glycine } 4\ (C_4\,H_5\,N\,O_4) & = C_{16}\,H_{20}\,N_4\,O_{16} \end{array}$$

'And it has already been shown that the quantity of urea rises in diabetes, while the increased size of the liver in this disease is indicative of increased functional activity.'

[1] Donder's Archiv. 1860, iii. p. 49.

[2] Studien des Physiolog. Inst. zu Amsterdam.

There is no fact better established in relation to diabetes than that the *albuminous* or *nitrogenous* principles of food become also converted into sugar by the morbid process. The saccharine transformation of albumen, however, unquestionably indicates an advanced stage of the disease.

For a time the exclusion of starch and sugar from the food causes the complete disappearance of the sugar from the urine; but as the disease advances, the sugar continues, notwithstanding this restriction, and the exclusive use of a purely nitrogenous food. This has been shewn by Traube, and by Dr. Parkes,[1] and is demonstrated by common experience. When the disease is so far advanced that this additional source of sugar becomes established, the dependence of the urine sugar on the food is still quite obvious; even when the carbonaceous compounds, starch, sugar, and fat, are excluded from the composition of the latter. It begins to be eliminated in greatly increased quantity shortly after meals, and this augmentation continues for several hours.

The amount of sugar formed from the nitrogenous compounds is at first small, but as the disease progresses it becomes more and more abundant. The quantity of albuminous food converted into sugar in

[1] Op. cit. p. 348.

any given case depends chiefly on the stage and severity of the disease, but to what extent the transformation ultimately attains has not been determined. According to the carefully conducted investigations of Griesinger,[1] made on a diabetic patient rigorously restricted to a meat diet, the quantity of sugar passed in the urine corresponded to two-fifths of the whole of the meat food taken, or to three-fifths of its contained albumen. From this it will be obvious how little is sometimes left available for the purposes of nutrition. But in the final stage of the disease there can be no doubt that even a larger proportion undergoes mal-assimilation and misappropriation. The extreme degree of emaciation, then, so frequently witnessed in the disease, and the excessive polyphagia with which it is so generally accompanied, are phenomena which are thus fully explained.

It seems highly probable that the process of mal-assimilation of starch and sugar *determines or originates, as well as increases the intensity*, of the saccharine transformation of albumen. Thus Dr. Pavy [2] has reported a case in which, at a time when sugar had for some days been entirely absent from

[1] Archiv. für phys. Heilk. 1859, p. 53.
[2] Op. cit. p. 241.

the urine, under a restricted animal diet, two ounces of ordinary bread were given daily for a couple of days, and then the restricted diet resumed. The result of this experiment was, that the four ounces of bread occasioned the elimination of 1,425 grains of sugar, which was a larger quantity than could possibly have been yielded by the bread itself, as two ounces of it, after complete dessication, left a residue of only 600 grains of solid matter; equivalent to 1,200 grains in the whole four ounces, only a portion of which was starch. Besides, it was further observed in this case, that the sugar continued to increase for two days, and did not entirely disappear for four days, after the bread had been discontinued.

Autophagia.—Some pathologists entertain the belief that in many instances, especially in which the disease is far advanced and attended with much emaciation, the sugar is formed at the expense of the tissues. This opinion is based on the fact, which has been observed in a few cases, that sugar continues to be excreted during fasting, even for several hours after the food last taken had ceased to influence the quantity of sugar in the urine.

Thus, in one of Mr. Sidney Ringer's cases (a male) already referred to, the patient fasted fifteen hours, and the influence of the food on the urine ceased in eight hours; it was found that during the next succeeding seven hours, or the period of *inanition*, there continued to be excreted 4·4 grammes of sugar, hourly, on an average, or an amount equivalent to $105\frac{1}{2}$ grammes in twenty-four hours.

In the second case (a female), who fasted seventeen hours, the average, hourly, amount of sugar excreted during the inanition period of nine hours, namely from the ninth to the seventeenth hour (inclusive) of fasting, was 1·938 grammes.

Traube also ascertained that the amount of sugar secreted by a diabetic patient during the period of inanition, and not derived directly from the food, amounted to 2·9 grammes, or 44·7 grains per hour.

It has been assumed that the whole of the sugar voided in the urine during inanition, in this case, was furnished by the saccharine metamorphosis of the tissues. Dr. Parkes supports this view, and refers to one of his cases in corroboration, in which he supposes a large amount of sugar was derived from this source during inanition, inasmuch as he found the blood very rich in sugar after a period of seventeen hours' fasting.

Such then are the data on which it is asserted that, in diabetes, sugar is frequently furnished by the transformation of the tissues of the body; or, in other words, by the accession of autophagia. But, on a careful consideration, we discover that the deductions based on observations during fasting, to determine this question, are subject to certain sources of fallacy, which have been overlooked.

In the first instance, diabetic sugar is a *crystalloid*, soluble, and highly diffusable in water: it readily dialyses through membranes; so that when the blood is constantly saturated with this substance, dissolved in the water of the blood serum, the latter becomes subject to *osmosis*, and passes out of the blood vessels into the surrounding fluids of the tissues; so that these perivascular fluids also become 'rich in sugar,' to use the expression of Professor Vogel already referred to. Consequently, when a diabetic fasts for several hours, and during the same period continues to excrete a large quantity of urine, the specific gravity of the blood is so much increased by the water thus lost that the tissue fluids pass into it by endosmosis through the walls of the vessels, and from this source it continues to receive a fresh influx of sugar, which in its turn is excreted by the kidneys long after the supply from the food has ceased.

I may further add that the fact, already referred to, of the *retardation* of water in the system of diabetics (so that a portion of the fluid ingested on one day may not be excreted in the urine until the next) throws considerable light on this subject.

In the second place, the period of inanition—from seven to nine hours—in the cases of fasting just cited, was not sufficiently prolonged to permit of the absorption into the blood, and subsequent removal of the whole of the sugar, when diffused in considerable quantity through the perivascular fluids of the body.

In the third place, the albumen of the blood may have supplied a pabulum for the formation of a portion at least of the sugar excreted.

It appears, from the observations of various authors, that alcohol increases the quantity of sugar in the urine. Alcoholic drinks are therefore inadmissible in the treatment of diabetes.

CHAPTER VII.

PATHOLOGY OF DIABETES. SACCHARINE CONDITION OF THE BLOOD, OR GLYCÆMIA: THEORIES AS TO ITS CAUSE.

On a careful study of the more important or essential phenomena of diabetes, detailed in the previous chapters, we cannot fail to recognise that they are all referable to two causes: first, to the saccharine transformation and misappropriation of the proximate principles of food, whereby the supply of materials for the nutrition of the body is very seriously curtailed and in the end almost entirely cut off; secondly, to the impregnation of the blood with glucose or grape sugar, constituting what has been termed *glycæmia* or *glycohæmia*. Thus far our knowledge is tolerably clear and definite, and it may with truth be said that there are few diseases the prominent features of which are better understood, or have been more clearly elucidated by modern pathological research. But beyond this, unfortunately, our knowledge is very defective and unsatisfactory, for when we come to enquire into the origin and nature of the morbid process, or diseased action, by which the food is converted into sugar, we encounter great obscurity and uncertainty.

Although a minute trace of sugar appears to be present in healthy blood, it cannot be considered to be a normal constituent of the latter in appreciable quantity. For a long period it was doubted whether sugar is actually present in the blood in diabetes, or not. This doubt arose partly from the defective methods of analysis then in use, and partly to the presence of sugar being obscured by the various constituents of the blood. Diabetic sugar was first detected in the blood in 1835, by Ambrosiani of Milan, who separated it in small quantity and in the form of crystals, together with a larger proportion of uncrystallisable and fermentable syrup; the form of analysis employed was of a complicated nature. Shortly afterwards it was detected by Dr. Charles Maitland.[1] The investigations of Ambrosiani and Dr. Maitland were subsequently confirmed by the researches of Dr. McGregor of Glasgow,[2] and since that period numerous researches have established beyond doubt that the blood in diabetes is impregnated with sugar.

[1] London Med. Gazette, vol. xvii. p. 900.

[2] Ibid. May 13 and 20, 1837, vol. xx.

The quantity of sugar found in the blood in diabetes is small, a fact which is readily accounted for by its strong affinity for water, by which it is rapidly cast out of the blood by the kidneys. The proportion of sugar found in 1,000 parts of diabetic blood is shown by the following analyses:—

Muller	1·10
Picard	1·25
Peligot	1·00
Rees	1·80
Drummond	2·00

Dr. Pavy states that he has made several examinations of diabetic blood removed by cupping and venesection, and has found it to contain sufficient sugar to produce a copious orange-yellow reduction with the copper solution. On one occasion he made a quantitative analysis of a specimen of blood abstracted from the loins by cupping, and found the sugar present in it to amount to 53-100ths, or slightly more than half a grain per cent., or to about two and a half grains to the fluid ounce.

The existence of diabetic sugar in the blood in ponderable quantity having been established, it is necessary to consider the more important and plausible hypotheses which have from time to time been advanced to account for its origin and presence in this fluid.

The first theory which claims attention may be termed the *gastric*; it was advanced by Rollo[1] near the end of the last century; he expressed the opinion that diabetes is produced by derangement of the function of digestion, and is confined chiefly to the stomach. According to him the disease consists in 'an increased action and secretion, with a vitiation of the gastric juice,' which acquires a morbid property of converting the vegetable portions of the food ingested into sugar. This hypothesis, however, became untenable on the discovery by Tiedemann and Gmelin that during digestion starchy matter is converted into sugar as a healthy process; and still more so when it was ascertained, by Magendie and other investigators, that during the digestion of starch the blood of the *vena portæ* becomes charged with sugar.

Mr. McGregor also advocated the gastric origin of diabetes in a modified form. By a series of experiments he discovered that sugar is present in the stomach and intestines of diabetics after the ingestion of animal food alone, from which sugar is not produced during digestion in healthy persons. This fact he ascertained by giving an emetic and purgative to a diabetic, to clean out the alimentary canal,

[1] On Diabetes, Mellitus, London, 1797.

and then feeding him on roast beef and water exclusively for a period of three days, at the end of which he obtained the contents of the stomach by an emetic of sulphate of zinc, and found that they fermented briskly, thus revealing the presence of a considerable quantity of sugar. The same experiment performed on a healthy person, on the contrary, yielded only negative results. Mr. McGregor of course found sugar in the stomach of healthy persons after the digestion of starchy food, but in much smaller quantity than in those suffering from diabetes.

The conclusions drawn from these experiments were: first, that in diabetes sugar is formed in excess; and, secondly, that the sugar thus formed, instead of undergoing further changes in the progress of assimilation, is imported into the blood, where it remains unchanged until it is eliminated by the kidneys. This arrest of the assimilation of sugar was attributed to deficient or exhausted influence of the nerves supplying the assimilating viscera and vascular system.

Dr. Prout[1] expressed the opinion, 'that diabetes is nothing more nor less than a form of dyspepsia; that this dyspepsia principally consists in a difficulty

[1] Op. cit. p. 38.

of assimilating the saccharine alimentary principle, and that, like all other forms of dyspepsia, whether it be an inherited or an induced affection, diabetes is liable to be much modified and aggravated by concomitant circumstances.'

With regard to Mr. McGregor's hypothesis, it must be observed that the presence of sugar in the stomach of a diabetic fed exclusively on animal food does not by any means prove that it was formed there during digestion. It has been already pointed out in the preceding pages, that after the blood has become thoroughly impregnated with sugar, the tissue fluids in their turn become saturated with it also; and so also do most of the secretions, and amongst them the gastric juice in particular. In this manner its presence in the stomach may readily be accounted for.

So much for the theories as to the *gastric* origin and nature of diabetes; it is necessary next to consider the hypotheses which have been advanced concerning its *hepatic* origin, or supposed seat in the liver.

Sugar when taken into the stomach is, on account of its solubility and highly diffusible nature, immediately absorbed into the circulating current by the blood-vessels in obedience to the laws of osmosis.

But starch, being an insoluble substance, is first transformed into sugar in the small intestines by the action of the secretions of the pancreas, the mucous and Brunner's glands, before it undergoes venous absorption into the blood. But whether sugar is absorbed directly by the blood-vessels of the stomach or by those of the intestines after its formation from starch, it does not pass directly into the general circulation, but into the vessels forming the *vena portæ*, by which it is at once conveyed into the liver.

This fact as to the absorption of sugar and its conveyance into the liver by the vessels of the portal system was fully established when Claude Bernard commenced a series of investigations for the purpose of determining experimentally whether sugar enters into the general circulation, and how far it can be traced in it, after making its exit from the liver. With this view he experimented on animals which he had fed with food containing an abundance of starch and sugar. After examining the blood at different points of the circulation, he came to the conclusion that the sugar passed through the liver onwards into the inferior *vena cava*, right cavities of the heart and pulmonary arteries, until it reached the capillaries of the lungs. Between these two points of the circulation (the liver and the lungs) it could be detected in considerable abundance. But as only a small trace could be found in the left side of the heart and in the arterial system, he concluded that the sugar is destroyed or burnt in the lungs by the process of respiration.

Bernard performed further experiments to ascertain whether sugar still continued to be present in the blood, when starch and sugar are excluded from the food. To satisfy himself on this point he experimented on a dog fed exclusively on animal food for a considerable period; to his great surprise he found that sugar in considerable quantity still existed in the blood in that part of the circulation extending between the liver and the lungs—namely, the hepatic vein, inferior cava, right cavities of the heart, and pulmonary arteries; he also found it in abundance in the liver, but in no other organ could it be detected; and it did not exist in the blood of the portal vessels beyond the liver, nor in any other part of the circulation, except that just stated. As the result of this discovery the question immediately suggested itself: 'Whence came the sugar, and how did it originate?' The only answer to be given under the circumstances was, that it had its source in the liver, and was formed by that organ.

The quantitative analyses made by Bernard showed that the liver on an average contained from one and a half to two per cent. of sugar, and that it existed in the hepatic vein to the extent of one per cent. during the period of fasting, and from one and a half to two per cent. during that of active digestion. It therefore appeared from these experiments that its formation proceeds with great activity.

But when Bernard pursued his investigations still further he discovered that sugar is formed in the liver after death. By passing a stream of water through the blood-vessels of the liver of an animal recently killed, he completely washed out the sugar with which it was impregnated, as he ascertained by chemical reagents. Afterwards he placed the liver aside for several hours, at the end of which period, on making a re-examination, he found that the organ was again strongly impregnated with sugar. It was thus clearly demonstrated that sugar is produced in the liver-tissue external to the blood-vessels by some chemical change taking place, independently of vital action, and from a substance much less soluble and diffusible than sugar itself.

Led on by these discoveries, Bernard was induced further to enquire whether there might not exist in the liver, and formed by its tissue, some substance by the metamorphosis of which the sugar is produced. Ultimately, in 1857, he succeeded in detecting and isolating such a substance, which in its characters he found to be intermediate between starch and dextrine, and capable of being readily converted into sugar by the action of ferments ; and as he believed the physiological use of this substance to be the production of sugar, he gave to it the name of glycogen. It was soon after detected by the researches of Henson[1] and Dr. Pavy,[2] who fully confirmed the observations of Bernard. It has been termed hepatine or amyloid substance by Dr. Pavy, and zoamyline by Rouget.

Glycogen has in recent years been made to play so important a part in the pathology of diabetes, that it is necessary here, in connection with the subject, to give some account of its physical and chemical characters, and its relation to the liver. It is a tasteless, inodorous, white, amorphous, or uncrystallisable, starch-like substance ; it is quite soluble in water, in which it produces an opalescent solution ; but it is insoluble in alcohol and glacial acetic acid, being precipitated by both from the state of solution. It belongs to the carbo-hydrate group, and, according

[1] Archiv. f. path. Anat. Bd. xi. p. 395.

[2] Guy's Hospital Reports, 1858, and Phil. Trans. 1860.

to the analysis of Pelouse, given by Bernard, its composition is $C_{12}H_{12}O_{12}$, and it is not destroyed or acted on by a boiling solution of caustic potash.

As far as observation has extended, it appears that glycogen is always found in the liver in a state of health, and that its secretion constitutes an important function of that organ ; it is deposited in the liver cells, in which it can be detected by a microchemical examination. But it appears, also, that it is absent from the liver after death from disease and starvation.

One of the most noteworthy characteristics of glycogen is its proclivity to be converted into grape sugar, when subjected to the action of certain reagents. Thus, boiling with a mineral acid, or contact with certain animal substances, such as blood, saliva, pancreatic juice, and liver substance, acting as ferments, quickly effect its transformation into sugar.

The important experimental researches of Dr. Pavy have clearly demonstrated that the nature of the food taken not only determines the quantity of glycogen present in the liver, but also, that the quantity of glycogen present exercises an important influence on the size and consistence of that organ.

Dr. Pavy fed eleven dogs on an exclusive animal diet for several days prior to death, and found that the average relative weight of their livers to their bodies was equivalent to 1 to 30, or slightly more than half an ounce of liver to every pound of the animal's body; he also found that the relative amount of glycogen present in the livers was on an average 7·19 per cent.

In the next place, Dr. Pavy subjected five dogs, for several days previous to death, to an exclusive vegetable diet containing a large quantity of starch, barley-meal, potatoes, and bread; and on an examination after death, found that the relative weight of their livers to their bodies was on an average 1 to 15, or rather more than an ounce of liver to a pound weight of the body; so that the relative weight of the liver was exactly doubled when compared with the result obtained on an animal diet, while the average amount of glycogen was 17·23 per cent. against 7·19. The livers, too, had become softer and more friable.

In a third series of experiments, Dr. Pavy kept four dogs for several days on a mixed animal and vegetable diet, the latter consisting of a quarter of a pound of common brown sugar daily; and after death ascertained that the average relative weight of the liver to the body was 1 to 16½, and the relative amount of glycogen 14·5 per cent. It appears, therefore, that the size of the liver, and the relative quantity of glycogen, was nearly doubled by the admixture of sugar with the animal food.

From these experiments it is evident that starch and sugar, taken as food, have the effect of greatly increasing the size of the liver, and of producing a greatly increased development of glycogen in the cells of that organ. It further appears from the same observations, that the liver also becomes pale, flabby, and soft.

Dr. Pavy's experiments on rabbits fully confirm those made on dogs.

With regard to the physiological purpose served by glycogen in the animal economy, and its ultimate destination, Dr. Pavy advances the opinion, contrary to that of Bernard, that its production may be considered as the first step in the assimilation of the starchy and saccharine elements of our food ; and as these elements are known to proceed on to the formation of fat, there are grounds for the surmise that glycogen is in a position intermediate between the two. The process of assimilation, he considers, may proceed on to the formation of fat in the liver, or may stop short at the formation of some other principle, which, after escaping from the liver, is elsewhere converted into fat.

But the fact that glycogen is found in the livers of the carnivoræ, and of animals fed for months on a diet containing neither starch nor sugar, militates strongly against this theory. Besides, it may be mentioned that this substance is found in several other animal tissues besides the liver, and also in fœtal organs.

The discovery that glycogen is a normal secretion of the liver, both in man and in the lower animals down to the mollusca, and that it has a strong chemical tendency to undergo transformation into sugar, led Bernard to conclude that the liver exercises a sugar-forming function in addition to that of secreting bile; the glycogen being converted into sugar as a natural physiological process by the agency of a ferment.

According to Bernard's theory, the sugar secreted by the liver is destroyed by combustion in the lungs for the purpose of producing animal heat; and, further, that in the healthy condition of the body, these two opposite processes—the secretion and destruction of sugar—are constantly in operation, and equally balance each other; so that no accumulation of sugar can take place in the blood.

On the hypotheses just stated, Bernard advanced an exceedingly simple theory of the cause of diabetes, according to which the disease is produced by an excessive secretion of sugar, or, in other words, more sugar is secreted by the liver than can possibly be destroyed by the lungs; so that the equilibrium between its formation and combustion is removed; the result of this being that sugar accumulates in the blood and produces the phenomena of diabetes.

Bernard attributed the excessive formation of sugar, constituting diabetes, to disordered innervation of the liver produced by some cause seated in the *medulla oblongata*. This conclusion he arrived at by discovering, experimentally, that a saccharine condition of the urine can be induced by puncturing the floor of the fourth ventricle, near the origin of the pneumogastric nerves. But it has since been ascertained that glucosuria thus produced is only transient, and disappears in a few hours.

According to the glycogenic theory of Bernard, the sugar taken as food, or formed from starch during digestion, becomes, after absorption into the *vena portæ*, first converted into glycogen by the secreting function of the liver cells, and afterwards changed by a ferment into sugar or *glucose*, which, entering the general circulation, is conveyed to the lungs, and there destroyed by the oxygen of the respiratory process. It must be confessed, however, that a complex *indirect* process of this description does not at all accord with the simple and ingenious contrivances displayed in the economy of nature; nor does it in the least harmonise with the 'principle of least action.' Consequently we are led to enquire into the validity of the propositions on which the hypothesis is founded.

The doctrine that sugar undergoes combustion in the lungs was first advanced by Liebig; but it does not appear to be based on any reliable data whatever. On the contrary, this opinion seems to be opposed to the results of experimental enquiry, from which it appears that sugar is not decomposed either in the lungs or in any other part of the circulation. Indeed it may be considered as fairly established that when sugar has once entered the general circulation it rapidly becomes diffused through the blood of the entire vascular system, and is ultimately excreted by the urine. While it remains in the blood it occupies the place of a foreign substance, and constitutes a *materies morbi.*

In the next place, the careful and important investigations of Dr. Pavy (corroborated by other experimenters both in this country and abroad) go far to disprove the validity of Bernard's glycogenic function altogether. Dr. Pavy, after repeating Bernard's experiments, satisfied himself of the accuracy of the facts advanced by the latter; but he, at the same time, raised the question whether the conclusions drawn from them are not unwarrantable in consequence of being subject to a source of fallacy which had escaped detection. Dr. Pavy performed a series of experiments for the purpose of deciding whether the results obtained by Bernard's investigations on animals after death actually represent what is in operation, or really exists, during life; in other words, whether the *post-mortem* conditions described by him represent the *ante-mortem* or *physiological* state.

Dr. Pavy found as the result of his experiments, of which he has given full details in his work already referred to, that when the liver is removed *instantly* after death and *quickly* subjected to the action of caustic potash, or to a freezing temperature, or to boiling water, so as to prevent the occurrence of post-mortem changes, no sugar whatever can be detected in the liver, but that amyloid substance (glycogen) is readily obtained. He also discovered that *during life*, under normal conditions, there is scarcely any appreciable difference in the quantity of sugar found in the blood drawn from different portions of the vascular system, whether from the systemic arteries or veins, or from the vena portæ, or, by means of a catheter, even from the right auricle; the actual amount of sugar obtained from all these different points of the circulating current being exceedingly minute, namely: from 47 to 73·1000ths of a grain per cent.

From these observations Dr. Pavy drew the following important conclusions:—

Firstly, that during life, as a natural condition, no sugar is found in the liver, or secreted by that organ.

Secondly, that normally during life scarcely any glycogen is transformed into sugar and taken up by the blood in its passage through the liver, in consequence of its *colloidal* character rendering it incapable of dialising through animal membranes.

Thirdly, that the sugar found so plentifully *after death* in the liver, and in the blood of that portion of the circulation intervening between it and the lungs (as revealed by the accurate experiments of Bernard), is produced by *post-mortem* changes and the development of a ferment in the liver itself, and that the evidence on which it was believed that the liver exercises a sugar-forming function was based on conditions occurring after death, and differing essentially from those existing during life. Consequently, to use Dr. Pavy's own words, 'there is not that flow of sugar into the circulation from the liver for the purpose of destruction in the lungs, which the former mode of experimenting led physiologists to believe existed.'

It may be here mentioned that numerous unsuccessful efforts have been made to discover the source of the ferment which Bernard supposed to be required to transform the glycogen in the liver into sugar. Thus Schiff extirpated the thymus, the thyroid, the salivary, and pancreatic glands, the spleen, and the supra-renal capsules in succession, without obtaining any information on the subject. According to Henson, the ferment is precipitated with the glycogen by the addition of alcohol to the cold aqueous infusion of the liver, that it is rendered inoperative by boiling, as was previously observed by Bernard, and that it is contained in arterial blood, and in the blood of the vena portæ, inasmuch as this blood has the property of converting a solution of glycogen into sugar. The existence of any *special* ferment, however, appears to be altogether hypothetical; although Dr. Pavy has pointed out that when glycogen is introduced into blood it is quickly converted into sugar.

Dr. Pavy believes that there are two distinct types or forms of diabetes.

In one form (the milder) he is of opinion that the only error existing is a want of proper assimilative power over sugar; in some of the cases of this class there is a *total* loss of assimilative power, so that if any starch or sugar is ingested, sugar will appear in the urine; in others, again, there are *various degrees of diminution*, so that the urine becomes saccharine only when more than a certain quanty of starch or sugar has been consumed; cases of this class, he considers, are not uncommon among elderly people.

In the other form of the disease, including the majority of cases—the bulk, indeed, occurring in young subjects and in those below the middle period of life—there must exist, Dr. Pavy thinks, something additional to the want of assimilative power over sugar, inasmuch as the urine continues to be saccharine even when starch and sugar are carefully excluded from the food. To account for this occurrence, he considers we must look to the amyloid substance (glycogen) existing largely in the liver, as reasonably constituting the source of the sugar in the urine; this substance being exceedingly prone to undergo a downward metamorphosis into sugar. 'Normally,' says Dr. Pavy, 'this metamorphosis is prevented from taking place to more than a barely appreciable extent; but under various unnatural circumstances it is more or less freely allowed to occur, and as the result, sugar appears to a corresponding extent in the general circulation, and from thence finds its way into the urine;' diabetes being thus produced.

The unnatural conditions which, according to Dr. Pavy, lead to the transformation of glycogen into sugar, are capable of being grouped into three distinct classes.

Firstly, a congested condition of the blood-vessels of the liver, giving rise to an unnatural relation between its cell contents and the blood-vessels, causing the escape of amyloid substance into the blood current, and its immediate conversion into sugar. The causes producing this vascular congestion being obstruction of the process of respiration, however produced, as for example by whooping cough, pneumonia, coma, and the inhalation of chloroform and other vapours.

Secondly, a change in the quality of the blood passing through the liver, as shown by the production of a saccharine state of the urine experimentally by tying the portal vein, by the injection of ether and ammonia into the portal vein, and the injection of phosphoric acid into the circulation, and by the frequent, if not invariable, association of glucosuria with boils and carbuncles, and, according to Schiff, with gangrene.

Thirdly, lesions of the nervous system, causing the removal of the influence which it exercises, during life under natural conditions, of holding in check the strong chemical tendency of amyloid substance to undergo transformation into sugar; the operations of this cause being well illustrated by the rapid production of sugar in the liver after death, and by the saccharine condition of the urine induced by maintaining the circulation by artificial respiration for an hour or so after the destruction of life by pithing, by woorali poison, and by strychnia; also by lesions of certain portions of the nervous system, especially of the medulla oblongata (as in Bernard's experiments), and of different parts of the sympathetic (as in Dr. Pavy's own experiments). The glucosuria produced by these lesions, however, is only of a temporary nature, and, in the opinion of Dr. Pavy, due to an influence produced on the circulation of the liver.

Against Dr. Pavy's theory, that diabetes, in its most serious form, is caused by the downward metamorphosis of amyloid substance, or glycogen, into sugar by the different classes of unnatural conditions just stated, important objections may reasonably be urged.

In the first place, a *temporary* saccharine condition of the urine, produced by experiments on animals, and by certain abnormal conditions in the human subject, cannot be regarded as identical with diabetes in which there is a *permanent* glucosuria intimately connected with a *persistent* mal-assimilation of food—a connection which can be as clearly traced in the more severe cases, where there is mal-assimilation of albumen, as in the milder form in which starch and sugar only undergo a diabetic metamorphosis.

Secondly: it has not been demonstrated by well authenticated observations, so far as I am aware, that amyloid substance exists in the liver in confirmed cases of diabetes.[1] It certainly by no means follows that because it is a normal constituent of the liver, in healthy subjects, it must also be secreted by that organ in diabetics.

It has often occurred to me *that diabetes may possibly depend on perverted functional action of*

[1] The observations of Grohe on this subject require confirmation (Greifswald's Medicinische Breiträge, B. iii, ii, i.)

the liver-cells whereby they morbidly secrete diabetic sugar instead of glycogen, their normal secretion. This is a much simpler explanation of the nature of the disease, and it is, moreover, not at variance with our knowledge of the varied secreting power of gland-cells, or glandular epithelium, of which the liver-cells are a modification. For example, the secreting gland-cells of the mammary glands, during the period of lactation, secrete lactin, or milk sugar, which closely resembles diabetic sugar; and this too in animals subsisting on food containing not a trace of starch or sugar. Thus we know that milk sugar is found in the milk of the carnivoræ, and of dogs fed exclusively for months on an animal diet. Judging from analogy, then, may not grape sugar be secreted by the glandular cells of the liver, as an abnormal secretion, in diabetes? We could thus account for the appearance of functional activity which this organ frequently, if not generally, presents after death from the disease. This opinion of the probable nature of diabetes, it must be admitted, is purely conjectural, but in this respect it is not more objectionable than the hypotheses already advanced on the subject.

With regard to the two distinct types or forms of diabetes described by Dr. Pavy, it is necessary to observe that clinical observation goes far to establish that they are merely different stages of one and the same morbid process or affection. The form of the disease in which there is a mal-assimilation of the starchy and saccharine principles of the food *only*, represents its *initial* or primary stage, often extending over a lengthened period. A time, however, arrives in the history of cases belonging to this category when sugar continues to be excreted by the urine notwithstanding the complete exclusion of starch and sugar from the food, or, in other words, when a portion of the albuminous alimentary compounds *also* undergo saccharine transformation.

The class of cases constituting the other form of the disease, in which, Dr. Pavy justly observes, there is something besides a loss of assimilative power over starch and sugar, comprises those instances in which the malady has not been detected, or come under observation, until the development of the second stage. In support of this opinion it may be stated *that it has not been established by clinical observation that in the initial period of diabetes sugar is ever formed from the albumen of the food.* But it is necessary to prove that such a transformation really does take place before the existence of two distinct forms of the disease can be admitted.

That the two supposed types are but different stages of the same malady was first suggested by Traube, and is supported by the opinion of Dr. Parkes, who observes that, 'in some cases—perhaps in all—(Traube's and my own, for example) the formation of sugar from albuminous food is a more advanced stage of the condition in which sugar is formed only from starchy compounds.' [1]

Such, then, are the most plausible theories which have been advanced, attributing diabetes to some morbid cause or process seated either in the alimentary canal or in the liver, and producing a mal-assimilation and misappropriation of the food taken for the nourishment of the body.

As yet we certainly do not possess any certain knowledge as to the origin of the disease, or as to the *location* and *nature* of the primary or essential morbid action producing the saccharine condition of the blood, which, in its turn, developes most of the important phenomena of the disease. We know that there is a primary and fundamental condition which continues throughout the whole course of disease: namely, an arrest of the normal metamorphic changes of starch and sugar. To account for this, Von Dursch conjectured that some substance

[1] On the Urine, p. 348.

is formed in the alimentary canal, and absorbed into the blood with the sugar. Dr. Pavy, indeed, admits the possibility of the malady being seated in the stomach and intestines. He asserts that in consequence of the morbid appearance of the tongue, and the great irregularity observed in the action of the bowels—constipation alternating with diarrhœa—'the idea has occurred to him whether a certain state of the digestive canal may not, by reflex action through the sympathetic system, occasion diabetes.'[1]

But the disease has likewise been attributed to the cerebro-spinal portion of the nervous system in consequence of cases of glucosuria, and apparently of genuine diabetes, having frequently come under observation associated with affections of the encephalon, both traumatic and idiopathic—such as injuries of the head, attacks of paralysis, apoplexy, and intra-cranial tumours—and with causes exercising a depressing influence on the brain, especially such mental disturbances as grief, anxiety, fear, rage, dissipation, sexual excess, and the like.

But it is necessary to observe that the association of affections of the cerebro-spinal nervous centres with genuine diabetes is not by any means of such frequent occurrence as to justify the conclusion that

[1] Op. cit. p. 198.

the two conditions stand in the relation of cause and effect. Besides, the saccharine state of the urine, in a large proportion of the reported cases apparently dependent on disturbance, injury, or structural lesion of the encephalon, have proved to be of a temporary nature only, and not attended by the grave symptoms observed in true idiopathic diabetes. In some cases, too, the affection or disturbance of the nervous centres and the glucosuria may have been purely coincidental conditions.

Very recently, however, Dr. W. Howship Dickinson, of London, has endeavoured to show that diabetes is essentially an affection of the brain and spinal cord.

In a paper read before the Royal Medical and Chirurgical Society in February 1870,[1] Dr. Dickinson stated that the view hitherto entertained that diabetes is a functional disorder, must be regarded as only provisional, inasmuch as function is simply an expression of structure; the two standing in relation to each other as cause and effect, and that where, as in diabetes, function is permanently altered, it almost follows of necessity that there should be equally abiding changes in the mechanism of the organs concerned.

Acting under the belief just expressed, Dr.

[1] Med. Times and Gazette, March 19, 1870.

Dickinson subjected the bodies of those who had died of diabetes to a searching examination, and found that the brain and spinal cord were the seat of important alterations, an observation which gained significance from Bernard's discovery that puncture of a particular part of the medulla oblongata produced a saccharine condition of the urine.

Dr. Dickinson laid before the Society the details of the examination of the organs of five diabetic subjects. The following is a summary of the results obtained from these investigations :—Peculiar morbid changes were constantly found in every part of the brain, medulla oblongata, and spinal cord. These diseased alterations especially affected the white or cortical substance of these organs, with the exception of the grey matter of the floor of the fourth ventricle and of the spinal cord, and were always closely associated with the arteries of these organs, being limited to the vicinity of arteries, and not generally diffused. The morbid changes, moreover, were detected in every part of the encephalon and spinal cord, but they attained their greatest development in the medulla oblongata and pons Varolii. The earliest alteration recognised was a dilatation of the arteries, and this was followed by a degeneration of the nervous matter external to them at certain points. An extension of the degenerative process occasioned destruction and excavation of the tissue around the vessel, producing cavities often large enough to be striking objects even to the naked eye, and contained blood-vessels, extravasated blood, grains of pigment, and the products of nervous decay. Finally, the contents seemed to be absorbed, and simple vacuities left behind.

Dr. Dickinson observes that these structural alterations may briefly be described as a destruction of the nervous matter along the course of the arteries of the brain and spinal cord; and, as far as could be observed by the microscope, *a widening or distention of the arteries was the initial change in the pathological series.* The *italics* are my own, as I desire to direct attention to the circumstance that the lesion and absorption of the nervous tissue was a *secondary* occurrence following the dilatation of the arteries.

Dr. Dickinson believes that the morbid changes just described are antecedent to and the cause of diabetes. He is of opinion that they are not the ravages produced by the saccharine condition of the blood, and for the following reasons:—

First, because the capillaries and veins appear to take no share in the morbid action, although equally permeated by diabetic blood; and secondly, because analogous failures of nutrition were not observed in any of the other organs of the body equally under the influence of the blood.

It appears to me, however, that the morbid changes *beginning in dilatation of the arteries, and ending in atrophy and absorption of nerve tissue immediately surrounding them*, can be explained by the atrophy of the muscular element of the arterial walls due to the same causes which produce the emaciation or general muscular atrophy, which forms so conspicuous a feature of the disease before its fatal termination. The causes which produce this atrophy are *general* in their operation throughout the body: namely, misappropriation of the materials requisite for healthy nutrition, and a saccharine impregnation of the blood, and *must*, therefore, affect *all muscular structures alike.* We know, from the œdema of the lower extremities so general in advanced cases, that the heart is, to a certain extent, involved in the general muscular atrophy, from which it appears impossible for the muscular tissue of the arteries to escape. It is the muscular structure of arteries which regulates their calibre, and holds in check the distending influence of the heart's action on their walls. The muscular element is most abundant in the coats of the smaller and ultimate ramifications of the arterial system, such as occur in the white substance of the brain, medulla, and spinal cord, the middle coat, indeed, of these arteries being purely muscular. It follows, therefore, that any degree of atrophy of this muscular structure must give rise to the dilatation of these vessels.

That the capillaries and veins do not share in the morbid process described by Dr. Dickinson can readily be accounted for by the peculiar structure of their walls. The capillaries are destitute of muscular structure, and consist everywhere of a single delicate structureless coat, while the veins of the white and grey substance of the brain and spinal cord, according to the authority of Kölliker,[1] contain not a trace of muscular fibre. Besides, the capillaries and veins are beyond the distending systolic force of the heart's action.

That a failure of nutrition analogous to that found in the brain and cord by Dr. Dickinson does not occur in any other organ in diabetes may be accounted for *by the peculiarity of the relation between the arteries and nervous tissue.* It is well known that the external elastic coat (*tunica adven-*

[1] Manual of Microscopic Human Anatomy. London, 1860, p. 242.

titia) of connective areolar tissue, intervening as a cushion between the arteries and the tissues of most of the organs of the body, is absent in the substance of the brain and spinal cord: the arteries in these organs being surrounded by a homogeneous envelope in close contact with the nerve tissue, which is consequently not shielded from the influence of the pressure exerted by the dilated arteries, this pressure producing the atrophy *observed only along the course of their distribution.*

If this explanation should be correct, it would follow that the phenomena described by Dr. Dickinson are the effect and not the cause of diabetes.

To sum up, it will appear, from the preceding observations, that neither clinical observation nor experimental research have as yet revealed the real nature of diabetes: which, therefore, must still be regarded as a disease of obscure and uncertain origin.

The *Etiology* of diabetes is certainly not less obscure than the nature of the morbid process constituting the disease. It has, in turn, been attributed to a great variety of causes, none of which, however, can be said to have been traced, with any degree of precision, as capable of generally exciting it. Intemperance, dissipation, sexual excess, mental emotions, and the like influences have been considered capable of producing the malady; but if such causes exercised any important influence in exciting it, diabetes would be, certainly, of more frequent occurrence. So far as my own observation goes, I have not seen it more frequently amongst the intemperate than in those of the most regular and careful habits. The disease occurs to the robust as well as to those of delicate constitution, to every variety of *temperament*, and to both sexes of every age, after childhood, during which period of life, however, it is but seldom observed. It does not appear to depend on any peculiar kind of food, nor to be influenced by climate, as has been asserted by several writers.

Diabetes is, indeed, considered as an hereditary affection, and undoubtedly it is to a certain extent, but by no means to the same degree as most other diseases known to have an hereditary transmission. Those who have an hereditary tendency to it are generally of a scrofulous or tubercular diathesis.

CHAPTER VIII.

PATHOLOGY OF DIABETES—PROGRESS AND DURATION; COMPLICATIONS: PULMONARY PHTHISIS, CONGESTION OF THE LUNGS, PNEUMONIA AND BRONCHITIS; CARBUNCLES, MALIGNANT BOILS, AND DIFFUSE INFLAMMATION OF THE SUBCUTANEOUS AREOLAR TISSUE; GANGRENE; DERANGEMENTS OF VISION.

DIABETES is a disease of *indefinite* duration; its progress being modified by a variety of conditions, such as age, idiosyncrasy, diet, and regimen: but more especially the invasion of incidental or secondary affections to which it gives a proclivity, or of which it determines the development.

The disease, as a very general rule, progresses much more rapidly towards a fatal termination in young subjects below the age of maturity, and even in those below the age of thirty or thirty-five years, than in persons at or beyond the middle period of life, after which its intensity becomes greatly diminished. Consequently, in elderly people, its progress is generally tardy, so that, occasionally, it never advances beyond the first stage, and continues so mild as not seriously to impair health.

The grave character of the malady in early life is well illustrated by Dr. Prout,[1] who states that in his extensive experience of thirty-five years, and embracing nearly seven hundred cases, he witnessed twelve instances of diabetes in young subjects between the ages of eight and twenty years, not one of whom reached the age of maturity; the greater proportion dying in various ways after a short course of the disease. Professor Christison has informed me that his experience as to the fatal character of the affection in youth is not of a more favourable description.

The fact that diabetes is very rarely recognised at its very commencement, owing to the insidious nature of its invasion, renders it extremely difficult to form an approximation even to a correct estimate of its duration in the vast majority of instances. According to the researches of Griesinger,[2] who has given an analysis of 225 cases, it would appear that the *average* duration of the disease is from two to three years. Dr. Prout states that out

[1] Op. cit. p. 36.

[2] Archiv. für physiologische Heilkunde, Jahrg. 1859.

of the 700 cases just referred to, only two were living at the end of ten years after it had been ascertained that the affection, existed in its fully developed condition.

The incipient or first stage of the disease is, beyond doubt, the most protracted, and, as has been pointed out by Dr. Prout, may extend over several years. Dr. Graves[1] has recorded a case, obviously a remarkable illustration of the kind, in which the patient had been affected with diabetes more than three years, having frequently during that period been under his observation in hospital. At the time of the last recorded observation (at the end of three years) this patient was daily passing eighteen pints of urine, containing, according to Dr. Graves' estimate, more than a pound and a quarter of solid matter (mostly sugar), but, singular to say, his condition had not become more aggravated. He was not suffering great inconvenience, and did not present any of the other symptoms indicative of the second stage of the malady.

The second stage is much more rapid than the first in its progress, and if not held in check by appropriate treatment, death generally ensues in a few months, or even in a few weeks, after its invasion.

[1] Lectures on Clinical Medicine, 2nd edit. vol. ii. p. 268.

It is during this second or advanced stage that the complications or secondary affections are developed, by which the further progress of the malady is so frequently cut short. As has been already stated, when not thus abruptly terminated, death results from emaciation and exhaustion, and is frequently ushered in by coma.

Lung disease, especially *phthisis*, is by far the most common of the secondary affections with which diabetes becomes complicated, and particularly in subjects below the age of thirty.[1] According to the tables of Griesinger[2] pulmonary phthisis produced forty-three per cent., or nearly one half, of the fatal cases which he has analysed. In some instances the chronic lung affection is the ordinary tubercular disease; in others, again, it is the result of inflammatory action, being, in fact, the pneumonic phthisis of Dr. Addison. But whether the disease begins as a genuine tubercular formation or as an inflammatory deposit, it runs much the same course, and is attended by the same symptoms; softening takes place, and lung cavities are formed; a fatal termination being the inevitable result.

[1] Dr. J. H. Bennett, Clinical Lectures on the Principles and Practice of Medicine, 5th edit. p. 908.

[2] Op. cit.

It is almost needless to observe that this *inflammatory form* of phthisis pulmonalis is not peculiar to diabetes, but attacks persons free from this disease. Its incidental development in diabetes must be regarded more as the result of impaired nutrition from an impoverished condition of the blood than as the effect of its saccharine impregnation; and the same may be said of the purely tubercular form. This opinion receives confirmation from the fact that pulmonary phthisis is very seldom observed in the first stage of diabetes when there is malassimilation of starch and sugar only, but when, nevertheless, the blood is strongly impregnated with sugar; its development not taking place until the second stage is somewhat advanced, and when a considerable proportion of the albumen derived from the food also undergoes saccharine transformation, and the function of nutrition is thereby seriously impaired.

Pulmonary phthisis, as a complication of diabetes, generally runs its course very rapidly towards a fatal termination.

Congestion of the lungs and *pneumonia*, the latter being generally double, are of frequent occurrence and of a very fatal character in diabetes; the pneumonia having a tendency to terminate in gangrene. Bronchitis, too, is frequently observed, and is prone to become chronic. The acute pulmonary affections are generally induced by exposure to cold, which has a powerfully pernicious influence on the debilitated frames of diabetics.

Carbuncles, boils, and inflammation of the subcutaneous areolar tissue, diffuse or circumscribed, are frequent and exceedingly dangerous complications of diabetes.

When carbuncle makes its appearance it is generally located in the nape of the neck or in the back, very rarely in the extremities; boils, on the contrary, are not confined to any particular locality.

The carbuncle incidental to diabetes is usually much less circumscribed than the ordinary form, being surrounded by a diffused inflammation of the adjacent skin and areolar tissue, and, moreover, it is attended with a profuse and very fluid purulent discharge. Another feature of diabetic carbuncles and malignant boils is their strong tendency to terminate in gangrene or sphacelus, either spontaneously or after incisions. In consequence of these peculiarities they are very fatal complications.

Inflammation of the subcutaneous areolar tissue, involving the skin, and generally diffuse, is also a very dangerous complication of diabetes, in consequence of the rapidity with which it passes into gangrene or sphacelus. It has often been observed, with regard to it, that the period of inflammation preceding the gangrene is generally so brief as to pass almost unperceived.

This low gangrenous form of local inflammation is in some instances developed spontaneously; but in others it is produced by bruises or slight injuries, or by minor surgical operations, more especially by the application of a blister, which consequently, in diabetes, is a procedure to be scrupulously avoided. We have in this local inflammation a significant manifestation of the impaired nutrition and low vitality of the tissues resulting from the morbid condition of the blood in the disease, and the same may be said of the boils and carbuncles.

Dr. Prout has stated that in his experience carbuncles and malignant boils were always found to be associated with diabetes; while other observers, struck with a similar coincidence, have affirmed that all who suffer from carbuncle must also be affected with glucosuria. But it has been shown by others again, that the two morbid conditions are not always associated. Thus Dr. Wagner[1] has given an

[1] See abstract of a contribution to Archiv. für patholog. Anat. Band xii. Hefte 4 & 5, in British and Foreign Medico-Chirurg. Review, July, 1858, vol. xxii. p. 259.

analysis of all the inflammatory and gangrenous skin affections which came under his observation during a period of fourteen months as Chief Physician to the Dantzic Hospital. These cases amounted to fifty-two, including eight of carbuncle, fifteen of furuncle, twenty-two of erysipelas, and seven of erysipelas phlegmonodes; of these four ended fatally and forty-eight recovered, but in *none* of them was sugar found in the urine. Dr. Jaccoud[1] also states that he has met with instances of a similar nature.

The exact relation between diabetes and carbuncular affections, so far as can be ascertained from the recorded investigations of various observers, may be represented as follows :—

1. That carbuncle and furuncle are not necessarily associated with diabetes, but may occur independently of the latter affection.

2. That diabetes frequently determines the development of the carbuncular disease with which it is so often complicated.

3. That carbuncle occasionally or frequently produces glucosuria, which in such instances appears to be only temporary. Schiff,[2] I must here state, has

[1] Nouveau Dict. de Médic. et de Chirurg. pratiq. Paris, 1869, tome xi. p. 269.

[2] Journal de l'Anatomie et de la Physiologie, Paris, 1866.

arrived at the conclusion that the glucosuria in such cases is due to the development of a ferment caused by the stagnation or retardation of the circulation in the affected part, and that genuine diabetes may be thus produced not only by carbuncular affections, but even by gangrene; so that, according to him, there is a gangrenous diabetes.

With regard to this important and interesting subject, I will only add that the fact of the great frequency of the association of boils and carbuncle with diabetes should always excite grave suspicion, and lead to an examination of the urine for the detection of sugar in cases in which the latter disease has not already been detected.

Gangrene is frequently developed *spontaneously* in diabetes, and without being preceded by any local inflammatory affection. The coincidental occurrence of the two affections was first pointed out by Carmichael, Adams, and Marsh;[1] these observers, however, did not attempt to establish any definite relation between the two affections. Subsequently, Hodgkin[2] expressed the opinion that gangrene is an effect of diabetes, and produced by profound injury

[1] Dublin Quarterly Journal, 1846.

[2] On Diabetes and certain forms of Cachexia, London, 1854; read before the Harveian Soc. of London.

inflicted on the vitality of the tissues by the latter affection. More recently still, the investigation of the subject has been carefully continued by Marcal (de Calvi),[1] who attributes the gangrene to a diabetic asthenia or hyposthenia.

Diabetic gangrene, in the majority of instances, attacks the lower extremities, and more especially the toes and feet; sometimes, however, it affects the body and upper extremities, and even, in exceptional cases, the region of the sacrum and perinæum. Its predilection for the most distal parts of the lower extremities can most probably be accounted for by the extreme feebleness and retardation of the circulation of the blood in these parts, caused by the weakened action of the heart, debilitated, as I have already stated, by the impaired nutrition and a certain degree of atrophy which it suffers in common with other muscular organs. When gangrene seizes the trunk and upper extremities it is probably excited by slight injuries from blows, or undue pressure, or any similar disturbing influence, which bring into force the strong proclivity to mortification.

Gangrene, as might be expected, is an exceedingly dangerous complication in diabetes, whether spon-

[1] Remarques historiques sur la Gangrène diabétique, Union médicale, 1861.

taneous, or the result of local inflammation. Generally the patient dies either before the separation of the eschars, or from the profuse discharge following their separation, or from septicæmia ; in some instances, indeed, phagedenic ulceration, producing extensive destruction of the surrounding parts, ensues.

Whenever gangrene coincides with diabetes it may very generally be regarded as a complication resulting from the glycæmia and greatly impaired nutrition characteristic of the latter disease. Recently, however, Professor Schiff, as already stated, has endeavoured to establish an inverse relation between the two affections. According to him, the local changes produced in the circulation by the mortification are sufficient to generate in the blood the ferment which he affirms to be the essential and constant cause of the glycæmia of diabetes. This hypothesis, founded on experiments on animals, is, however, opposed to clinical observation, even although it does appear that local gangrene, like carbuncular affections and a variety of other conditions, is capable of developing, in certain instances, and for a time, a saccharine condition of the urine.

Anasarca, or dropsy, especially of the lower extremities, is a frequent complication developed in the *advanced* stage of diabetes. I have myself seen three such instances in patients greatly emaciated by the disease, and in whom there was not, as far as could be ascertained by the most careful examination during life, any structural disease capable of producing dropsy, either in the heart, kidneys, liver, or lungs. In all of these cases the pulse was quick and feeble. I therefore attributed the dropsy to enfeebled action of the heart arising from its impaired nutrition, and partial atrophy resulting from causes already described as affecting the muscular structures of the body generally.

This appears to me to be the correct explanation of the phenomenon of anasarca in a large proportion of instances; and it is confirmed by the well-known fact that the dropsy so common in advanced fatty degeneration of the heart is due to a similarly diminished propelling power of that organ. In this manner we can account for the anasarca of diabetes occasionally becoming so excessive as to be the cause of death, and, as pointed out by Professor Christison,[1] its great resistance to remedial measures. This, moreover, seems to be the only intelligible explanation of what is justly considered by the same eminent authority 'a singular symptom to be found

[1] On Diabetes, Library of Medicine, vol. iv. p. 253.

united with diuresis: for it may occur where the patient is passing eight or ten pints of urine daily.' In one of my own cases, just referred to, the patient was passing the enormous quantity of twenty pints of urine of a specific gravity of 1040° daily, and had done so for a considerable period.

It seems probable that, in some instances at least, the dropsy may be the result of disease of the kidneys.

Disorders of vision are of frequent occurrence in diabetes, more especially *cataract*, to which Dr. Prout seems first to have directed attention, and which Mr. France[1] has since shown by clinical observation to be one of the secondary affections produced by this disease. It would appear from the experimental investigations of Dr. Wier Mitchell,[2] Dr. Richardson,[3] and Stæber,[4] that diabetic cataract is due to the direct action of sugar on the crystalline lens. In the experiments of Dr. Mitchell syrup was injected beneath the skin of a frog, and in twenty-four hours the lens had become quite opaque; the opacity, however, was again completely removed by allowing the frog to remain twenty-four hours in

[1] Guy's Hospital Reports, 1860 and 1861, &c.

[2] American Journal of Medical Science, Jan. 1860.

[3] Journal de la Physiologie, par Brown-Séquard, 1860.

[4] Gaz. méd. de Strasbourg, 1855.

water. But Dr. Richardson has pointed out that to obtain this effect the specific gravity of the syrup employed must exceed 1045°, or, in other words, that of the blood.

But there are other forms of impaired vision besides cataract incidental to diabetes. These have been described as *diabetic amblyopia*. The mildest of these affections has been found by Von Græfe [1] of Berlin, to depend on weakness or simple *paresis* of the ciliary muscle, causing want of adjusting power, or atony of the system of accommodation.

Another and graver form of amblyopia developed during the advanced stage of diabetes, and attended with more or less atrophy of the retina, is considered by Von Græfe to have its origin in deep-seated cerebral lesions, especially in the neighbourhood of the fourth ventricle.

Such then are the more important of the secondary affections or complications which are liable to become developed in the course of diabetes, and which may fairly be considered as resulting from this disease.

[1] Archiv. für Opthalmologie, 1858. Deutsche Klinik, 1859.

CHAPTER IX.

TREATMENT OF DIABETES—MEDICINAL AND DIETETIC — DR. ROLLO'S TREATMENT.

To write a history of the *medicinal* treatment of diabetes would be an equally laborious and fruitless undertaking, inasmuch as almost every known medicine has been tried in succession without the discovery amongst them of a single agent possessing any specific or curative action over the disease. The only drug which has been found by experience to exercise any ameliorating influence over it is *opium*, which generally palliates or mitigates its more formidable symptoms to a greater or less degree, and in some rare instances, when given in large and increasing doses for a long period, seems to have removed the sugar from the urine altogether. But it must be admitted that, as a very general rule, the good effects of opium disappear after its administration has been suspended. Besides, it must be remembered that in many instances, on account of idiosyncrasy and other causes, the operation of this drug is injurious; a well-marked case of this description has come under my own observation.

Every attempt to cure this formidable malady seems to have been futile until the publication in 1797 of the case of Captain Meredith, whom Dr. Rollo certainly cured by restricting him to a purely animal diet.

It is justly due to Dr. Francis Home[1] to state that he was the first to suggest the employment of animal food and alkalis, which he believed, on theoretical grounds, to exercise a powerfully septic operation. But to Dr. Rollo[2] belongs the honour of having first cured the disease by a properly regulated diet, excluding all starchy and saccharine compounds, and consisting entirely of animal substances. Dr. Rollo believed that the first and essential indication to be fulfilled was 'the prevention of the formation or evolution of the saccharine matter in the stomach,' resulting from a morbidly increased action of this organ; and although his theory as to the seat and nature of the disease may not be correct, yet the practice which he has indicated for its cure has, since his time, been almost universally

[1] Chemical Experiments, 2nd edit.

[2] Cases of Diabetes, Mellitus, London, 1797.

acknowledged as the only effectual remedial resource at our command to arrest the progress of the disease. In proof of this assertion I may refer to the writings of those who have paid special attention to the subject, namely, Dr. Prout, Dr. Bardsley, Professor Christison, Bouchardat, and several other more recent writers.

From the experience which has accumulated since the date of Dr. Rollo's publication the principle of practice seems to be conclusively established *that starchy and saccharine vegetable compounds must be rigidly excluded from the food of diabetics, otherwise the treatment pursued will not be productive of a successful issue, or even of much benefit, except in rare and exceptional instances.*

Dr. Prout, whose experience in the disease was perhaps greater than that of any other physician, and whose practical sagacity needs no commendation, was so fully impressed with the importance of this principle, that he altogether excluded articles of food containing starch or sugar from the diet of his patients suffering from confirmed diabetes. 'The practical importance of this rule is so great,' he observes, 'that I am doubtful, if it be neglected, whether good can be obtained from any plan of treatment. Even its occasional infringement cannot be indulged in with impunity. Thus, I have known the use of a few saccharine pears undo, in a few hours, all that I had been labouring for months to accomplish; and the disease, with all its horrors, has become re-established in an aggravated form.' It would be superfluous to adduce further evidence in confirmation of the testimony of Dr. Prout on this all-important practical question, inasmuch as it is in perfect accordance with the common experience of those whose attention is much directed to the treatment of diabetes.

The dietetic treatment introduced by Dr. Rollo consists in restricting the patient to a purely animal food (all vegetable matter being excluded) comprising meat—fat beef, mutton, pork, and game—fish, oysters, light boiled eggs; and a mixture of milk, and beef or mutton decoction, and water for drink. The meat to be cooked, but no seasonings allowed except a little salt. Dr. Rollo strictly enjoined the importance of restricting the animal food taken to a certain limited quantity. With regard to meat, however, he recommended that it should be as fat as possible. He also pointed out the necessity of continuing this regimen for a considerable period after the disease had been removed, in order to subdue the marked tendency it manifests to return for a long period afterwards, if the patient is guilty of indiscretions in his diet, or of irregularities in his mode of living. It is necessary to add that Dr. Rollo recommended the use of alkalis in addition to the regimen prescribed.

In making a change from a purely animal regimen, Dr. Rollo recognised the necessity of excluding such vegetable substances as are known to contain starch; he considered it the safest course to pursue to allow 'brocoli, spinach, cauliflower, cabbage, and lettuce. These,' he observed, 'do not seem to furnish sugar when prudently used in the diabetic stomach, after a proper adoption of animal diet.'

Dr. Prout strenuously advocated the essential, practical importance of Dr. Rollo's treatment, but modified his system so far as to recommend the *green* portions of vegetables (on account of their not containing starch or sugar) to be taken from the *commencement* of the treatment *in addition* to animal food, of the exclusive use of which he did not approve. In preference to other kinds of animal food Dr. Prout recommended beef and mutton, plainly cooked, especially mutton chop or beef steak lightly done, taken twice daily. The other meals to consist of such simple dishes as can be prepared from eggs, milk, butter, and the like animal substances.

Dr. Prout, too, strongly insisted that the *quantity* of food taken daily, and at each meal, is a point of equally as great importance, in the treatment of diabetes, as its *quality*; and, in illustration of this, points out that the frequent occurrence of cases of sudden death in the disease has been clearly traced to errors in the quantity as well as in the quality of the food taken; the patient having 'been usually cut off after a *hearty meal*, as it is vulgarly termed.' Consequently he recommended a strict regimen, adjusted to the peculiarities of each case, to be rigidly adhered to, and a meal taken every four, five or six hours; and that all fluids should, as far as possible, be abstained from at each meal of solid food, and for an hour or two afterwards.

Since the time of Rollo no other important modifications deserving of special notice have been made in his treatment of diabetes, with the exception that Bouchardat has interdicted the use of milk altogether; but he has recommended that cream should be taken; and it appears that his opinion on this subject has been adopted by some more recent writers, and, amongst others, by no less authorities than the late Professor Niemeyer [1] of Tubingen and Dr. Pavy.

[1] Éléments de Patholog. et de Thérapeutiq., tome ii. p. 886. Paris, 1866. French edition.

A serious objection to Dr. Rollo's regimen is the difficulty encountered in subjecting patients to it for a sufficient length of time. In some individuals, indeed, the loathing or disgust felt for an exclusive meat diet, under any form, is so great as to present an insuperable obstacle to putting the prescribed treatment in force; while in other instances again, although it may be borne with impunity for a certain period, yet, sooner or later, a dislike to it becomes engendered, and this increasing in intensity renders further perseverance utterly insupportable; so that the regimen must be abandoned, notwithstanding all that may be attempted by cookery or variety to render it more palatable. No one regretted more keenly this serious obstacle to the treatment than Dr. Rollo himself, who discovered that his patients, however well informed as to the serious consequences of indulgence, frequently violated the strict rules laid down for their observance, and concealed their clandestine transgressions to themselves.

It is unquestionable that the regimen just described has hitherto been the only treatment found capable of exercising any control over diabetes, and that when rigorously pursued it has been of very great utility. In some cases, indeed, it has undoubtedly cured the disease; while in other and more numerous instances it has, without effecting a cure, removed its worst symptoms, and held it in check; so that patients have continued to enjoy for several years, moderately good health, who otherwise would probably have died in a few months after extreme suffering.

On making a careful investigation of the cases in which a diet consisting essentially of meat has been either completely or partially successful, it will be found that the instances in which *complete* success was obtained, as in the case of Captain Meredith recorded by Dr. Rollo, the disease had not advanced beyond its first stage when the whole, or nearly the whole, of the urine sugar is formed from the starchy or saccharine principles of the food: none, or very little of it being derived from the albuminous alimentary compounds.

But those cases of *partial* success, on the other hand, and they have been the most numerous, in which the disease was not removed, but only held in check and its symptoms subdued by the treatment, the urine still continuing to be more or less saccharine, are instances in which the affection had passed into the second, or confirmed, stage, in which there is a considerable saccharine transformation of the albuminous food. Indeed, it would appear that such cases are never cured by this treatment, which is found to act with diminished energy in proportion as the disease is more advanced at the period of its application, until at last a time arrives when it ceases to exercise any controlling influence whatever. From this fact it follows, that in a considerable number of cases but little or no improvement is effected. Besides it has been shown by Dr. Bardsley[1] that the life of the patient is sometimes cut short by the sudden accession of inflammatory affections of the abdominal and thoracic viscera when under the influence of a purely animal diet.

I shall now proceed to the consideration of the *skim-milk* treatment, which I have already introduced into practice through the pages of the 'Lancet' by the contributions already referred to.[2] This treatment, I may venture to state, is incomparably superior to that of Rollo in its most approved form, inasmuch as I have found it after numerous trials to yield results far beyond my own expectations, formed at the time when it first occurred to me that it might act beneficially in diabetes.

[1] Cyclopædia of Practical Medicine, vol. i. p. 545.
[2] See p. 16.

CHAPTER X.

THE SKIM-MILK TREATMENT OF DIABETES.

When the idea first occurred to me to try an exclusive regimen of milk as a remedy for diabetes, I certainly received no encouragement whatever from consulting the writings of the more recent of the acknowledged authorities on the treatment of this disease. On the contrary, I found that they condemned the use of milk with a unanimity highly discouraging, and in itself sufficient to lead to the inference that it must be specially injurious to those suffering from the affection. Thus, Bouchardat[1] of Paris, in a contribution to the French Academy of Medicine, has distinctly forbidden the use of milk, although he has recommended sweet cream, and all kinds of cheese; and from the high estimation in which his opinion is held, his condemnation of milk has been adopted in several important works

[1] Mémoires de l'Académie nationale de Médecine, tome xvi. Paris, 1852.

on medicine both abroad and in this country. Dr. Pavy, in his work already referred to (p. 263), has given, in a tabular form, an elaborate dietary for diabetics, to enable them to select the suitable or harmless articles of food from those which are prohibited as injurious; and in this table milk is placed at the head of the list of the liquids they are forbidden to drink in consequence of the sugar they contain. Dr. Bence Jones,[1] too, although he does not express himself in equally disparaging terms, in referring to the treatment of diabetes in a recent work, observes that 'milk is more or less injurious according to the stage of the complaint. When animal sugar can be consumed, milk is comparatively harmless.'

It is evident that the strong objection which has prevailed against the use of milk in the treatment of diabetes originated in the fact that it contains from four to six per cent. of milk sugar or lactin, which was supposed to be readily converted into diabetic sugar in the system. It appears that lactin, when taken in a pure, *unmixed* condition, is transformed into diabetic sugar, and as such is voided by the urine. But this certainly is not the case with lactin

[1] Lectures on some of the Appliances of Chemistry and Mechanics to Pathology and Therapeutics, p. 62. London, 1867.

administered as a constituent of milk; for no sooner is milk taken into the stomach than its lactin undergoes fermentation, apparently through the agency of casein as a ferment, and is converted into lactic acid, which is incapable of being changed into glucose, or diabetic sugar. That the lactin of milk undergoes lactic fermentation in the healthy stomach, is a well-known physiological fact;[1] and it appeared to me that, in all probability, no abnormal condition exists in the stomach in diabetes to prevent the same process from taking place. This conclusion has been verified by my subsequent experiments with skim-milk in the treatment of the disease. It occurred to me that if milk did produce an injurious effect in diabetes, or if it failed to act beneficially, this might possibly be dependant on the presence of the large quantity of fatty matter, or butter, it contains. From these considerations, and others about to be stated, I resolved to try skim-milk (from which the cream had been carefully removed) as a remedy for the disease.

Skim-milk, as stated in a previous chapter, is (with the exception of a little contained fatty matter) a simple aqueous solution of the salts requisite for

[1] Dr. Bence Jones, Lectures on Digestion, Respiration, and Secretion, Med. Times and Gaz., April 19, 1851.

nutrition, and of casein and milk-sugar. It therefore contains an albuminous and a saccharine proximate principle of food—the *latter* being the *analogue* of vegetable starch and sugar (entering into the composition of a perfect human food), and destined to undergo the same metamorphic changes, and to serve the same purposes in the process of healthy nutrition. But milk-sugar differs from these vegetable substances in the very important particular, that, being immediately or quickly converted into lactic acid in the stomach, it is incapable of being misappropriated or wasted in the system by the morbid action of diabetes. By the employment of skim-milk, therefore, it struck me that it would be practicable to give to diabetics a *saccharine alimentary principle, capable of being assimilated* in spite of the disease; and surely to do this would be to surmount one of the greatest difficulties to be encountered in its treatment.

With regard to the casein of skim-milk, it appeared to me also that, as it is a *primitive* nutrient albumen formed in the laboratory of nature with the *special* design of being converted into healthy living tissues, it would be much more likely to effectually resist the mal-assimilating or sugar-forming force of the disease than the albumen of muscular fibre, which has been highly organised to perform an important vital function, and which, moreover, is further deteriorated by the process of cooking.

Since I have put the skim-milk treatment to the test of direct experiment, my anticipations have been fully realised by the success attained, and now I am fully confirmed in the opinion that the great superiority of this remedy consists in restricting the patient to a food containing *a quality of albumen in the highest degree capable of assimilation with the addition of a saccharine principle which is also assimilated.* By no other treatment can this be effected.

Another important feature of the treatment consists in the accuracy with which the daily allowance of food can be measured and regulated, and a uniform regimen secured from day to day.

Besides, I must not neglect to mention that instead of being repugnant to the taste and inclination of the patient, like the meat diet of Rollo, I have without exception found the skim-milk highly grateful to diabetics, especially when first administered, from the sudden relief given to the symptoms, and especially to the thirst, which is often so distressing.

Another very important advantage of the skim-milk treatment is its cheapness, which brings it within the reach of the poor; skim-milk (from which the cream has been removed for sale or to make butter), quite undiluted with water, can readily be obtained at a cost of about a penny per pint.

When a patient, in whom the more distressing symptoms are fully developed, is placed under the skim-milk treatment, it is truly surprising to witness the almost magical *rapidity* with which they are subdued, twenty-four hours being generally sufficient for the production of a marked improvement, and seldom more than from two to six days being required to procure complete relief from suffering, except from the feeling of debility when this is dependant on great emaciation. The quantity and density of the urine suddenly fall from the great diminution in the quantity of sugar secreted by the kidneys, and, *pari passu*, with the reduced formation of diabetic sugar the intense thirst and voracious appetite disappear. The previously parched skin becomes moist and perspiring, the symptoms referable to the nervous system are as rapidly relieved, profound, refreshing sleep succeeds to the previously sleepless, restless condition during the night-time, rendered almost intolerable by the incessant, insatiable thirst; the feelings of languor, of lassitude, and of impaired sensibility are also greatly relieved, and the spirits become much more buoyant. The patient expresses thankfulness for the sudden and unexpected change. I may add that I have seen this wonderful amelioration in the condition of the patient in the most severe and advanced cases, even in instances in which the disease had advanced so far, and so thoroughly undermined the constitution of the patient, as to render a complete cure, or the entire removal of the sugar from the urine, impossible. I shall adduce illustrations in proof of this assertion further on, and in the present place will only remark that in one instance, to be again referred to, the skim-milk treatment, *without the aid of any other remedy*, reduced the daily quantity of the urine from 27 pints of a mean specific gravity of 10·40 to $4\frac{1}{2}$ pints, specific gravity 10·27, at the end of the third day. In other words, there was a reduction of $22\frac{1}{2}$ pints in the daily quantity of the urine and of about 32 ozs. in the daily amount of its contained sugar at the end of three days, and this was attended with a correspondently rapid improvement in the general condition of the patient. The sugar was completely removed from the urine at the end of 35 days. I shall again refer to this case, which is well authenticated, the patient having been examined by Dr. Wiltshire, of London, and by several of the medical profession of Sunderland, after the sugar was removed from the urine.

The last symptom to yield *completely* to the influence of the skim-milk treatment is the saccharine condition of the urine; but that it should be so might reasonably be inferred from the fact that this is the *essential* or fundamental phenomenon of diabetes, and that it must necessarily continue so long as a trace of the disease or morbid action remains in operation. The entire removal of the sugar from the urine must, therefore, be regarded as indicative of the complete subjugation of the affection, and especially so when a restoration of the natural condition of the urine is accompanied with freedom from suffering, and with a feeling of restored health. It follows from this that we must judge of the efficacy of any treatment in diabetes by its influence on the condition of the urine and general health combined. If, in any given case, the sugar continues absent from the urine and there is a restoration of health, we must regard the success attained as complete and the disease to have been cured. But if, on the other hand, sugar remains *permanently* present in the urine, even in small quantity, although the feelings of general health may have been restored, the success achieved will have been partial, although it may be very considerable. If, however, no impression is made on the quantity of urine sugar voided, and no improvement effected in the health of the patient, we must regard the treatment applied to have been useless. Now this is the standard of comparison by which the utility or efficacy of the skim-milk treatment of diabetes must be judged.

My experience now extends over a large number of cases in which this remedy has been applied in the most careful and methodical manner, several of them having been very far advanced and of the worst possible character. From the experience thus gained I have arrived at the following conclusions:—

1. That the skim-milk treatment will very generally cure diabetes if the second stage is not too far advanced, and if it is not of too long standing; the time required for the complete removal of the sugar from the urine, in these curable cases, varying from twelve days to five or six weeks.

2. That if the disease is of very long standing and the second stage too far advanced, a complete cure will not be effected; but in a large proportion of cases the further progress of the disease will be arrested for a longer or shorter period, so that patients will be restored to a feeling of comparative

health and comfort. I have seen this result obtained when the patient seemed moribund; the case of J. W., recorded at p. 230, is an illustration of this effect.

Of course these conclusions do not apply to cases which are complicated with pulmonary phthisis or any other serious or necessarily fatal affection, although, in such hopeless instances even, the most extraordinary and rapid subjugation of the more distressing symptoms is generally witnessed.

The most important and valuable property of the skim-milk treatment, and that which gives it a pre-eminent superiority over the meat regimen, is the fact, which I shall prove by illustrative cases, that it will remove the sugar from the urine and cure the disease when the latter method has completely failed to accomplish this result after a protracted trial. In short it will cure the disease in the second stage when the urine continues to be strongly saccharine notwithstanding the complete exclusion of starch and sugar from the *ordinary animal food* of the patient. This fact proves most conclusively *the very great superiority of the casein of milk over the albumen of muscular fibre in resisting the mal-assimilating operation of diabetes.* I may further add that it is this peculiarity of casein which, combined with the fermentable property of lactin, confers on skim-milk such a powerfully curative influence over the disease.

I have already, at page 41, laid down precise rules for the application of this treatment, and shall only here repeat what I have already stated most emphatically, that if these rules are not scrupulously observed success is not to be expected, more especially if any other kind of food is permitted until some time has elapsed *after* the complete removal of the sugar from the urine, which will be effected within six or seven weeks at the latest, or not at all, the average period in the more successful cases being about fifteen or sixteen days.

In about three weeks or a month after the disappearance of the sugar I give, in *addition* to the skim-milk previously taken, from two to four pints of skim-milk made into curd by the essence of rennet, and at two or three separate meals. This forms, as I have stated, a *middle course* in the treatment, and when it has been continued a length of time, suitable to the exigencies of the particular case under care, lean meat and *green* vegetables are allowed, *also in addition*, at one meal and in moderate quantity. In some instances the meat is tried without the vegetables for a week or so, and if no evil effect is produced the latter are added to the meal. Gradually the patient is allowed eggs, fish, game, poultry, potted head, cow-heel, and a variety of dishes made from lean meats, so that two solid meals in the day are taken in addition to the skim-milk, which is then either reduced in quantity, or the curd is partly or wholly withdrawn, according to the inclination of the patient.

Such are the principles on which the treatment is to be conducted, but no two cases can be treated equally alike ; differences must be made in individual cases, and changes in the same case, from time to time, which cannot be anticipated by rules, however carefully devised. I may add that however simple the skim-milk treatment may appear on paper, it is not so in practice ; I have never known any success attained unless the patient is kept closely under observation and the condition of the urine carefully ascertained from day to day. A wholesome check is thus maintained against any infringement of rules, and in favourable cases the progress towards recovery is pointed out, and great encouragement thus given to continued perseverance. Besides, any little inconveniences of casual occurrence are at once remedied, and any uneasiness they may create in the mind of the patient allayed.

It is necessary here to state that general medicinal treatment is not excluded, but that I have been in the habit of giving such remedies as appeared to me to be required in consequence of the peculiar conditions connected with individual cases. But, at the same time, I have in several very successful instances considered it unnecessary to prescribe any medicines whatever. In most cases the skim-milk treatment gives rise to constipation, which is best remedied by an occasional dose of castor oil. If diarrhœa should ensue, which is rarely the case, a little of essence of rennet in water after each meal of skim-milk is generally sufficient to allay it; but if necessary, some such astringent as acetate of lead and opium may be given.

After complete recovery from diabetes, a *strict regimen*, excluding vegetable substances containing starch and sugar, must be adhered to for a lengthened period, the exact limit of which it is impossible to determine, in consequence of the strong tendency which these substances have to excite a return of the disease. Indeed, it would appear that with a considerable proportion of those who have been affected with diabetes an idiosyncrasy remains, rendering them incapable of assimilating starch and vegetable sugar. With such persons, therefore, a cure is purely *conditional*: they may continue perfectly free from the disease, and in the enjoyment of health, so long as they strictly refrain from partaking of all kinds of food containing these substances; but if, on the other hand, they persist in breaking through this rule, sugar, in all probability, will reappear in the urine, and the disease will gradually become re-established. So frequently does this occur that I firmly believe the disease always *originates* in the malassimilation of starch and sugar, especially the former, which appears to be the fuel requisite to kindle up the morbid action.

It follows that convalescents must refrain from taking the following vegetable substances:—

Bread of all kinds; flour in any form; macaroni; vermicelli; rice; sago; tapioca; arrowroot; peas, or peameal; beans, or beanmeal; French beans; turnips; carrots; parsnips; artichokes; cauliflower; the white central portion of cabbage; celery; seakale; every kind of fruit, in any form; pastry of every description.

The following vegetable substances are permissible:—

Lettuce; greens; spinach; the green leaves of young cabbage; Brussels sprouts; mustard and cress; watercress.

Experience has clearly shown that a saccharine alimentary principle, such as is supplied by the vegetable substances prohibited in the above list, is essential to the healthy nutrition of the human body, and that the complete withdrawal of such a substance from the food for any length of time is productive of injury to health. Fortunately, milk supplies a principle of this nature, in a form, too, harmless to diabetics, and not prone to reproduce the disease. Consequently by allowing skim-milk to enter largely into the diet of those who have recovered from the affection, we supply a perfect substitute for the prohibited vegetable substances, such as bread, potatoes, and the like, which enter so largely into the composition of ordinary food. The starch and gluten which these substances contain are the analogues, chemically and physiologically, of the lactin and casein of skim-milk.

Under the head of Pathology I have directed attention to certain clinical observations which show conclusively that during the progress of diabetes fatty substances increase the formation of sugar, and aggravate the symptoms of the disease. Convalescents, therefore, should partake sparingly of fatty matter, and limit themselves to the little fat contained in the leaner portion of the meat of superior quality, of which they partake. Pork and bacon must be avoided, and also butter and cream. I have known these substances productive of considerable injury. Cheese, too, must be avoided.

On account of the quantity of skim-milk consumed, patients seldom require any other fluid. But for drink I have generally been in the habit of allowing a cup of tea or coffee, without sugar, and with or without skim-milk, twice or thrice daily. I have also allowed cocoa, free from fatty matter, especially Cadbury's essence, which is an agreeable and excellent preparation. I have always strenuously opposed the use of alcoholic drinks for the reason already stated.

While patients are under the skim-milk treatment I am in the habit of prescribing out-door exercise when the weather is fine or mild, especially walking, or working lightly in the garden; this they find particularly agreeable, in consequence of the greatly increased, or newly-acquired, strength they generally feel after the sugar has been greatly diminished, and the other symptoms allayed. So great is the improvement in this respect that, as will be shown by the cases recorded further on, patients, after having lived on skim-milk exclusively for several weeks, have been able to walk six or seven miles *without fatigue*, who were previously incapacitated from walking more than a quarter of a mile without resting. This sudden restoration of strength has often created astonishment in the minds of relatives and of the patients themselves, who were previously prejudiced against the treatment, on the ground that they believed it impossible for anyone to subsist on what appeared to them to be such exceedingly slender fare.

In cold and damp weather the patient must be confined to the house; both on account of the pernicious influence of chills and because of the small amount of heat-forming material consumed under a skim-milk regimen. For the same reasons thick warm clothing should always be worn in the winter and spring seasons. In summer even flannel should be worn next to the skin; but the dress should be light though of warm material, on account of the tendency to perspiration imparted by a liquid diet, and the necessity of guarding against sudden vicissitudes of temperature.

CHAPTER XI.

THE SKIM-MILK TREATMENT OF DIABETES. CASES.

To illustrate the observations made in the preceding chapter, I shall now proceed to give the details of a few cases of diabetes placed under the skim-milk treatment, which, in each instance, was followed out under my own supervision with extreme care. But in doing so I shall avoid selecting any of the milder instances in which the malady existed in its incipient condition, and in which the mere exclusion of starchy and saccharine substances from the food for a period of three or four days is sufficient to remove the sugar entirely from the urine. On the contrary, I shall direct attention to cases in which the disease manifested itself in a much more serious form, and in which the second or more formidable stage presented itself in every phase of development.

The first two cases are fair average examples of what may be expected from the treatment when the disease is uncomplicated, and not too far advanced.

Case II. is specially interesting and instructive, inasmuch as it supplies conclusive evidence of the very great superiority of the skim-milk treatment over an exclusive regimen of ordinary animal food (consisting chiefly of *muscular fibre*), which has hitherto been the only remedy on which any reliance could be placed.

It is necessary here to direct attention to the fact that during the first two or three weeks of the treatment there is *always* loss of weight experienced by the patient; this I attribute chiefly to two causes, namely, the great diminution in the quantity of excrement contained in the intestines under a skim-milk diet, and secondly to the gradual withdrawal of the sugar with which the blood and tissue fluids are saturated when the treatment is begun.

CASE I.—*Diabetes Mellitus; Removal of the Sugar from the Urine in Fourteen Days; Complete Recovery.*

Mr. J. G——, aged fifty-eight, a highly respectable merchant, of large, robust, muscular build, and of regular and temperate habits. He has devoted himself very successfully to business pursuits, with all the anxiety attendant thereon.

For two years prior to May, 1870, this patient had grown much stouter and shown a decided tendency to corpulency, and, to use his own expression, 'had been very bilious.' He suffered much during this period from loss of energy and fatigue on exertion, always feeling dull, heavy, and languid, sleepless at night and drowsy in the daytime. This general indisposition he attributed to his habits having become much more sedentary and his application to business much closer. He took no stimulants whatever during the daytime, but in the evening, at dinner and after it, he took daily a pint of bitter ale and one or two glasses of whisky, but never more than this quantity.

The condition of general debility and suffering just described continued until the beginning of May, 1870, when the patient's health completely broke down, and his feeling of debility increased so greatly that he could with extreme difficulty walk in the morning after breakfast between his own residence and his place of business, a distance of less than half a mile.

This state lasted until the 14th of June (about six weeks), when I was called in consultation with Mr. M. Francis, surgeon to the Sunderland Police Force, and when we found the state of the patient to be as follows:—He was unable to attend to business, and could not walk more than a quarter of a mile without taking a rest. He suffered much from a dull heavy pain across the forehead, with a painful dragging sensation in the face, or as if something was dragging down his cheeks. There was great dimness of vision and loss of energy, no sleep at night (although he slept occasionally towards morning), coldness and numbness of the limbs, and loss of sensation on the anterior surface of the thighs. There was not very excessive thirst nor inordinate appetite; the skin was somewhat dry and not perspiring; the gums were spongy, and the teeth loose. There was nothing abnormal in the state of the pulse, and no organic disease could be detected.

Such were the general symptoms; and a careful examination of the urine revealed the nature of the disease. The daily quantity of urine varied from eight to ten pints; and its specific gravity was from 1035 to 1040, and it was loaded with sugar. The case was, therefore, unquestionably one of confirmed diabetes.

On the following day (the 15th of June) the skim-milk treatment was begun; and, on account of the large muscular frame of the patient and his sharp appetite, from eight to ten pints were taken daily, and at the ordinary temperature. The cream was taken off carefully after it had stood a sufficient length of time, and according to directions. *All other food was scrupulously refrained from;* and no medicine whatever was in this case prescribed. This treatment (an exclusive diet of skim-milk) was persevered in *without variation or intermission for a period of five weeks.*

And now let us consider with what result.

At the end of the first week of the treatment, the urine had fallen in quantity to six or seven pints daily (the quantity being always in direct ratio to that of the daily consumption of milk), and its specific gravity was reduced to 1015, the quantity of sugar having undergone a very great diminution.

At the end of the second week (June 28th), or *fourteen days after the commencement of the treatment, the sugar had completely disappeared from the urine;* not the slightest trace could be detected on the most careful examination. The specific gravity of the urine was now reduced to 1009 and 1010 daily, the quantity ranging from six to seven pints, according to the quantity of milk taken daily; but whenever the quantity exceeded seven pints the specific gravity was always below 1010. From this date the sugar continued absent from the urine.

As regards the general symptoms of the disease already enumerated (most of which were referable to the nervous system), they gradually diminished, and at length completely disappeared within a fortnight, and were succeeded by a feeling of perfect health, accompanied by profound refreshing sleep at night. The lethargy, too, entirely subsided.

One of the most remarkable changes produced in the patient's condition was the restoration of his strength: *at the end of a month he walked seven miles without once resting, and without fatigue* or subsequent injury; his diet having been all the while exclusively skim-milk, as already stated.

At the commencement of the treatment the patient was flabby and inclining towards obesity; but two months afterwards his flesh was firm and compact, his features presenting a ruddy, healthy hue, instead of his previously yellow, pasty look; his gums and teeth regained their firmness.

As already stated, the skim-milk treatment was continued for five weeks. At the end of this period from two to three pints of the daily allowance of milk (from eight to ten pints) were converted into curd by the use of Proctor's essence of rennet; this curd was taken at two meals, and it assisted materially in filling the stomach, and was thus very grateful to the patient. This slight change was continued two weeks; but, as it was a mere modification of the milk diet, the latter may therefore be said to have extended over a period of seven weeks.

At the end of seven weeks, and as an *addition* to the milk and curd diet, still continued, a dinner was allowed, consisting of about three quarters of a pound of beef or mutton roasted, or steak or chop, with a moderate quantity of green vegetables (cabbage, greens, lettuce, spinach, &c.). This change of diet did not cause any return of the sugar in the urine, but contributed much to increase the strength of the patient, and was very grateful to his appetite.

Since the disappearance of the disease, on the 28th June, up to the present time, a period of more than thirteen months, the patient has continued and still continues in excellent health, and sugar is still absent from the urine, which is subjected to a frequent examination. Additions have been made to his diet, but all articles containing starch and sugar have been excluded as far as practicable. He has been taking the following diet daily:—For breakfast: ½ lb. of mutton chop, a pint of milk, and about ½ pint of coffee. For lunch: ½ lb. of potted head or potted meat and a pint of milk. For dinner: about ¾ lb. of roast beef or mutton, chop or steak, fowl or turkey, with green vegetables (brussels sprouts, cabbage, lettuce, &c.). After dinner, up to bedtime, tea and a liberal quantity of milk are taken. Six pints of milk are consumed daily; from this the greater portion of the cream has been separated. Under this diet the health of the patient is *robust*, and he has gained considerably in healthy flesh, the obesity and flabbiness having quite disappeared. This dietary will be continued for some time longer, until it is considered safe to introduce articles of food containing starch or sugar.

CASE II.—*Diabetes Mellitus; Removal of the Sugar in Twelve Days; Complete Recovery.*

Mr. D. S——, a highly respectable and prosperous tradesman of robust, muscular build and of temperate habits, but much confined within doors by his business. His health had generally been good until January, 1870, when he began to suffer much from general indisposition, and when he placed himself under a medical practitioner, who ascertained that he was suffering from diabetes, but did not prescribe a dietetic treatment, or produce any amelioration of the condition of the patient.

On the 15th of April he consulted an experienced surgeon in Newcastle. At this time his weight was

11 st. 10 lb., having lost 1 st.; and he passed daily from six to seven pints of urine, having a specific gravity of 1040 to 1045, and highly saccharine. He suffered from dry skin and excessive thirst (not greatly increased appetite), great dimness of vision, and almost complete loss of sleep. He had a dull, heavy, aching pain over the loins, great listlessness, entire loss of energy, and experienced great fatigue on the slightest exertion.

The patient was now placed under Rollo's dietetic treatment, consisting of animal food—beef and mutton,—of which he partook about 2½ lb. daily, in four meals, with the addition of two or three of Camplin's bran biscuits to each meal; tea was allowed, and also a pint of claret daily, and occasionally a little brandy and cold water. Bread, sugar, and all food containing starchy matter, were strictly prohibited.

On the 19th of April (four days after commencing this treatment) his weight was 11 st. 5 lb.; and on the 25th, 11 st. 10 lb.

The effect of the treatment was to diminish the daily quantity of urine to 4½ pints on an average; but its specific gravity never fell below 1038, and continued to be abundantly impregnated with sugar. The patient, however, experienced considerable relief from the general symptoms of the disease up to the 25th of July: but the disease itself showed no indication of yielding, and was pronounced incurable. At this period he became much worse, there being a great aggravation of all the symptoms of the disease up to the 3rd of August, when he first came under my observation.

When, at the date just mentioned, he consulted me, I found the patient labouring under all the symptoms already detailed, and from which he was suffering when placed under a dietetic treatment in the beginning of April. He was passing from six to seven pints of urine daily. The specific gravity on the 3rd of August was 1040.

On the 4th of August, the day following, I placed him under the skim-milk treatment. He was allowed six pints daily, from which the cream had been carefully separated, after standing eighteen or twenty-four hours in a cool place. *All other food was strictly prohibited*, and stimulants were disallowed. The subjoined table shows the effect of the treatment on the urine, which was carefully collected and measured every twenty-four hours, and the mean specific gravity ascertained. In this table I give the condition of the urine only on the days on which the patient was seen by me, and the examination made by myself.

Table showing the Effect of the Treatment on the Quantity and Specific Gravity of the Urine, which also contained an abundance of Phosphates.

		Daily quantity in wine pints.	Sp. gr.
Aug.	3rd	6	1040
	5th	$3\frac{1}{2}$	1030
	8th	$4\frac{1}{2}$	1013
	10th	$4\frac{1}{2}$	1013
	13th	$3\frac{1}{2}$	1015
	15th	$4\frac{1}{2}$	1011
	18th	$3\frac{1}{2}$	1016
	20th	4	1014
	23rd	5	1010
	26th	$4\frac{1}{2}$	1015
	29th	5	1010
	31st	$5\frac{1}{2}$	1013
Sept.	3rd	3	1019
	6th	$2\frac{1}{2}$	1023
	12th	$3\frac{1}{2}$	1019
	19th	3	1020
	23rd	$2\frac{1}{2}$	1026
	27th	$4\frac{1}{2}$	1017
	30th	$2\frac{3}{4}$	1024
Oct.	3rd	$3\frac{1}{2}$	1024
	10th	$3\frac{1}{2}$	1023
	23rd	$4\frac{1}{2}$	1015
	29th	$5\frac{1}{2}$	1019
Nov.	2nd	$3\frac{1}{2}$	1024
	10th	4	1018

The dates of the following report of the general condition of the patient correspond with those of the table above.

Aug. 3*rd* (the day before the treatment was begun).—The urine was loaded with sugar. There was great thirst, a dry skin, no sleep at night, loss of energy, and great fatigue on exertion.

5th (the day after the commencement of the treatment).—Not much improvement in general symptoms; but the urine was reduced $2\frac{1}{2}$ pints in quantity and ten degrees in specific gravity.

8th.—The quantity of sugar in the urine very much diminished; *thirst gone*; skin moist and perspiring, especially at night. Had slept soundly on the previous night; listlessness much less, and feels as if he had got rid of a load.

10*th.*—Much less sugar in urine. A great improvement in every respect.

13*th.*—Sugar reduced to a very small quantity. Thirst quite gone since the 8th. Skin continues moist; sleeps soundly every night; vision improved; pain in the loins gone; feels much more energetic and active; takes a long walk daily without fatigue.

15*th.*—Only a mere trace of sugar observable in the urine. Continued improvement, especially in strength.

18*th.*—Sugar totally absent from the urine; still improving in strength and energy; has no desire for more food.

20th.—Sugar continues absent; 'feels quite well'; can walk a long distance without fatigue. The daily allowance of skim-milk increased to seven pints.

23rd.—No sugar; keeping quite well. After consulting me on the 20th he walked to Whitburn, and then to Cleadon Station (about five miles), without fatigue.

29th.—No sugar; feels quite well.

31st.—As before.

Sept. 3rd.—As before. Now allowed, in addition to seven pints of skim-milk daily, two pints of the same made into curd by essence of rennet.

6th.—No sugar; quite well. Has taken much exercise daily, and perspires freely. Bowels constipated, and relieved by castor oil.

12th.—No sugar; feeling well and strong. At this period the patient was examined, as well as his urine, by my neighbour, Dr. Charles Natrass, of Sunderland, who considered him cured of the disease. The patient, moreover, declared to Dr. Natrass and myself that, on the 6th of Sept., he had walked from my house by the sea-shore to South Shields, a distance of nearly eight miles, without fatigue, and after having lived on skim-milk solely for forty-one days. He further declared he could not have done this feat three years previously, when in health and living generously.

15th.—No sugar in the urine; weight 11st. 10lb.; health excellent.

The patient had now lived solely on a skim-milk diet for a period of thirty-two days, and on skim-milk and curds solely for an additional twelve days, in all forty-four days (six weeks and two days).

On Sept. 16th he was allowed, as an *addition* to the skim-milk and curd diet, half a pound of mutton chop to dinner.

Sept. 19th.—No sugar in the urine; patient continuing well; takes daily, with the chop, five pints of skim-milk in the liquid form, and from two to three made into curd. The change in the diet diminished the quantity of urine and raised its specific gravity.

23rd.—Urine free from sugar, but containing a deposit of uric acid crystals.

27th.—Patient perfectly well; has been drinking more milk; allowed the green part of cabbage, greens or lettuce to dinner, with butcher meat.

30th.—As before.

Oct. 3rd, 10th, 23rd and *29th.*—No sugar in the urine; health excellent; has been taking much out-door exercise; now allowed Van Abbott's gluten bread to dinner, as an addition to the food last mentioned.

Nov. 2nd and *10th.*—No sugar in the urine; health excellent. It was now considered unnecessary to keep a regular record of the case. On the 8th of March following he had gained 8 lbs. in weight.

Since the above date up to the time of writing, a period of several months,[1] the disease has not returned, notwithstanding that the patient has lived on a mixed diet, though carefully regulated to exclude as far as possible starch and sugar, and also fat, except a small quantity. The dietary on which he has been living is as follows:—

Five to seven pints of skim-milk daily (two or three pints of it converted into curd by essence of rennet); eggs (occasionally a portion of the curd and of the eggs are made into puddings); tea and coffee, with skim-milk; a meal of roast beef or mutton, chop or steak, turkey or chicken, with green vegetables, such as the green part of cabbage, greens, Brussels sprouts, lettuce, spinach, &c. Tea

[1] While these pages are passing through the press, this patient has informed me that he has just visited the Westmoreland Lakes, during which occasion, on a hot day in August (twelve months after his recovery), he walked over the mountains from Borrowdale to Whyburn, a distance of above eight miles, without fatigue.

has been taken in the evening, and supper has consisted of curds and milk. With this diet the patient is vigorous and quite contented.

I have now treated several cases with as much success as that attending the two instances just recorded, which may be considered as fair *typical* illustrations of what the treatment will achieve under similar circumstances. I shall now pass on to show what it will effect under much more unfavourable conditions.

The following case is that of a boy of 17 years of age, of a scrofulous diathesis, and of strong hereditary tendency to the disease; his brother having died of diabetes complicated with pulmonary phthisis at the age of 23 years.

This case was treated under my care in the Sunderland Infirmary, and is specially interesting as being the second instance in which I tried the skim-milk treatment, and the first in which it was fully carried out, and without any other remedy than a mixture of the sulphate of quinine and iron.[1] I may further remark, that the second stage, which at this period of life is rapidly fatal, was evidently developed, as shown by the formidable character of the symptoms, namely, the large amount of highly

[1] See 'Lancet,' October 23, 1869, p. 569.

saccharine urine, the intense thirst and parched skin, the voracious appetite, the extreme emaciation and debility, and the rapid pulse. The invasion of the second stage appears to have dated from the period at which a carbuncular affection made its appearance on the neck; previously, the first stage seems to have progressed insidiously and undetected.

Case III.—*Diabetes Mellitus; Rapid and Complete Recovery.*

Thomas H——, aged seventeen, was admitted into the Sunderland Infirmary on July 7, 1869. Three months previously he was seized with a feverish attack; a large abscess formed in the neck below the right inferior maxilla, burst, discharged for a fortnight, and then healed. Shortly afterwards he was seized with intense thirst, which has continued up to the present date. Simultaneously with the thirst, he began to pass large quantities of pale-coloured urine, amounting, during the eleven hours each night while under the observation of his mother, to 6 pints—equal to about 12 pints daily. The appetite also became voracious; and he now suffers very much from dyspepsia. Bowels regular; skin dry and parched; pulse feeble and rapid. He has lost much flesh, having been previously stout and robust, but now greatly emaciated, and his strength so much reduced that he can scarcely walk. Weight 5 st. 13 lb. He sleeps badly, being much tormented with thirst, and suffers greatly from a feeling of aching and feebleness in the limbs. His diet has been of the ordinary description.

July 8th.—Condition as above. Quantity of urine, 11 pints; sp. gr. 1038, and containing about $15\frac{1}{2}$ oz. of sugar. The patient was at once placed on a milk diet, consisting of six pints of skimmed milk, warmed, and divided into four meals, with an interval of four hours between each; all other food was strictly prohibited. As a tonic, one grain of sulphate of iron and two grains of sulphate of quinine, in mixture, were given thrice daily. *This constituted the whole of the treatment of the case* from beginning to end; and, although commenced after midday, there was considerable improvement on the following forenoon, when the quantity of urine was a pint and a half less.

The following table gives a correct measurement of the quantity and density of the urine throughout the case: daily for the first eight days; and every other day subsequently up to the 27th of August, when, in consequence of the continued absence of sugar from the urine, and of all the symptoms of the disease, a change was made in the patient's diet.

Table showing the Change effected in the Urine.

	Daily quantity in wine pints.	Sp. gr.
July 9th	9½	1038
10th	6	1032
11th	5	1032
12th	5	1033
13th	6	1030
14th	5½	1032
15th	5½	1039
16th	4½	1023
18th	5½	1020
20th	6	1017
22nd	5	1015
24th	4½	1015
26th	3½	1007
28th	4	1007
30th	5½	1008
Aug. 1st	4	1007
3rd	4	1006
5th	3½	1006
7th	4½	1007
9th	4½	1007
11th	4½	1007
13th	5	1007
15th	4	1006
17th	4½	1007
19th	4	1005
21st	4	1010
23rd	4½	1013
25th	4½	1012
27th	4	1009

10*th.*—Patient has slept much better; thirst greatly diminished; appetite much less urgent. Urine 5 pints less than on admission, and 8 degrees less in density. (*This improvement was effected in less than forty-eight hours.*)

19*th*.—Thirst and inordinate appetite almost gone; sleep sound every night, accompanied with perspiration; skin moist during the daytime; strength much improved, and the sensation of weariness in the limbs much diminished; urine 5½ pints, sp. gr. 1018.

28*th*.—The thirst and inordinate appetite gone; the sound sleep and perspiration continue; the feebleness and uneasiness in the limbs quite gone. The patient says he feels quite well. Urine 4 pints, sp. gr. 1007.

Aug. 4*th*.—The patient continues to feel quite well. *Every symptom of the disease gone.* Urine 3½ pints, sp. gr. 1006; it yields a *very faint* indication of sugar with Trommer's and Moore's tests.

19*th*.—Health still improving; strength much increased; urine 4 pints, sp. gr. 1005; not a trace of sugar to be detected.

27*th*.—The report as on the previous occasion. Urine 4 pints, sp. gr. 1009; sugar entirely absent. Half a pound of lean mutton or beef, with cabbage in moderate quantity, to be allowed for dinner, and the quantity of milk to be reduced to 5 pints daily.

Sept. 29*th*.—The patient still continues free from every indication of the disease, and the urine, *free* *from sugar*, has ranged during the past month in quantity from 3 to $4\frac{1}{2}$ pints daily, of a specific gravity from 1006 to 1013. His strength is wonderfully improved, and he has gained four pounds in weight since the date of the last report, the same diet having been persevered in.

The patient continued to take the diet prescribed on the 27th of August up to the beginning of October, and during this period the sugar remained absent from the urine, and he continued to improve in health and strength, and gained 8 lb. in weight—in all, 12 lb. since the disappearance of the disease. On the day of his dismissal, however, sugar was found in the urine, and, on investigating the cause it was found, by the testimony of the patient occupying the next bed, and by his own confession, that he had been partaking freely of bread, oatmeal porridge, and spirits, given to him by the other patients in the ward. His mother was now apprised of what had taken place, and, as the consequences of infringing on strict rules as to diet was fully explained to her as well as to the patient himself, she undertook to ensure their observance. On his removal from the infirmary, he was placed on a skim-milk diet, and the sugar disappeared in three days; and at the end of a week he was allowed, in addition to the milk, one meal of beef or mutton, with green vegetables. Under this regimen he continued to improve, and the urine continued free from sugar. At the end of a month he was, as an addition to his previous diet, allowed eggs to breakfast, and cow-heel seasoned to supper. This change agreed remarkably well, and he continued to enjoy excellent health, and to increase rapidly in weight and strength.

On the 3rd of January, Dr. A. Wiltshire of London, then Government Inspector of Vaccination, examined the patient very carefully, and found him in perfect health; his cheeks having become plump, and his weight having increased 15 lb. since he left the hospital, three months previously—or 1 st. 13 lb. since his recovery in August. Dr. Wiltshire could not detect a trace of sugar in the urine. A similar examination was made at this period with the same result by Mr. J. Wilson, Dr. Lambert, and Mr. M. Douglass of Sunderland.

From the above date up to the end of March—an additional period of three months—the patient continued under my observation, and his urine was examined weekly, but without the slightest trace of sugar being detected in it. All the while he continued perfectly free from the disease, and his weight and strength kept increasing.

At the end of March, unfortunately, after the uninterrupted enjoyment of perfect health for a period of *nine months*, the patient commenced to disregard the rules of regimen, under which he had been living since his recovery from the disease, and, regardless of the consequences, began to indulge in prohibited articles of diet, and the result was his urine became saccharine, and diabetes was gradually developed. He now refused to be placed under the skim-milk diet a second time, and therefore I declined to give any further professional advice in the case. I have since learnt that the disease kept increasing, and that pulmonary phthisis set in, and proved rapidly fatal in the month of November following the above date.

It is instructive to mention that the patient belonged to the poorer and more ignorant class of the community, and affords a melancholy illustration of the extreme difficulty of carrying out the treatment of diabetes to a successful issue in persons of this class (either in hospital or private practice),—a difficulty which is greatly increased in the case of young subjects, who are exceedingly prone to secret indulgence in injurious articles of diet. Indeed, this seems to be one of the reasons why the disease is much more fatal at this period of life. In the present case the robust health of the patient after his recovery, and for such a lengthened period, so long as he lived according to rule, affords sufficient ground for the belief, that very probably he would have remained free from the disease, if it had been practicable to insure a continued observance of a regimen which, however strict, produced no loathing, and contained all that is essential for the healthy nutrition and development of body. The case, moreover, supplies conclusive evidence of the efficacy of the skim-milk treatment.

I shall now proceed to give the details of one of the most severe examples of diabetes, which has ever come under my observation, and in which the skim-milk treatment completely removed the sugar from the urine in thirty-five days, although the quantity voided for a long period prior to the commencement of the treatment was colossal, amounting to not less than thirty-five ounces daily, and sometimes exceeding this quantity. The patient was a master mariner in command of a small collier; he had spent the most of his life as a seaman, and endured all the hardships of this occupation; and unfortunately his constitution had been seriously injured by irregularities and intemperance.

This case is particularly interesting as being the one mentioned at p. 99 (as an example of the injurious action of fatty matter in diabetes), in which the administration of *new milk*, rich in cream, caused a return of the saccharine condition of the urine and of the disease after the patient had been more than a fortnight completely convalescent. The case, moreover, was the *third* in which the skim-milk treatment was applied, and the second in which it was strictly followed.

Case IV.—*Severe Case of Diabetes. Removal of the Sugar from the Urine in Thirty-five Days.*

J. K., a master mariner, æt 38 ; had been exposed to the severities of his occupation and addicted to intemperate and irregular habits while in port ; he had suffered from various attacks of illness, but in the interim between these had enjoyed moderately good health until two years prior to November, 1869, when he began to suffer from great languor and debility with great indisposition for work. In this condition he continued, without any other particular symptom, until eleven months previous to the above-mentioned date (the 19th of November), when he began to pass unusually large quantities of water daily, which he observed left a white stain on his dark cloth trousers. The quantity of urine kept increasing, and then great thirst set in about two months afterwards. Both these symptoms kept increasing in degree until seven months before he came under my observation on the 19th of November, 1869. At this period he was voiding daily twenty-seven pints of urine on an average; but occasionally the quantity exceeded thirty pints, and sometimes amounted to thirty-six pints; and this was exclusive of the amount he passed every night, involuntarily in bed, and which he believed exceeded three or four pints. At this time his urine was frequently examined by his medical attendant, and its specific gravity was found to range between 1035 and 1040.

Simultaneously with the excessive thirst and flow of urine the patient's appetite became so exceedingly voracious, as to be almost insatiable; so that, to appease it, he took daily enormous quantities of food, including two pounds of beef or mutton, eggs, puddings, bread, potatoes, tea, coffee, and also *from eight to ten pints of the best milk daily*, with large draughts of water. But, notwithstanding this excessive quantity of food consumed, he lost much flesh, and his weight suffered a diminution of two stone in a few months. His nights were very restless, and his sleep was short, disturbed, and broken—never longer than an hour and a half—with unquenchable thirst and a dry parched mouth; his skin was dry and unperspiring.

On the 19th of November when he consulted me, he complained of great feebleness and exhaustion, excessive thirst, a dry skin, sleeplessness, an insatiable appetite: the tongue was furred, the pulse feeble and frequent, and he had passed during the previous twenty-four hours twenty-seven pints of urine, which he had been in the habit of carefully measuring (exclusive of the quantity voided involuntarily in bed during the night). Of this urine he brought me a specimen, the specific gravity of which I found to be 1040, and from the examination and estimate I made, I found that he was passing not less than thirty-five ounces of sugar in the twenty-four hours. The patient, moreover, declared that the quantity of urine often greatly exceeded that of the previous day.

On returning home the patient was placed immediately on an exclusive skim-milk diet (all other food was strictly prohibited), consisting of six pints warmed and given at intervals during the twenty-four hours, and at the end of this period I ascertained that the quantity of urine had fallen to four and a half pints, of a specific gravity of 1040.

The following table shows the daily progress of the case as regards the quantity and specific gravity of the urine. The involuntary nocturnal micturitions ceased on the first night, and never returned, except on the nights of the 23rd and 24th of November to a slighter degree, when it will be observed there was a rise in the quantity of urine, and the patient was more restless than on the four previous nights, and altogether not quite so well. This I attributed to the very inclement and unfavourable weather then prevailing.

The patient slept soundly and uninterruptedly on the first night, and continued to do so subsequently except on the two nights just alluded to, and on a few other rare occasions.

It is necessary to mention that the patient was a very intelligent and ingenious man, and wrote a remarkably neat hand. I supplied him with reagents and apparatus including a urinometer, for the examination of his urine; so that, under my constant supervision, he accurately measured its *mean* daily quantity and specific gravity, and tested it for the presence of sugar. At the same time he kept a daily record, in a tabular form, of the result of his examinations, and with as much care and accuracy as he had been in the habit of keeping his ship's log. He kept a duplicate of this table for me, which I carefully compared with my own recorded observations to insure accuracy, and which is the one published below because of its containing appended *his own* remarks, showing the effect of the treatment on his general health. This renders it the more valuable and interesting. The table shows that, after the first day of the treatment, there was at first a sudden and then a gradual diminution in the specific gravity of the urine until the complete disappearance of the sugar at the end of thirty-four days (on December 24).[1] It will be observed that the daily quantity of urine fluctuated ; but this was due to the quantity of skim-milk taken daily, which the patient was allowed to vary from six to eight pints, according to inclination. In addition to this table the patient, at my request and with my assistance, drew up another showing the specific gravity of the urine at four different periods of the day while under the skim-milk treatment. A portion of this table I have given, with certain remarks pertaining to it, at pages 81 and 82, under the head of Pathology.

[1] I have already referred, at p. 175, to this rapid diminution of sugar in the urine in this case during the first three days of the treatment.

I shall only add with regard to these two tables, that they were shown by the patient to Dr. Wiltshire on the 3rd of January: an occasion to which I shall again refer.

Table showing the Daily Quantity and Specific Gravity of the Urine.

Date	Density	Quantity	Remarks	Date	Density	Quantity	Remarks
1869		pints		1869		pints	
Nov. 19	1040	27	No sleep.	Dec. 13	1013	5	Sleeping well,
20	1040	4½		14	1012	6	free from
21	1035	4½	Free from	15	1012	5	thirst and
22	1027	4½	thirst, and	16	1008	6	all lassitude
23	1028	6	sleeping	17	1010	6	and weari-
24	1030	6	well.	18	1008	6	ness of
25	1025	5		19	1010	5½	spirits, and
26	1025	5	Sleeping well,	20	1007	5	perspiring
27	1020	4½	and free	21	1007	5½	occasion-
28	1024	4½	from thirst.	22	1009	5½	ally.
29	1020	6		23	1008	6	
30	1020	6		24	1008	6	*Free from*
Dec. 1	1018	7	Sleeping well,	25	1008	6	*sugar.*
2	1016	5	and free	26	1008	6	
3	1018	6	from thirst.	27	1008	6	Sleeping well,
4	1014	6		28	1008	6	free from
5	1016	5½		29	1007	6	thirst, and
6	1014	5½	Sleeping well,	30	1008	6	perspiring
7	1014	6½	and free	31	1008	6	freely.
8	1020	7	from thirst	1870			
9	1024	3½	and all las-	Jan. 1	1008	6	Ditto.
10	1014	5	situde and	2	1008	5	
11	1012	5	weariness	3	1008	6	
12	1015	4½	of spirits.	4	1007	6	

In this case the urgent symptoms of the disease were rapidly subdued, so that by the 24th of December, when the last trace of sugar was removed from the urine, the patient was restored to a feeling of health and convalescence, although suffering from weakness incidental to the emaciation left behind by the disease. From the above date he continued to improve rapidly in strength, and was gaining weight up to the 3rd of January, when he was visited by Dr. A. Wiltshire[1] of London, who examined him very carefully, and inquired minutely into the history of his previous illness. Dr. Wiltshire found the patient free from every symptom of the disease, and, on testing his urine, could not detect the least trace of sugar. The patient, moreover, expressed himself quite contented and satisfied with the skim-milk diet under which he was then living, and of which he was taking eight pints daily.

This progressive improvement continued up to the 6th of January, when I tried an experiment which acted most injuriously. Dr. Wiltshire suggested that if the patient, now quite convalescent, took new milk containing the cream instead of skim-milk, in all probability he would gain weight and strength much more rapidly. At this period, although I had a strong impression that fatty substances are injurious in advanced diabetes, I had no certain data, derived from personal observation, to

[1] This patient was also examined at this time by the medical gentlemen in Sunderland, whose names are mentioned in connection with the preceding case.

guide me; consequently I put the suggestion into practice. The patient was now ordered to take, daily, four pints of new milk, with an equal quantity of skim-milk in the twenty-four hours, then six pints of new and two of skim-milk on the following day. Most unfortunately, the effect of this experiment was an immediate return of the saccharine condition of the urine, and, with it, the unequivocal symptoms of the disease. The new milk was continued for four days, and the urine, sugar, and other symptoms kept increasing, so as to leave no doubt on my mind as to the injurious operation of cream in consequence of the butter it contains.

The patient was now placed, a second time, on an exclusive skim-milk diet, when the sugar began to diminish, but a fortnight elapsed before it was again entirely removed from the urine, and the other symptoms completely subdued. This was effected on the 23rd of January, when the urine voided amounted to six pints of a specific gravity so low as 1005.

When the patient was a second time convalescent he was in a much weaker condition than before the relapse of the disease, and the emaciation had decidedly increased; nevertheless, he continued convalescent, and improved greatly in every respect up to the 19th of February, on which day his urine amounted to six pints, specific gravity 1009.

The following table shows the uniformly low density of the urine during this period; a specific gravity, however, which is not below the normal standard, when we make due allowance for the large quantity voided in consequence of a purely liquid diet, but much too low to be compatible with the presence of sugar.

Table showing the Daily Quantity and Specific Gravity of the Urine.

Date	Pints	Specific gravity	Date	Pints	Specific gravity
Jan. 23	6	1005	Feb. 6	7½	1007
24	6	1005	7	7	1006
25	6	1006	8	6½	1005
26	6	1007	9	6½	1006
27	7	1007	10	6½	1006
28	7	1006	11	6	1006
29	6	1010	12	6	1006
30	7	1007	13	7	1007
31	6½	1007	14	6½	1006
Feb. 1	7	1010	15	5½	1007
2	6	1007	16	6	1007
3, 4	No examination.		17	6	1008
			18	6	1010
5	5½	1007	19	6	1009

At this period, the 19th of February, the patient was doomed to another misfortune, which proved to be of a decisive character. The weather at this date was very severe, with cold, cutting, north-easterly winds blowing from the sea; so that, when taking a walk, he received a chill, and was seized with bronchitis and a congested condition of the posterior and inferior portion of the left lung, accompanied with bloody expectoration, great thirst, and fever; but, so far as I could discover, there was no consolidation of the lung, at least near its surface. Unfortunately, this pulmonary attack caused a return of sugar in the urine, but not to such an amount as was produced by the new milk on the previous occasion. The patient recovered from the acute stage of this attack, but a chronic bronchitis remained, attended with an occasional expectoration of blood. The strength of the patient was now much reduced, and in the beginning of March, after having lived on skim-milk exclusively for *fifteen weeks* (except on the four days when he had new milk), he was allowed one meal of beef-steak or mutton chop, with green vegetables, in addition to the skim-milk, and afterwards he took eggs at breakfast, and cow-heel or potted head at supper. But the sugar never again left the urine; and, although this change in the diet increased its quantity, it never reached a large amount. The urine ranged in quantity from five to six pints, and its specific gravity from 1020 to 1035.

But the patient's strength was gone, anasarca became developed from enfeebled action of the heart, and he died on the 19th of September following.

Although the result in this case was in the end unfortunate, it demonstrates, in a conclusive manner, the remarkable influence of skim-milk over diabetes. If, in the first instance, I had not caused a return of the disease by the administration of new milk when the patient was quite convalescent (and for this, I may mention, he blamed me ever afterwards); and if, in the second place, acute pulmonary disease had not been induced, by exposure to cold, at a period when the vital powers of the patient were too much reduced to enable him to throw off the affection, I feel convinced, from his condition in the beginning of January, that he would have been restored to health.

The disease had lasted at least two years without being controlled, and for a period of eleven months in its fully developed and most formidable condition, before the patient came under my observation. Therefore, I cannot help reflecting how very different the issue would have been if the treatment had been begun several months earlier (before it had inflicted such severe injury on the constitution of the patient), or in the previous spring or summer, when the weather was warm and genial, and when plenty of out-door exercise could have been taken with great advantage.

The following case was published in the 'Lancet' on the 23rd of October, 1869. I reproduce it here, in consequence of its being the first instance in which I tried the skim-milk treatment in diabetes, and because it possesses other points of interest. The patient was restored to a condition of health, but the disease was not eradicated; first, because it was impossible to get the patient—an ignorant man—to adhere strictly to rule, and, secondly, because the disease was probably too far advanced.

Case V.—*Diabetes mellitus; rapid Disappearance of the Symptoms, and Restoration of Health.*

J. H., aged thirty-one, a seaman, of temperate and regular habits, and always healthy until the commencement of his present illness, in the month of May, 1867, during a voyage from Rio Janeiro to Shanghai. It began with loss of sleep, great thirst, and a large flow of urine; the loss of sleep, accompanied with thirst at night, had been very distressing; he had never slept soundly since the above date.

At Shanghai he went into hospital for ten days, and was then told he was suffering from diabetes mellitus, but no dietetic treatment was recommended. Subsequently he sailed to various ports in China, and thence to New York, in May, 1868, having then suffered from the disease twelve months. After remaining here some time he visited some other transatlantic ports, and returned to Liverpool in the following October, and was paid off. He now come home to Sunderland, and after remaining a week, sailed to Hamburg, and then returned late in November, when he placed himself under the care of my friend, Mr. Francis, surgeon to the police.

On the 13th of December, I met Mr. Francis in consultation. At this date, nineteen months after the disease had fully developed itself, the patient was suffering from excessive thirst; inordinate appetite; dryness of the skin; a spongy, bleeding condition of the gums, with looseness of the teeth; great depression of spirits, and almost complete loss of sensation over the outer surfaces of both thighs; also, great impairment of vision. In addition to these symptoms he was passing daily, and had done so since the beginning of his illness, above *fifteen pints* of pale, straw-coloured urine, the specific gravity then being 1040.

While under Mr. Francis's treatment, during the three previous weeks, he was placed on a diet of butcher meat (from $1\frac{1}{2}$ lb. to 2 lbs. daily), with brown bread and new milk occasionally. In addition, two grains of opium were given nightly, and a preparation of iron thrice daily. No improvement took place; and on the 18th of December he was placed under my treatment in the Sunderland Infirmary, his condition on admission being that just described. No other disease could be detected. The tests of Trommer and Moore showed an abundance of sugar in the urine.

On admission, on the 18th of December, the patient was placed on a *skim-milk diet*; consisting of six pints daily, taken, previously warmed, at four meals, with an interval of four hours between each. *All other food was excluded.* Opium was prescribed in four-grain doses each night at bedtime; and one grain of sulphate of iron, and three grains of sulphate of quinine, in mixture, thrice daily.

The following table shows the results obtained as regards the quantity of urine daily voided and its specific gravity. The first line of the table indicates the state of the urine prior to the commencement of the treatment; the second, its condition at the end of the first *three* days.

Date	Daily quantity	Specific gravity	Date	Daily Quantity	Specific gravity
1868	pints		1869	pints	
Dec. 18	15	1040	Jan. 23	3½	1030
21	7	1043	24	4	1030
22	3½	1035	25	3½	1035
23	3½	1027	26	4	1040
24	5½	1018	27	4	1040
25	5	1030	28	4	1030
26	3	1038	29	4	1025
27	4	1027	30	4	1030
28	5	1021	31	3½	1025
29	4	1025	Feb. 1	3½	1018
30	4	1020	2	3	1020
31	4	1020	3	3	1020
1869			4	3	1020
Jan. 1	4	1020	5	3	1020
2	4½	1040	6	3½	1017
3	4½	1020	7	3¾	1028
4	4½	1020	8	3½	1015
5	4	1019	9	3½	1020
6	4½	1016	10	3	1020
7	4½	1019	11	3	1020
8	4	1020	12	4	1023
9	4	1020	13	3½	1027
10	3½	1019	14	4	1031
11	3¼	1018	15	3½	1026
12	4	1015	16	3½	1024
13	4	1024	17	3½	1030
14	4	1018	18	3	1025
15	4	1019	19	3½	1024
16	4½	1012	20	3½	1022
17	4½	1018	21	3½	1022
18	4½	1018	22	3½	1020
19	4½	1020	23	3	1040
20	3½	1017	24	3	1026
21	3¾	1016	25	3	1024
22	3	1027	26	3½	1020

The improvement of the patient's general health was quite as rapid and striking as that of the condition of the urine. On the second night he slept soundly, for the first time for nineteen months ; and each succeeding night brought with it prolonged refreshing sleep; the extreme thirst and voracity of appetite rapidly diminished; the skin became moist and perspiring at night; the state of the gums improved from day to day, the loss of sensation in the thighs diminished, and the eyesight grew gradually stronger.

On the 1st of January (fourteenth day of treatment) the condition of the patient was as follows:—Thirst *quite gone*, also the inordinate appetite, although he sometimes has a craving for solid food; his appetite is appeased by each meal of milk, though previously no amount of solid food satisfied the morbid craving which always troubled him. Gums very much improved and consolidated. Skin perspires freely at night and after each meal of warm milk. Sleep sound and prolonged. Anæsthesia on the surface of the thighs nearly gone. Mental depression greatly relieved. Sight very greatly improved; he can now read for more than an hour together, although previously this was impossible, because, as he says, so soon as he attempted, 'the words ran all together into blotches.' Bowels regular. *Four* pints of urine; specific gravity 1020. Weight 9 st. 2 lb.; having lost 2 st. 13 lb. since the commencement of his illness. He says he feels himself quite a new man.

Jan. 10th.—Progressing favourably; all the symptoms remaining at the date of the previous report rapidly diminishing. Quantity of urine during previous twenty-four hours $3\frac{1}{2}$ pints; specific gravity 1019; solid matter below $2\frac{3}{4}$ oz. The weather being dry and mild, he took a walk in the grounds for an hour on the two preceding days, and on each occasion returned fatigued, went to bed, and slept soundly for some time, and also perspired freely. Wishes to have more milk, but not at all thirsty.

It would be uselessly tedious to detail the daily progress of the patient from this period onwards. His general health rapidly and steadily improved up to Feb. 26th, where the table ends. Prior to this date he declared himself to be perfectly well, the only remaining effect of the disease being a looseness of his front teeth (one of which was extracted) from the previously diseased condition of the gums, now quite healed. All the symptoms referable to the nervous system — sleeplessness, greatly impaired vision, local anæsthesia, mental depression, muscular prostration, the thirst, dryness of skin, and inordinate appetite, all of which had produced intense suffering — had completely disappeared. In short, the presence of a small quantity of sugar in the urine alone remained to show that the disease was not eradicated.

The table demonstrates that the daily quantity of urine fell, from the very commencement of the treatment, from above 15 pints containing 22½ oz. of sugar; to 7 pints and 10½ oz. of sugar, in three days; and to 3½ pints, and less than 3½ oz. of sugar, in five days; and that, *with five exceptional occasions*, the quantity of the urine and its sugar steadily diminished up to the 21st of January, a month afterwards, when the amount was 3¾ pints, specific gravity 1016, and contained a little above an ounce of sugar; but on the 16th there was less than an ounce.

On the exceptional five days alluded to, and on some other occasions, I have since ascertained that the patient clandestinely indulged in other kinds of food (offered by other patients who chaffed him about his milk diet), and probably in spirits on New Year's Day, as the table shows that on the 2nd of January the urine was 4 pints, specific gravity 1040, and contained nearly 6 oz. of sugar.

As a desire was expressed for some solid food, I allowed 6 oz. of Dutch cheese in addition to the milk; but as this addition caused the quantity and specific gravity of the urine to rise steadily during the next six days, until the daily amount was 4 pints, specific gravity 1040, sugar $4\frac{3}{4}$ oz., it was discontinued. The milk alone was now persevered in for another month, during which it will be seen there was a marked and steady decrease in the quantity of sugar in the urine, subject to an occasional rise, which I attributed to secret indulgence in other kinds of food.

On the 26th of February the table ends; the quantity of urine was on that day $3\frac{1}{2}$ pints, specific gravity 1020, and the patient felt perfectly recovered, and without the slightest feeling of discomfort. Consequently the daily allowance of milk was reduced to 5 pints; and about half a pound of lean mutton or beef, with a moderate amount of cabbage or greens, was allowed for dinner. The effect of this was to raise the density of the urine to 1035, but without augmenting its quantity. This diet was continued and the opium withdrawn without any ill-effect. From this date the urine varied daily in quantity from $2\frac{1}{4}$ to $3\frac{1}{4}$ pints, and in density from 1030 to 1044, but at the same time it continued to deposit a copious quantity of lozenge-shaped crystals of uric acid.

On the 27th of April the patient was continuing well and improving in strength, having gained 4 lb. in weight. The quantity of urine was $2\frac{1}{2}$ pints, sp. gr. 1030. He was now dismissed with the injunction to continue the same diet for some months to come. I saw him frequently up to the 25th of September following, when he informed me he still continued well and had gained nearly a stone in weight since the date of admission into the Infirmary.

This case is an illustration of the extreme difficulty, or almost impossibility, of continuing the skim-milk treatment, rigidly and successfully, in hospital practice, amongst an ignorant class of men. No sooner was the patient relieved from his sufferings than he began to break through rules and to do his best to thwart the efforts made for his complete recovery.

I shall now direct attention to the two following cases to show how powerful an impression can be made on the disease, and how rapidly its most formidable symptoms can be relieved by the skim-milk treatment, even when it has reached its final stage, and when the condition of the patient is that rapidly approaching dissolution.

CASE VI.—*Diabetes of long standing; final stage; immediate relief and arrest of the disease.*

J. W., æt. 27 years, a draper's assistant, tall, and of fair complexion, had suffered from diabetes for more than two years, and from its more severe symptoms for more than twelve months.

On the 24th of June I visited the patient at his own house at Newcastle, and found him to be in the following condition:—Skin dry and parched, mouth parched, tongue denuded of epithelium, and preternaturally red; thirst intense and unquenchable; appetite voracious; extreme emaciation, so that he was reduced to a mere skeleton, with extreme debility; legs cold and very œdematous; pulse very feeble and frequent, 120 per minute; heart's impulse weak, but no valvular disease; no sound sleep at night for months past. Urine 20 pints, specific gravity 1040; it was loaded with sugar, but contained no albumen; he had never passed less than this quantity of urine daily for a considerable period; bowels regular, though occasionally constipated; the patient had been getting gradually worse; he had been under the treatment of a physician who had restricted his diet, but not very rigidly; he had been taking large quantities of butcher's-meat, and, as a stimulant, drank a bottle of claret daily. It appeared to me that he was approaching dissolution—almost moribund, so that I considered his case utterly hopeless, and much doubted whether any relief could be afforded.

The patient was at once placed under the skim-milk treatment, from six to eight pints being allowed daily; the quantity afterwards being raised to nine pints. The effect was instantaneous; during the next twenty-four hours he voided only seven pints of urine of a specific gravity of 1045. On the following morning he began to sleep, and continued to do so during the whole of the succeeding night, when he began to perspire freely; by this time the thirst had in a great measure subsided.

Next day (June 26), he was wonderfully relieved and greatly refreshed by the prolonged sound sleep he had enjoyed; his skin was perspiring, the thirst completely gone, his appetite was appeased; in short, he expressed himself free from suffering, and felt only the great debility attending the emaciation produced by the long continuance of the disease.

The urine on this day amounted to seven pints, having a specific gravity of 1038.

Three days afterwards (June 29), he was much improved in every respect, and dressed himself, and came down stairs; his urine was now reduced to five pints, of a specific gravity of 1035, and showing an enormous decrease in the quantity of sugar in so short a time.

The subjoined table shows the state of the urine during the first four weeks of the treatment. It will be observed that on the twenty-seventh day (July 21) the specific gravity of the urine had fallen so low as 1019, the quantity being seven pints, thus showing an enormous reduction in the quantity of sugar, and presenting a strong contrast with the previous condition on June 24.

Table showing the Daily Quantity and Specific Gravity of the Urine.

Date	Pints	Specific Gravity	Date	Pints	Specific Gravity
June 24	20	1040	July 8	7	1023
25	7	1045	9	—	—
26	7	1038	10	7	1026
27	6	1038	11	7	1024
28	5	1040	12	7	1026
29	5	1035	13	7	1024
30	6	1031	14	7	1024
July 1	6	1038	15	7	1022
2	7	1030	16	7	1023
3	6	1033	17	7	1022
4	6	1025	18	7	1023
5	7	1035	19	7	1024
6	6	1032	20	7	1023
7	7	1022	21	7	1019

During the whole of the period included in the table the patient continued to improve in health and strength, indeed all the symptons of the disease had vanished except the saccharine urine, the emaciation, and attendant debility; the anasarca of the lower extremities also completely subsided.

On July 22 he was allowed curd made from three extra pints of milk in addition to his previous allowance of skim-milk; and in the course of a fortnight later he was permitted a meal of beef or mutton and green vegetables and two light boiled eggs at breakfast; the quantity of skim-milk was now diminished to six pints daily, but the curd was continued.

The patient was removed into the country, and took much exercise in walking and driving in a pony phaeton; this he continued to do during the remainder of the summer and autumn; his strength and general health having been restored to a degree which could not have been anticipated. Sugar, however, continued to be present in the urine, but in such a moderate quantity as to indicate clearly that the disease existed in a subdued condition.

Unfortunately in this case the treatment was begun too late, and the constitution had been previously sapped by the malady; its ravages could not be effaced; the vitality or powers of nutrition of the body had been too much enfeebled to repair the wasted tissues and remove the emaciation and debility.

The patient lingered on without further improvement until his life was cut short by an attack of bronchitis on November 27 following. As it was, his sufferings had been removed and his life protracted for several months by the treatment.

The next case is an example of diabetes of many years' standing and in its last stage, the patient having been under treatment and a restricted diet for more than five years; he was a newspaper compositor residing in a large town in Lancashire. I never saw him, so that my knowledge of the case is entirely derived from a series of letters which he wrote to me, and from which the following is an abstract. They show that the patient was fully alive to the seriousness of his position, of which he gives a remarkably lucid and graphic description.

Case VII.—*Diabetes: final stage, remarkable improvement.*

'November 29, 1869.

'Sir,—I read in the "Lancet" of October 23 your treatment of diabetes mellitus by milk alone, and having lived exclusively on cabbage and all kinds of flesh meat from June 1864 to August 1869, when a complete disrelish for this diet took place, I went to the Isle of Man for rest, hoping that the change of air would restore me, and make my diet again serviceable to me and enable me to follow my work. I may state that during these five years I followed my employment as a newspaper compositor without being absent, except a week or so during each summer for rest and enjoyment. After being at the Isle of Man for nine weeks I returned far worse than I went, and gave myself up as having arrived at that stage of diabetes when recovery may be considered hopeless. At this time, the beginning of November, the "Lancet" of October 23 was shown to me, and I resolved to try the milk under medical sanction, and did so for eighteen days, when I abandoned it. When I commenced with the milk I was in a miserable condition, scarcely able to walk across the house, suffering from great costiveness, dry skin, and parched lips, and dryness of the mouth, with no appetite for food, but no great excess of water. The first day's milk gave me a pleasant motion (which before taking the milk had to be produced by a soap injection), and three days' continuance of the milk brought about a delightfully moist skin, a moist mouth, and profuse perspiration—such as I had not known for the previous five years. The milk was to me the most delicious food I had ever had, and was satisfying to a degree I never anticipated. But while it was everything that could be wished for in the way of delight in taking it, it did not appear to be in any way capable of attacking the disease in my case. The water increased, and the sugar did not seem likely to diminish ; and at the end of eighteen days, having lost three pounds in weight of flesh, and being anxious again to try the use of cabbage and beef, and wishing to get work (if ever I shall be able), I gave up the milk, thinking it would be unsuccessful in my case. I am now fifty-two years of age.'

This letter was accompanied with a request for advice, and enclosed a table showing the daily quantity and specific gravity of the urine, on the day previous to, and during the eighteen days of the milk treatment. This table showed that, prior to beginning the treatment, and when on a restricted meat diet and cabbage, he was voiding 3½ pints of urine daily of a specific gravity of 1035 ; that during the milk treatment it ranged from 4½ pints to 5 pints with a specific gravity varying from 1020 to 1025, thus showing a diminution in the quantity of sugar.

I explained to him *that the increase in the* *quantity of his urine was due solely to a purely liquid diet*, and that his loss of weight was attributable to his intestines containing less fæces, and his blood and tissues less sugar. I advised him to recommence the milk treatment, and gave him precise rules for his guidance.

On the 14th of December he wrote to me as follows:

'My condition is much improved since last Tuesday when I wrote to you; for the four days previous I had been trying an experiment of eating bread along with alum boiled in milk, but the result of this experiment was very bad. The dry skin returned, thirst, and a clammy and a dry mouth with great costiveness, accompanied by great weakness in the legs and thighs, along with a general coldness in the whole body. These diabetic symptoms are now disappearing; the mouth is now moist and free from all clamminess, the dry skin is gone, the thirst has entirely disappeared, and a genial warmth is now felt by me. The stiffness and coldness remain in the legs and thighs yet; the improvement not having been so great in those parts as it has been in other parts of the body. The same good result has followed a return to the milk as took place when I first adopted it, and I shall not be so ready to leave it off as I was on the first trial. The motions are now daily and pleasant. I weighed on Monday December 6 (the day before the skim-milk treatment was recommenced), and was then $65\frac{1}{4}$ pounds, having been 76 pounds September 17, thus showing a loss of 11 pounds from the latter date. I may mention that I have to get up stairs on my hands and knees, not being able to get up erect. I enclose two tables showing the condition of the urine; one during the four days eating bread along with 3 drachms of alum boiled in 4 pints of milk, and the other during the last seven days. You will see how rapidly the sugar increased in the four days, and how it has decreased in the last seven.' (In the former instance the urine rose to $5\frac{1}{2}$ pints, sp. gr. 1041; in the latter it fell to $4\frac{1}{4}$, sp. gr. 1028).

On the 21st of December the patient wrote as follows:—

'I am glad to be able to report to you an improvement in the legs and thighs, the coldness and numbness having diminished, particularly in the thighs, a little yet remaining in the calves of the legs. The warmth I feel all over the body has not reached the feet yet. I cannot get up stairs without pressing my hands on the stairs. I find the milk is doing much good in giving comfortableness and buoyancy to the general feeling of the body. The moist and pleasant mouth I have after taking so much milk very much surprises me, as milk has always been either strictly forbidden, or only allowed very sparingly, by the different medical gentlemen I have tried in the six years I have been struggling with the complaint.' The table of the urine for the week, accompanying this letter, showed the quantity to be from $5\frac{1}{4}$ to $5\frac{1}{2}$ pints, and the sp. gr. to range from 1025 to 1028.

The next letter, dated the 28th of December, was as follows:—

'I am very glad to be able to say that the end of the third week on the milk diet finds me much better than at the end of last week. There is an improvement in the legs, feet, and thighs, there being more warmth in them. The numbness in the calves of the legs has almost entirely disappeared, although the temperature has been very low here, and the weather very cold; had it been mild I do not doubt but that I should have been better than I am. My voice is much stronger than it was, and I can raise myself off a chair with greater ease than I could.'

The table sent with this letter showed the quantity of the urine to be the same as during the previous week, but the sp. gr. to be lower, and to range from 1025 to 1022.

On the 4th of January he wrote as follows:—

'I am happy to inform you that the end of the fourth week finds me improved in my general health, and that I have gained a little in physical strength, that is, I can walk with a firmer step, and am stronger on my legs and feet. I weighed yesterday (Monday) the same as a fortnight previous, namely, 65¼ lbs.; not having lost in weight is satisfactory. I still enjoy a very moist mouth and skin, and feel a comfortableness of frame which is very pleasant. I can rise from a chair a little better, and can get up stairs with less pressure of the hand than I could when I last wrote to you.'

The table accompanying this letter showed the condition of the urine to be the same as before, and a great regularity in the specific gravity.

In the next letter, dated the 11th of January, he said:—

'The fifth week, I am glad to write you, the continuance of the milk diet finds me in continued improvement in general health. There is a further gradual increase in strength of body and ability in walking, and there is also progress in the ability to get up stairs, less pressure on the hands being required. You will see by the appended table that the quantity and specific gravity of the urine remain stationary. I may add, that there is an improvement in the great impairment of vision, for I can now read with pleasure for more than an hour together. I have very few signs of diabetes remaining; the parched mouth, dry lips, dry skin, and great costiveness having disappeared, and I am only suffering now from the great weakness consequent on the complaint.'

The table on this occasion showed no change in the state of the urine.

On the 18th of January, at the end of the sixth week of the treatment, he described his condition as follows:—

'I am glad to be able to send you such an encouraging letter as this one is. I weighed yesterday (Monday), and I have gained 4 lb. in weight in the last fortnight. I now weigh $70\frac{1}{4}$ lb., having only weighed 65 lb. six weeks ago, when I commenced the milk diet. This is a very hopeful sign. You will see by the appended table that at last the sugar begins to give way, as yesterday's urine only reached in specific gravity 1019°. I must inform you that previous to your last letter the milk had only stood twelve hours, and sometimes only eight hours, but since your letter I have allowed it to stand twenty-four hours, and I now see the benefit. In strength I am much about the same as last week, but I hope to improve in this. The reduction in the sugar and the increase in flesh will stimulate me to persevere in the use of milk.'

I must mention that in the three last letters there was a strikingly marked improvement in the hand-writing of the patient, showing much greater strength and steadiness in the muscles of the hand and arm, as well as an increased control over them. The decrease in the specific gravity of the urine, mentioned in the last letter, is a circumstance of great interest, inasmuch as it was clearly due to the more careful separation of the cream from the milk, by allowing the latter to stand twenty-four hours before skimming it. This I had recommended in my letter to which he alludes; and I made the suggestion thinking that possibly this was a precaution which was not sufficiently attended to by the patient, and the neglect of which might account for the fact that there was no diminution in the sugar in the urine.

Nothing could have been more satisfactory than the remarkable improvement made by the patient under conditions so extremely desperate. Unfortunately, however, his next letter conveyed the intelligence that, in consequence of an attack of diarrhœa, he had been induced to abandon the skim-milk treatment; but by whose advice, or with what result, I have not been informed, as all correspondence between us ceased from this date. The case clearly shows the great superiority of skim-milk over a meat diet in the treatment of diabetes, and equally illustrates the vacillation of mind peculiar to those who have long been subject to this malady.

CHAPTER XII.

BRIGHT'S DISEASE—STRUCTURE OF THE KIDNEYS—THE CIRRHOTIC OR GOUTY KIDNEY—THE WAXY KIDNEY—THE FATTY KIDNEY; INFLAMMATORY STAGE—FATTY STAGE—TERMINATION IN ATROPHY—CONDITION OF THE BLOOD—HYDRÆMIA AND DROPSY—URÆMIA AND COMA—INFLAMMATION OF THE SEROUS MEMBRANES—HYPERTROPHY OF THE HEART—CAUSES OF THE DISEASE.

THE term Bright's Disease, as now understood, has a *generic* meaning, and includes different pathological conditions of the kidneys altogether distinct from each other in their origin, anatomical characters, and the phenomena with which they are associated. These pathological conditions are not produced by the introduction or developement of new and abnormal histological elements, but by the *morbid alteration* of the tissues of which the kidneys are composed: consequently, a correct knowledge of the different forms of Bright's disease is based on an accurate acquaintance with the structure or histology of these organs. To this subject, therefore, I shall briefly refer.

Exclusive of the nerves with which they are supplied, the kidneys are composed of three distinct structures, namely, of *tubules, lined with epithelium*, of *blood-vessels*, having a complex and peculiar arrangement, and of *a fibrous matrix*, forming a skeleton, by which the tubules and blood-vessels are bound together and held in position; the whole being surrounded by a firm membrane or capsule.

The tubules may properly be considered as involutions of the mucous membrane of the pelvis of the kidney, into which they open and discharge their secretion. When they are traced from their openings, seated on the papillæ, or apices of the cones or pyramids dipping into the pelvis, they are found to pursue a *direct* course through the medullary substance of the organ. In this straight course they divide and subdivide about ten times, and very generally in a *dichotomous* manner, and at an acute angle, the branches thus formed pursuing a parallel course. In this manner the *straight* tubules by their ramifications form the *cones* or *pyramids* of the *medullary* substance, beyond the periphery of which no further subdivision takes place. On arriving at this point—the bases of the pyramids—

the *ultimate* branches of the tubules begin to separate from each other, and to pursue a strongly *convoluted*, *tortuous* course, until each terminates in a large flask-like, spherical dilatation—the *malpighian corpuscle*; the *cortical* substance of the kidney is thus formed by the convoluted terminal branches and their globular extremities. The object of this tortuous arrangement evidently being to increase enormously the secreting surface of the gland. The walls of the tubules consist of a delicate, elastic, homogenous, basement membrane, lined with epithelium, which differs in its characters according to whether it invests the convoluted or straight portion of the tubules. In the *convoluted* tubules of the cortical substance, the epithelium is polygonal in shape, and *glandular* in character. It occupies about one-half of the diameter of the tubule, leaving the middle half free for the flow of liquid secretion. The office of these cells is evidently to secrete, or separate from the blood, the *solid excreta* of the urine; in their histological character, they closely resemble the glandular cells of other secreting organs. The convoluted tubules are, therefore, the proper glandular portion of the kidneys; their dilated extremities (containing the capillary tufts for the elimination of water) are destitute of lining epithelium, according to some authorities; but according to others[1] they are invested with a layer of the flattened tesselated variety. The straight and wider tubules, forming the medullary pyramids, are lined with flattened, or tesselated, epithelium, approaching, in character, to that investing the urinary passages. From this, it is evident that the straight tubules simply act as ducts, receiving the secretion of the convoluted, and pouring it into the pelvis of the organ.

In considering the blood-vessels of the kidney in a pathological point of view, I shall begin at a point where the branches of the renal artery, after having entered the cortical substance, ultimately ramify into *terminal twigs.* Each of these terminal vessels penetrates the *distal* extremity of a malpighian corpuscle, and is, therefore, termed an *afferent* vessel; within the corpuscle it divides into from five to eight branches, each of which subdivides into a tuft of capillaries, which are coiled and twisted together in various ways, but do not anastomose with each other. These capillaries form a dense rounded bunch or coil, which lies uncovered *in the interior* of the corpuscle; they again reunite,

[1] For a discussion of this question, see Kolliker's Human Microscopic Anatomy. Lond. 1860, p. 408.

and form a single, narrow vessel which makes its exit from the corpuscle, in proximity to the entering artery, and is, therefore, termed the *efferent* vessel. This efferent vessel is arterial in character, so that the relation between it and the afferent artery is not that subsisting between arteries and veins. It is interesting to observe that the arrangement of the minute vessels, forming the malpighian tufts, is such that the finest capillaries of the coil are *always* found in the locality where the corpuscle opens into the tubule, or, in other words, at the point where the latter commences.

There can be no doubt that, as was first pointed out by Mr. Bowman, the special function of the malpighian tufts of capillaries placed *within* the corpuscles which are continuous with the tubules, is to separate the water of the urine from the blood, for which purpose they are admirably contrived. To use the words of Mr. Bowman:[1] 'A large artery breaks up in a very direct manner into a number of minute branches (afferent vessels), each of which suddenly opens into an assemblage of vessels of far greater aggregate capacity than itself, and from which there is but one exit. Hence must arise a

[1] Todd and Bowman's Physiological Anatomy and Physiology of Man, vol. ii. p. 495.

very abrupt retardation of the current of blood. The vessels in which this delay occurs are uncovered by any structure. They lie bare in a cell, from which there is but one outlet.' The effect of the impediment to the flow of blood, by the mechanism thus described, through the coils of capillaries, is to produce a considerable lateral pressure on their walls, which pressure must cause the continuous escape of a considerable quantity of the water of the blood serum through the opposing membrane. But, as in the normal condition albumen does not pass out with the water, it is evident that these capillary walls must possess some structural condition or peculiarity, at present unexplained, which secures the retention of the one, and permits the escape of the other. Probably the retention of albumen is due to its *colloidal* character. But certain disturbing influences, or morbid conditions, increase the lateral pressure of the blood on the walls of the malpighian capillaries beyond a normal degree, and thus produce such an amount of distention that albumen escapes, and is found in the urine; in other words, blood serum escapes instead of water, and a little saline matter.

Such, then, is the arrangement and office of the capillary vessels of the malpighian tufts; the efferent vessels formed by their union (one for each tuft), after emerging from the corpuscles, break up into a fine, close, roundish angular, network of capillaries, which are everywhere distributed between the convoluted tubules, which they surround on all sides, and with which they are in contact. This network is continuous throughout the whole cortical substance of the organ. The capillaries supplying the medullary cones,which are not so vascular, are derived from the same source, but are larger and not so numerous; they follow a somewhat direct course amongst the straight tubules, and ramify only to a slight degree. In this manner is formed the *proper capillary system* of the kidneys; analogous to that of other glandular organs, and conveying the pabulum for the nutrition of their tissues and the materials for their proper secretion. It is needless to add, that the capillary network just described terminates in the venous radicals of the organ.

A careful study of the remarkable distribution and of the anatomical relations of the renal vessels, reveals the following peculiarities of great importance in a pathological point of view.

1. That the capillaries of the kidneys form two distinct sets: a *proximate* and a *distal.*

2. That the *proximate* capillaries—the malpighian

tufts—consist of a series of globular coils of *short non-anastomosing* vessels, each coil being placed *within* a dilated extremity of a uriniferous tubule, and terminating abruptly in a single narrow vessel.

3. That the *distal* capillaries are formed by the ramification and anastomosis of the narrow vessels in which the primary terminate, and are placed *outside* and *between* the uriniferous tubules.

4. That the whole of the blood of the renal artery must first pass through the proximate capillaries, where its flow is much impeded, before it enters the distal capillaries; and, consequently, any impediment to the circulation through the distal must immediately cause a damming back of the blood in the proximate vessels and mechanical distention of their walls.

I shall show, further on, that these peculiarities of the renal circulation have an important relation to the production of albuminuria.

The *matrix* or stroma of the kidney, in which the tubules and blood-vessels are embedded, and by which they are held in position, may be regarded as the skeleton or framework of the organ; it is composed of interlacing fibres of areolar tissue, and is more fully developed in the medullary than in the cortical substance; but on the surface of the latter it becomes considerably condensed, so as to assume a membranous form, and is loosely connected with the capsule enveloping the organ.

The capsule enveloping the kidney is a smooth, whitish, thin, but *firm* membrane of dense fibro-areolar tissue, with a network of numerous elastic fibres. The great firmness of this fibrous membrane gives it particular significance in relation to the albuminuria of Bright's disease, as I shall have occasion to point out.

Such, then, are the chief structural peculiarities of the kidneys; which require to be understood in order to investigate the different pathological conditions grouped under the designation of Bright's disease.

Pathological research and clinical observation, of late years, seem to have fully established that there are at least three distinct or typical forms of chronic renal affection included under the term Bright's disease: these being, 1, the *cirrhotic kidney*, 2, the *waxy kidney*, 3, the *fatty kidney*. Each form commencing in one of the three histological elements composing the organ, and ultimately destroying its normal structure. This classification of course excludes *mixed* cases, in which different forms are combined. I shall briefly advert to the two former of these diseased conditions, and then enter into a fuller description of the third and most common form, which is especially the subject of this essay.

Cirrhosis of the kidney is very generally associated with gouty or arthritic disease, and is produced unquestionably by the *materies morbi* of these affections. In some instances it has been found associated with lead poisoning, which, according to the observations of Dr. Garrod [1] and others, gives a proclivity to the development of gout. But it must be remembered, that this form of kidney disease occasionally occurs independently of gout or rheumatism.

The cirrhotic or gouty kidney essentially presents a morbid condition, or *hypertrophy of the connective tissue*, of which the *matrix* of the gland is composed; especially of its cortical substance, to which the disease is chiefly confined. This hypertrophy in the course of its development produces atrophy of the other tissues, especially of the convoluted tubules embedded in the matrix of the organ; and apparently in the same manner as disease of Glisson's capsule or cirrhosis of the liver causes atrophy, or wasting of its glandular structure.

As the disease progresses the kidneys gradually

[1] Garrod on Gout.

contract, and finally become much reduced in size and granular on their surfaces. The contraction and shrivelling which takes place, being at the expense of the cortical substance, which, in advanced cases, becomes reduced to a thin layer, or to a mere fraction of its normal diameter. There is *wasting of the gland cells*, but the tubules remain pervious to fluids, and the malpighian tufts retain the power of excreting water. The medullary cones are but slightly affected, though sometimes streaked by deposits of urate of soda.

The clinical features of this form of renal disease are not very prominent, though characteristic ; it is very generally a local manifestation of gout, or rheumatism of the gouty form, and is developed insidiously. The urine is seldom below, and frequently above, the natural quantity : it is of a pale colour, and of low specific gravity, and contains but few tube casts, which are hyaline, or granular, and sometimes fatty. *Albumen* is generally present in the urine, especially in the early stage of the disease, but in *small* quantity, and is frequently intermittent. In *exceptional* cases, complicated with dilatation of the right side of the heart, or with acute renal irritation from an attack of gout, albumen has been found abundantly.

Dropsy is occasionally absent altogether, though generally present, especially in the advanced stage of the affection; but it is usually very *slight* in degree when no cardiac complication exists, and there is no acute renal irritation. The dropsy generally consists in a slight swelling of the feet and ankles, and puffiness of the eyelids; it is, therefore, by no means a prominent symptom in cirrhosis of the kidney: a circumstance which can be explained by the fact, that the water of the urine is but seldom diminished, and that there is only a slight draining of albumen from the blood.

Although the disease *begins outside* the tubules in the tissue surrounding them, it *results* in the more or less complete destruction of the glandular or secreting tissue of the organ *within* them, so that *uræmia*, associated with disturbance of the nervous centres, is the inevitable consequence, if the affection runs its course; and, as might be anticipated, death from this cause, or *renal epileptic coma*, is much more frequent in this form of Bright's disease than in any other.

The waxy kidney is characterised by a peculiar *degeneration* of the small blood-vessels of the organ, attacking the capillaries of the malpighian tufts and small arteries, and inducing infiltration of the tubules, although it rarely affects their basement membrane or cell contents. This degeneration essentially consists in the normal tissues of the blood-vessels (the muscular especially) being *re-placed* by a pale, dimly translucent, waxy material, which is not prone to undergo decomposition, and resists the action of most re-agents; it undergoes characteristic changes of colour by the application of iodine, sulphuric acid, and certain colouring matters. In its chemical composition it is an albuminoid material probably deficient in alkali; and in its origin and developement it is dependent on chronic, exhausting diseases attended with cachexia, especially syphilis, scrofula, tuberculosis, caries of the bones, and chronic suppuration.

Waxy degeneration of the kidney is an exceedingly chronic affection, passing, by gradation, through three distinct stages. In the *first*, the blood-vessels *only* are affected, the organ itself not being altered in size, shape, or colour, nor is there any change in the relative size of the cortical substance and the medullary cones. In the *second* stage the organ is increased in size and weight, and its surface is pale and smooth; its medullary cones are normal, but its cortical substance is relatively increased and rendered dense, its colour and appearance being similar to white bees' wax. This alteration in size, density, and colour, is caused by degeneration of the capillaries of the malpighian tufts and small arteries, and the distention of a large proportion of the tubules, with a transparent material, of the same character as the hyaline tube-casts found in the urine in such cases, and produced by transudation of blood serum through the degenerated walls of the malpighian capillaries, and the coagulation of its fibrin. The *third* stage is one of atrophy. The surface of the kidney becomes uneven and granular, and the bulk of the organ is diminished; these changes being caused by wasting of the cortical substance and shrinking of its tubules: the malpighian corpuscles become large and prominent and closely approximated, and there is dilatation and thickening of the walls of the smaller arteries.

This form of renal disease becomes developed in persons who, for a lengthened period, have suffered from some wasting disease with its attendant cachexia, especially from those attended with exhausting discharges. It, therefore, becomes frequently superadded to constitutional syphilis, to phthisis, to scrofulous discharges, and to caries and necrosis of the bones.

The clinical history of the disease is of course much modified by the character of the primary affection to which it owes its origin. It is always attended with a greater or less degree of emaciation and debility, and the complexion is frequently sallow. There is great thirst, and the urine becomes excessive in quantity, in many instances, to such a degree as to simulate diabetes;[1] but it is of low

[1] Although it is not intended in the present work to enter into the history of Bright's Disease, I must not omit to remark, that Dr. Grainger Stewart has committed an error in his valuable monograph (A Practical Treatise on Bright's Diseases of the Kidneys, 1868, p. 90) in supposing that Dr. Harris of London was the first to recognise polyuria as a symptom of this disease. The honour, in short, belongs to Professor Christison, who, thirty years ago, (Tweedie's Library of Medicine, vol. iv. p. 243,) when writing on Diabetes Insipidus, shows that one form of this affection is undoubtedly a form of Bright's disease having all the clinical features, now recognised as characteristic of waxy degeneration of the kidneys. 'In the experience of the writer,' observes Professor Christison, 'it (the peculiar form of diabetes insipidus referred to) has been almost always referable in adults to one or other of those forms of organic disease of the kidney which have been usually considered as belonging to the generic affection, granular degeneration; and in the majority of instances where an inspection was made after death the kidneys were found much shrivelled, rugose, or roe-like on their surface, and with most of their cortical and much of their tubular structure destroyed. . . . It may be observed that, in frequent instances, where the kidneys were found extensively diseased, and where death evidently arose from one or other of the affections secondary to granular degeneration, the urine presented for a long period the characters described above, being from five to ten or even twelve pints in quantity, between 1004° and 1008° in density, slightly coagulable by heat and nitric acid, almost colourless, and deprived of one half or three fourths, or even more, of its urea.'

specific gravity, from 1005° to 1010°, and it is albuminous, and throws down a slight deposit which contains a small quantity of hyaline tube casts. There is only *slight* dropsy, which is confined to a little œdema of the feet and ankles, after exertion or after remaining in the sitting posture. In occasional instances, however, an inflammatory attack of the kidneys has supervened, the urine has become scanty, and highly albuminous though of low specific gravity, and general dropsy, and ascites have become developed, or life has been cut short by renal epileptic coma. Often, however, death results from the primary disease.

It is necessary to add, that waxy degeneration of the kidneys is generally accompanied by a similar condition of the liver, spleen, and intestines; the affections of the last-named organs producing intractable diarrhœa, often fatal.

Purely practical considerations have induced me thus briefly to describe the cirrhotic and waxy forms of chronic renal disease, of which neither albuminaria nor dropsy are prominent symptoms, except from causes which are exceptional, and extrinsic to the nature of these affections. In these two forms I have never tried skim-milk as a remedy; their treatment indeed must, in a great measure, be that of the primary diseases to which they owe their origin. In the fully developed gouty kidney the destruction of the glandular structure of the organ is so extensive and irreparable as to be altogether irremediable by therapeutic agencies; while the waxy affection is generally the consequent accompaniment of maladies which in their nature are essentially fatal. I shall, therefore, pass on to the consideration of the third form, which is *par excellence*, Bright's disease, and which commences in an inflammatory condition, acute or chronic, then passes into a stage of fatty transformation, and, lastly, into atrophy of the organ. The most prominent and characteristic features of this affection are *albuminuria* and *dropsy*. It is in this species of kidney disease that I have found the skim-milk treatment so extremely valuable.

In acute inflammation of the kidney there is vascular engorgement of the organ producing effusion of serum, and extravasation of blood from the over-distended capillaries of the malpighian tufts, into the tubules, so that a large proportion of them become blocked up by solid casts of coagulated fibrin, which cements together into one mass both the lining epithelium and the blood corpuscles which have escaped from the ruptured vessels. The epithelium is everywhere swollen and distends the tubules: it is also shed by a process of desquamation more or less rapid, but always replaced by a growth of new cells. The shed epithelium frequently accumulates in the tubules, and causes their further dissension. These changes produce relative enlargement of the cortical substance and increased weight of the kidney. The attack is generally ushered in by rigors and some amount of febrile disturbance.

The urine at this stage is scanty, of a bloody or smoky hue, highly albuminous (so that it becomes almost solid by boiling and the addition of nitric acid), and of varying specific gravity (below and above the normal standard); it deposits a copious dark-coloured sediment, abounding in casts dislodged from the tubules by the urine, and composed of epithelium and blood corpuscles cemented together by a fibrinous matrix; the deposit also contains free blood globules, and is rich in free epithetical cells shed by the tubules, and having a *granular* appearance.

The condition of both organs is similar, each being involved to a greater or less extent.

The rapid invasion of dropsy (*acute* or *inflammatory* dropsy as it is termed) is a very prominent symptom of the disease; the anasarca is general, and often accompanied with effusion into the serous cavities, especially the peritoneum, and into the lungs and pleural cavities producing *hydrothorax*, and it commences, not in the most dependent parts of the body, as in the chronic form, but in those offering least resistance to the escape of fluid; it is generally first observable in the scrotum, the eyelids, and face.

Acute renal inflammation often terminates in complete recovery. Frequently, however, it is fatal either from the intensity of the dropsy, or from uræmic coma, or from inflammation of the serous membranes. In some instances it passes into fatty degeneration of the kidneys, or, in other words, into Bright's disease.

Subacute, or chronic inflammation, produces the same morbid changes in the kidney as the acute, but much less intense in degree. The urine is not so scanty, it contains less blood and albumen, and fewer casts and epithelial cells; the dropsy is much more slowly developed, though it may ultimately become so general and intense as to *prove fatal*, and generally begins in the feet and ankles. Indeed, the chronic form of renal inflammation from the absence of constitutional disturbances and local distress often comes on so insidiously that its existence is not even suspected until swelling in the feet and ankles, gradually increasing upwards, and a little puffiness of the eyelids, cause attention to be directed to the urine. But it is this form which so frequently terminates in Bright's disease.

The inflammatory condition of the organ becomes gradually, and in some instances slowly, *transformed* into the stage of *fatty degeneration*, which produces the enlarged, pale, fatty kidney of Bright. In this stage the kidney is very much enlarged, and increased in weight; its capsule is readily separated, and its surface is smooth with occasional depressions, it is of a pale yellow colour, with a peculiar mottled appearance from the intermingling of some healthy tissue with the great mass of diseased. On a longitudinal section of the organ being made, the medullary cones generally present a healthy appearance, and no alteration in size. The cortical substance is observed to be greatly increased in diameter, and to have a pale yellowish white colour. This increased bulk and altered colour are produced by distention of the convoluted tubules, by the deposit and gradual accumulation of fatty matter within their lining, glandular, epithelial cells. This fatty matter is deposited in the shape of globules and granules of various sizes, and distends the cells to such a degree that many of them burst or fall to pieces, and their contents accumulate within the tubules, and block up their channel, so that the tubules, in their turn, become swollen and distended, and in some instances ruptured; the accumulation of fat within them being facilitated by their length and tortuous arrangement; the diseased epithelial cells and their débris are generally cemented together into casts by a fibrinous matrix. Under the microscope the tubules present an opaque black appearance. It is necessary to mention that the swollen tubules compress the *distal* capillaries distributed *between* and *around* them to such a degree that the circulation of the blood through these minute vessels is retarded and very greatly diminished; it is this condition which imparts to the surface and cortical substance of the enlarged fatty kidney its peculiar exsanguine appearance.

The whole of the tubules are never equally affected by fatty degeneration: in the worst cases some are left in a more or less healthy condition and capable of discharging their secreting function.

When the disease runs its full course, the stage of fatty enlargement is succeeded by atrophy; the size of the organ is considerably diminished; its surface becomes very uneven, numerous elevations alternating with depressions; and when a section is made, the cortical substance is observed to be wasted, this being effected by absorption and washing away by the urine of a large proportion of the fatty degenerated epithelium, and consequent shrivelling, atrophy and even closing of a large proportion of the tubules. The malpighian corpuscles are less conspicuous, many of them being reduced in size, the fibrous matrix is relatively increased, and the arteries are thickened and much more prominent. When the kidneys have reached this phase of disorganisation, they are no longer able to discharge their function, and death from uræmia is the usual result.

When fatty degeneration is established the urine becomes more abundant, much paler, and less albuminous than during the inflammatory period; it contains no blood corpuscles, nor granular epithelium, nor tubule-casts containing them; it throws down a light coloured, flocculent deposit, in which are found an abundance of tube-casts containing fat globules and granules (fatty casts), and some that are hyaline; also free epithelium loaded with fatty particles. The urine is still *highly albuminous*, this condition being *persistent* throughout the whole progress of the disease.

The specific gravity of the urine in this stage varies considerably, according to the extent to which the kidneys are involved, and the quantity of albumen. But when the density is low, notwithstanding the addition of albumen, and the urine at the same time is scanty, it indicates greatly diminished secretion of the solid urinary excreta and their consequent retention in the blood to a highly dangerous degree; so that, under such circumstances, the invasion of uræmic coma may be dreaded.

The morbid condition of the kidneys, just described, is productive of three exceedingly important conditions, which it is necessary to study separately, namely: 1. *Albuminaria.* 2. *Retention of water in the blood.* 3. *Retention of the solid excreta of the urine.*

Albuminuria is the earliest and most persistent symptom, being the last to disappear, even in cases terminating in complete recovery. It is not only a symptom of great interest pathologically, but the mechanism of its production, concerning which there has been much difference of opinion, supplies one of the most important indications of treatment in Bright's disease. In the inflammatory stage this symptom and the accompanying hæmorrhage are undoubtedly caused by the hyperæmia or active congestion of the vascular system of the organ, producing distention of the malpighian capillaries, and the escape of blood serum, and of blood through their walls; similar to what occurs in the inflammation of other parts, but with this difference that *the serum, instead* of accumulating in the surrounding tissues is, in consequence of the peculiar position of the vessels from which it escapes, poured into the tubules and discharged in the urine. I may add, that it is the peculiar position and arrangement of these vessels which cause hæmorrhage from them in renal inflammation. It is necessary to state that by the blocking up and distention of the tubules by solid fibrinous casts, and the pressure thereby exerted on the distal capillaries, passive congestion becomes superadded to the primary, active hyperæmia, so that the effusion and hæmorrhage give no relief to the distended malpighian vessels, and the albuminuria is maintained.

The albuminuria of the fatty stage, when blood corpuscles have disappeared from the urine, is produced by a mechanism similar, in character, to that which gives rise to dropsy, from obstruction of the venous circulation, as in heart disease. To understand this mechanism, it is necessary to bear in mind the anatomical relation subsisting between the tubules and capillaries and the capsule of the kidney, and to study carefully the manner in which this relation is disturbed by the morbid changes which have taken place in the organ.

Fatty degeneration of the kidneys is essentially a disease of the glandular epithelium of the convoluted tubules, which become swollen and distended by morbid accumulations. But the tubules are pent up in a *limited* space surrounded by the dense, fibrous, and remarkably firm capsule which yields very slowly and gradually to the internal pressure exerted on it by their increased bulk and solid consistence; the result being, that as room is not made for them with sufficient rapidity by the expansion of the capsule they become approximated, and press against each other so closely and firmly that the whole of the *distal*, or proper, capillaries of the organ, distributed everywhere *between and around* them, become so squeezed and compressed that there is no longer a free, healthy flow of blood through these vessels, but instead, there becomes established a permanent mechanical obstruction, more or less intense, to the onward passage of the blood out of the *proximate* or malpighian capillaries, and in consequence it becomes dammed back in them, and distends their walls to such a degree that a portion of the blood serum escapes with the water of the urine, and thus albuminuria becomes permanently established. Exactly the same process takes place in dropsy from mechanical impediment to the venous circulation, as in anasarca from heart disease, or in ascites, from cirrhosis of the liver; with this difference only, that in these instances the effused serum accumulates in the areolar tissue or in a serous cavity, instead of escaping from the body.

It is necessary to add that the compressing action of the swollen tubules on the capillaries between them is favoured by the feebleness of the circulation in these vessels; its force having been broken immediately *behind* them by the retardation of the blood in the malpighian tufts. The capillaries of the malpighian tufts are shielded from the compression of the distended tubules, first: because they are seated *within* the dilated globular extremities of the tubules themselves; secondly: because they are short non-anastomosing vessels twisted and coiled into spherical masses; and thirdly: because they are next to the arteries, and are thus kept distended by the systolic force of the heart's action, which powerfully counteracts the influence of external pressure on their surfaces.

Retention of water in the blood, causing a scanty secretion of urine, is due to the same agency as the albuminuria, namely distention of the tubules, and obstruction to the circulation through the renal capillary plexus.

It has been calculated by Brown Séquard[1] that in the healthy adult the quantity of blood passing through the kidneys reaches the enormous amount of 2,000 pounds per diem. Each portion of the blood loses a portion of its water in its retarded passage through the capillaries of the malpighian tufts. It is, therefore, evident that the *absolute* quantity of water escaping from these vessels during a definite period must be in a *direct* ratio to the whole amount of blood which has circulated through them. Consequently, when the quantity of this blood is greatly diminished by obstruction of the capillaries immediately in front of them, the water secreted by the kidneys daily must be proportionately reduced. It follows therefore that the degree of scantiness of the urine is a certain index of the degree of renal capillary obstruction existing in any given case.

The deficient secretion and consequent retention in the blood of the solid constituents of the urine, *or uræmia*, in this disease, is a fact too well established to require further illustration. It is a con-

[1] Journal de la Physiolog. tom. i. p. 335, 1858.

dition attributable to the combined operation of two causes, namely: the diseased state of the glandular epithelial cells of the kidneys, rendering them incapable of performing their proper function: and the greatly diminished circulation through the proper renal capillaries; it is these vessels which, in the healthy state, convey to the secreting cells of the tubules the materials for their secretion. It follows, therefore, that when these materials, the solids of the urine, are conveyed into the kidneys in quantity much reduced below the normal standard, in consequence of a greatly reduced flow of blood through these organs, they must necessarily accumulate in the blood; especially when the greater proportion of the secreting cells have lost their functional activity. This accumulation, however, is in many instances retarded by dropsical effusions and vicarious discharges from the intestines.

The morbid changes produced in the blood by the conditions just described deserve the most careful consideration; inasmuch as it is to these alterations that a fatal termination of the disease is to be ascribed in almost every instance.

The persistent drain of albumen from and the retention of water in the blood, by destroying the normal relative proportion of its ingredients, seriously alter its physical characters, and impair its vital properties. Thus the proportion of albumen is very greatly diminished, and that of water as greatly increased; so that the specific gravity of the blood serum falls from its normal degree of 1028° or 1030° to so low, even, as 1018,° as has been ascertained by Professor Christison.[1] Dr. Babington[2] found the albumen reduced from 65 to 69, its normal proportion in healthy blood, to so low as 16 parts in 1,000. The quantity of blood corpuscles also invariably undergoes a great and rapid diminution in consequence of the *hydræmic* and probably *uræmic* condition of the blood. Hence the peculiar pale, pasty, anæmic appearance presented by those suffering from Bright's disease. In short, the solid constituents of the blood are in many instances reduced from 100 or 102, their normal proportion, to so low as even 61 in 1000 parts; it thus loses much of its *colloidal* character, and its water, containing dissolved albumen and salts, transudes through the walls of the blood-vessels, the process being favoured by an impediment to the capillary circulation and vascular plethora. But, it must be observed, that the degree to which the blood suffers

[1] Tweedie's Library of Medicine, vol. iv. p. 282.

[2] Quoted by Sir Thomas Watson, Lect. on the Pract. of Phys. vol. ii. p. 677, 4th ed.

in the manner described is always in proportion to the loss of albumen and the scantiness of the urine.

The first and most important effect, therefore, of the hydræmic condition of the blood, and of its deteriorated vital properties—the latter impairing the *vis-à-fronte* force of the circulation in the capillaries—is *dropsy*, which, in some instances, is rapidly, and in others slowly, developed; and in severe cases becomes general, and is often fatal by producing œdema of the lungs and hydrothorax. It is a very persistent and intractable symptom when the urine continues highly albuminous and at the same time scanty, as might be anticipated from the effect of these two conditions of the blood.

Blood poisoning, or *uræmia*, from retention of the solid urinary excreta in the blood, is an invariable accompaniment of Bright's disease; and when it becomes intensified beyond a certain degree, it constitutes an exceedingly dangerous condition: it is then apt to attack the brain and produce coma usually accompanied with convulsions—*renal epileptic coma*—which is either suddenly, or gradually, developed, and is extremely fatal. Indeed, death from this cause occurs in a large proportion of fatal cases, and may be considered as the most frequent of the natural terminations of the disease.

Uræmic coma is generally associated with a great diminution, or suppression, of the urine; but it appears to be less frequent in cases in which the dropsical effusion is considerable; the explanation being, that in these instances the urinary poison is withdrawn from the blood, and its accumulation prevented by the fluid effusion, in which, certainly, urea can be detected. In cases fatal from this kind of coma, no morbid alteration can be detected in the brain, which generally presents an anæmic appearance. Much difference of opinion has prevailed as to which constituent of the urine, or to what particular poison, the coma is due; as yet, however, this question remains undecided.

Inflammation of the serous membranes, of a very dangerous and fatal character, is a frequent occurrence, especially in the earlier, or inflammatory stage of the disease, although it occurs later; and it appears to result from the impure, uræmic condition of the blood. Of the serous membranes the pleura is much more frequently attacked than the peritoneum, and the latter more so than the pericardium.[1]

[1] Dr. Grainger Stewart found amongst his cases 14 per cent. of pleurisy and 7 per cent of pericarditis, but none of peritonitis (Practical Treatise on Bright's Diseases of the Kidneys, p. 45). The

Hypertrophy of the heart is another consequence of Bright's disease, and was first recognised as such by Dr. Bright, who discovered that, in a considerable proportion of cases of chronic renal disease, there was hypertrophy of the heart, unconnected with valvular disease, or arterial obstruction, or any other visible impediment to the circulation whatever. The observations of Dr. Bright on this subject have been fully confirmed by subsequent investigation. Nearly all are agreed that this peculiar cardiac affection is the result of *impeded* circulation through the systemic capillaries, eliciting more forcible action of the heart, resulting in its increased muscular development. But, at the same time, there is considerable variety of opinion as to the exact cause of the capillary obstruction. Several pathologists attribute it *solely* to blood impurity from retention of the urinary excrement. Most probably, however, it is produced by the *combined* influence both of uræmia and hydræmia, impairing the vitality of the blood, and disturbing the normal relation between it and the tissues to so great a degree as to considerably weaken the *vis-à-fronte* force of the circulation, which, in the normal con-

order I have given in the text is that which has been found to prevail by Frerichs and Rosenstein in their important works on renal diseases.

dition, expedites the transit of the blood through the capillaries. But Sir Thomas Watson [1] expresses the opinion that the cardiac hypertrophy is simply the result of anæmia.

The great prevalence of hypertrophy of the heart as a consequence of Bright's disease has received important illustration from the recent researches of Dr. Grainger Stewart,[2] who has shown that the frequency of the cardiac affection, in this form of the renal malady, is in *direct* ratio to the *duration* of the latter. Thus, in twenty-seven fatal cases examined in the Edinburgh Royal Infirmary, he found hypertrophy of the heart of *purely renal origin* present in forty per cent. Further, on tracing the exact relation subsisting between the cardiac affection and different stages of the renal disease, he discovered that it occurred in 12 per cent. of the cases fatal in the first stage; in 38 per cent. fatal in the second; and in no less than 100 per cent. in those who died in the third. It would, therefore, appear that cardiac hypertrophy is developed in every case which survives until the final stage has been reached. It appears also from the researches of the same pathologist, that when the

[1] Lectures on the Practice of Physic, vol. ii. p. 683, 4th edit.
[2] Op. Cit. p. 41.

inflammatory form of Bright's disease is *casually* complicated with valvular disease and *consequent* hypertrophy of the heart, the patient never survives until the final stage of the renal affection is developed.

With regard to the *causes* of the fatty form of Bright's disease, resulting from inflammation, it is *unlike* the gouty and waxy species in not being associated with any morbid diathesis or cachectic condition. This peculiarity, indeed, was remarked by Dr. Bright himself, who states that according to his observation the instances in which the affection is associated with phthisis or any other form of tubercular or scrofulous disease, are extremely rare. But although this is certainly an important clinical feature of the malady, and notwithstanding it very often attacks robust subjects, free from every species of constitutional taint; it is, nevertheless, highly probable, nay, almost certain, that in every instance it is produced by a *materies morbi* circulating in the blood, or by some special impurity of that fluid, in the elimination of which the kidneys become involved in a condition of inflammation.

The peculiar origin of the disease points to this cause. Thus, we know that owing to interference with the action of the skin, it is often developed in an acute and severe form (seldom advancing beyond the first stage), by the poison of scarlet fever, while cases, subacute or chronic at the outset, as a very general rule, originate from exposure to cold or wet. Acute cases, too, are engendered by the same cause. The common history of the disease in adults is, that its symptoms make their appearance shortly after exposure to wet or cold. The vast majority of such cases owe their origin to no other detectable cause. These facts strongly indicate that the *materies morbi* or poison is of a character which gives it a strong tendency to be eliminated by the skin.

The disease is much more frequent in males than in females, and in adults of both sexes than in children. The greater proneness of men being due to their occupations and habits, which expose them more to vicissitudes of temperature, and to indulgence in eating and drinking, which, especially if associated with sedentary habits, engenders blood impurities, giving a strong proclivity to visceral inflammations on exposure to cold or damp. When Bright's disease becomes developed in children, it is generally the sequence of the renal inflammation following scarlet fever.

CHAPTER XIII.

THE SKIM-MILK TREATMENT OF BRIGHT'S DISEASE.

From the description given in the preceding chapter, it will be observed that the species of renal affection which is, properly speaking, Bright's disease—beginning in an inflammatory condition, acute or chronic, passing into fatty degeneration and enlargement of the kidneys, and in which a scanty, highly albuminous condition of the urine associated with dropsy, more or less general, are prominent symptoms—is, in cases not casually complicated, essentially a *primary* affection and not, like the other forms of so-called Bright's disease, consequent on and the result of previously existing, chronic, wasting maladies or cachexias. It is on account of this *specific* difference, that it is much more amenable to treatment than any of these other forms: even although known to be a very intractable and fatal malady. It is, moreover, in this species of renal affection that I have prescribed the Skim-milk Treatment with such remarkable success. A success which, to say the least, has convinced me that when the disease has lasted a considerable period, and assumed its confirmed chronic condition with a gradual increase of its symptoms in spite of remedial measures, this is the only treatment on which any reliance can be placed, or which offers a reasonable chance of recovery. Not only is this so, but I consider myself justified, by an experience now extending over a large number of cases in every stage, in stating that the disease can be cured in the vast majority of instances, provided the treatment has not been delayed until the third stage of atrophy, or of irreparable destruction of the kidneys has begun. But even then much good can be done and much suffering alleviated. I have now seen cures effected under such desperate and apparently hopeless circumstances, that I will even go the length of unhesitatingly stating that in the skim-milk treatment of Bright's disease, *rigidly and properly administered*, we possess a remedy of such extreme potency, that almost every uncomplicated case can be cured, if the treatment is commenced even so late as the early period of the second stage and the constitution of the patient is moderately good; and this is almost equivalent to declaring that scarcely any one should die of this affection, inasmuch as its symptoms are *always palpably* *manifest*, and indeed frequently so severe, that death, by dropsy and other conspicuous causes ensues, before the first stage is far advanced. Consequently, there is not the same valid excuse for not beginning an efficient method of treatment sufficiently early to insure recovery, as there is in several other affections whose symptoms are at first so equivocal and obscure as to escape detection until it is too late to save life. It must not be inferred from what I have just stated, that a cure will not be effected at even a later period of the disease. I have seen cases recover in which the second stage was undoubtedly far advanced; but of course the chances of recovery diminish in proportion to the duration of this stage of fatty degeneration, and when irreparable destruction of the kidneys, or atrophy, is established it would be folly to say that the disease can be cured.

When a patient suffering from this disease associated with severe general dropsy and highly albuminous, scanty urine, and whose pale, pasty, anæmic countenance betrays too surely the extent to which his blood has been thinned and deprived of its essential and highly vitalised constituents, is placed under the skim-milk treatment, and its curative action is the result, the following are the changes which are effected.

In the first place, a powerful diuretic action is produced, so that in the course of a few hours there is a considerably increased discharge of urine, which continues augmenting until at the end of the second or third day, when a quantity is voided as large or even larger than that of the milk consumed, so that if 6 pints of skim-milk are taken during the twenty-four hours, the quantity of urine passed during the same period will range from 6 to 8 pints, or even more; and I may mention that, as a general rule, the more intense the dropsy the greater the diuretic effect produced, and the greater the excess of urine over the quantity of skim-milk ingested. This profuse diuresis continues until the dropsy has nearly subsided, when it gradually diminishes until the latter has disappeared, when the daily quantity of urine falls to about 1½ or 2 pints below the daily allowance of skim-milk; and this relation between the two fluids continues from day to day so long as the skim-milk treatment is strictly adhered to. It is necessary to observe, that the surplus water of the skim-milk is accounted for by the quantity daily exhaled by the lungs and skin. Diaphoresis to a greater or less degree is the usual accompaniment of the increased flow of urine.

During the diuretic action of the treatment the specific gravity of the urine ranges from 1008° to 1012°, and always bears a direct relation to the quantity of the urine. When, however, the urine falls considerably in quantity, after the disappearance of the dropsy, there is a considerable rise in its specific gravity, and it regains its natural colour. The albuminuria, after the commencement of the treatment, becomes greatly diminished ; there being both a relative and an absolute diminution of the albumen, and a progressive reduction continues, until it finally disappears from the urine. But in old standing cases a considerable period is frequently required to effect a serious reduction in the quantity of the albumen. Under any circumstances the albuminaria is the last symptom to disappear ; so that it sometimes continues, though in greatly reduced and diminishing quantity, for weeks or even months after the kidneys have apparently regained, in other respects, their healthy condition, and are performing their secreting function vigorously, and every other trace of the disease has disappeared. The persistence of this symptom under such circumstances, appears to me to be attributable to the long continued distention to which, in protracted chronic cases, the walls of the malpighian capillaries have been subjected ; and which has the effect of altering or impairing their delicate structure (which in the healthy state permits the escape of water only) to such a degree that a long period is necessary to enable them to regain their normal condition; so that, in the meantime, some albumen escapes with the water of the urine, even although every other structure of the organs may be perfectly healthy, and no impediment exist to their capillary circulation.

So soon as the diuretic action of the skim-milk is fairly established, the dropsy begins to subside and continues to decrease rapidly until it finally disappears; the time required for its complete removal being from five days to two or three weeks, or even more. In recent cases, and sometimes even in those of long duration, it vanishes with a rapidity truly astonishing; but generally in old standing, confirmed instances, a longer period is required, and a little swelling of the feet and ankles continues for a few weeks after the general anasarca and ascites have completely disappeared. No better illustrations could be given of the remarkable power of the skim-milk treatment over renal dropsy than *Cases* I. and III., to be recorded further on; in the latter case (that of W. M.), treated under my care in the Sunderland Infirmary, the dropsy was so urgent as to threaten the immediate destruction of life; yet no less than 24 lbs. of dropsical fluid were removed in nine days. I shall, further on, refer to other examples equally conclusive. I may add, that so powerful is the action of the treatment in this respect, that in every instance which has come under my own observation, the dropsy has been removed, and although in some instances treated at too late a period of the disease to insure recovery, or from indiscretions of the patient, the dropsy has reappeared to a greater or less extent, yet *in not a single instance* has it proved fatal or become uncontrollable.

From these observations it will be perceived that the effect of the skim-milk treatment, when timely applied, is to produce immediate and profuse diuresis, generally attended with diaphoresis, rapid removal of the dropsy, and, at first, a great diminution, followed by the gradual and complete disappearance, of the albuminuria. These important results are followed by recovery of the patient; the pale, pasty and puffy countenance gives way to a clear or ruddy complexion, accompanied with a restoration of health and strength. Consequently, the question naturally presents itself: to what influences are we to attribute such extremely important results from a remedy which, to all appearances, is so exceedingly simple? Now, I shall endeavour to answer this question by giving the following explanation, based on the pathological conditions pertaining to the disease already described :—

The therapeutic action of skim-milk in Bright's disease is dependent on the morbid condition of the blood, which it restores to its normal condition. This is the initial change, from which all the others follow as consequent effects.

When a patient, suffering from this affection and severe general dropsy, and whose blood is reduced to the condition described in the preceding chapter (hydræmic, and its serum of a specific gravity of 1018° or 1020°, and far below the normal standard from the retention of water and the loss of albumen and salts, together with great destruction of red corpuscles), begins to consume daily from 6 to 8 pints of skim-milk—rich in albumen, easily assimilated, and the salts which the blood has lost, and having moreover a specific gravity of from 1035° to 1040°—the greater portion of which is absorbed into the blood, the immediate and invariable effect is to restore the lost albumen and salts to the blood, and to raise the specific gravity of its serum to the natural standard, *and greatly above that of the* *dropsical fluid accumulated outside the vascular system.*

Not only is the specific gravity of the blood serum increased by the accession of the solid matter, but the sudden influx of so large a quantity of fluid, greatly augments the volume of the blood, so that a plethora of the vascular system is produced. But this plethora cannot now be relieved by the transudation of a portion of the blood serum through the walls of the blood-vessels, so as to augment the dropsy, this being effectually prevented by the laws which regulate the force of *osmosis*, and the result is that the *intra*-vascular pressure, thus engendered, excites profuse diuresis, by which the tension of the vascular system is relieved. But as the large quantity of urine voided has a specific gravity of only 1008°, or 1012° at the outside, the withdrawal of so much water raises the density of the blood serum still higher, and *endosmosis* of the dropsical fluid, already begun, into the blood is established, and, as this continually progresses as the administration and absorption of skim-milk continues, a constant vascular plethora is maintained, and the profuse flow of urine becomes continuous. It will, therefore, be observed that the first effect of the skim-milk is to raise the density of the blood serum, and thus prevent its further escape from the vessels to augment the dropsy; that the second is profuse diuresis; and the third is the setting in motion the physical force of osmosis, which produces the absorption of the dropsical effusion, and its ultimate discharge from the system by the urine, the last fluid to be absorbed, being that in the most dependent parts—the feet and the ankles—probably in consequence of its containing more albumen.

But the continuous diuresis excited as a secondary effect of the treatment, produces, in its turn, very important salutary changes in the condition of the kidneys; changes, indeed, which lead the way to a restoration of the normal structure of these organs. The immediate effect of a profuse flow of urine is to flush the obstructed, dilated tubules, and to wash out of them the solid casts and accumulated morbid products and débris of the diseased epithelium, with which they are blocked up and distended, so that, being emptied, they regain their normal calibre by the resiliency of their elastic walls; the pressure they have so long exerted on the network of the capillaries distributed between them, and the consequent obstruction to the flow of blood through these vessels is thus withdrawn, the circulation of the organs is gradually re-established, and the blood, being no longer dammed back in the malpighian capillaries, these vessels are relieved from distension, and albumen gradually ceases to escape from them with the water of the urine.

A little reflection will at once show that all these effects are produced by one and the same cause, namely diuresis. Thus it is clearly impossible for 6 or 8 pints of urine to pass daily through the kidneys for several days in succession, without the blocked up and distended tubules being completely washed out and cleansed of all solid accumulations; it is equally impossible for the tubules to be thus emptied without their distension being removed; it is impossible to remove their distension without relieving the pressure they exerted on the intervening *distal* capillaries; and it is impossible to withdraw this external pressure from these vessels without permitting the free flow of blood through them out of the *proximate* malpighian capillaries, and thus remove from the latter the cause of distension which produces the albuminuria.

When the normal circulation of the kidneys has been re-established, under the influence of the skim-milk treatment, it is no longer a watery, depraved blood, of deteriorated vital properties, which flows through them, but a healthy, nutrient fluid which, by the agency of the remedy, has regained its normal composition and recovered its vital power. Consequently a healthy nutrition takes the place of the diseased, and healthy glandular epithelium is developed to replace the previous morbid, degenerated tissue, and the secreting function of the organs is again restored, and the excrement of the body removed.

It will appear from the explanation just given, that the powerfully diuretic action of skim-milk in the dropsy of Bright's disease is produced by the restoration of the lost solid constituents of the blood, and the increase thereby effected in the density of the blood serum; the effect of this altered or improved condition of the blood being to put a purely physical force into operation in it. This interpretation, the legitimacy of which is quite obvious, enables us to understand why diuresis almost always attends this treatment of the disease, and why it is so profuse, the urine often *exceeding* the measure of the fluid ingesta. Indeed, no other known remedy is nearly so certain, or so potent, under the circumstances, in producing this desirable effect, and consequently no other remedy possesses such a remarkable control over the dropsy. In addition to the cases, already referred to, I shall, in the present place, cite two other illustrations of this remarkable influence; in one the disease was in its first stage, in the other considerably advanced, so that fatty degeneration of the kidneys had become established.

The first was a case which I saw recently in consultation with Dr. W. O. Lambert, of Sunderland. The patient, who was the master of a screw steamer, while in Hamburg was exposed to cold after taking a Turkish bath, and soon after his legs and face became puffy and swollen, and his urine very scanty and high-coloured. A fortnight after this latter event, he arrived in Sunderland, suffering from intense general dropsy and ascites, which had increased gradually; he had now much difficulty in breathing, and inability to lie down in bed, owing to a sense of suffocation; œdema of the lungs and hydrothorax were setting in, and death from asphyxia impending. The urine was very scanty, not exceeding half-a-pint in the twenty-four hours; it was high-coloured, and became nearly solid, from the abundance of albumen, when treated with heat and nitric acid. The patient was immediately placed under the skim-milk treatment; on the first day he took 6 pints, and afterwards 8 pints daily. The quantity of urine suddenly increased, so that at the end of the third day of the treatment he voided no less than *twelve pints* of urine, having a specific gravity of 1008°; on the fourth day he passed 11 pints, and on the fifth $10\frac{1}{2}$ pints, and containing very little albumen.

On the third day of the treatment the dropsy had in a great measure subsided, and on the fifth day it was entirely gone, and the albumen now produced a mere cloudiness in the urine. At the end of nine days the albumen had entirely disappeared, and the patient was perfectly recovered and able to leave the house. How effectually, in this case, must the large flood of urine have washed away the solid fibrinous casts and accumulated epithelium, which distended the tubules, and obstructed the renal capillary circulation. I may add that in this case the diuretic action was attended with diaphoresis.

In the second case the disease was of nearly *four months*' duration, fully confirmed, and of a severe, intractable character; it was caused by exposure to rain while on horseback and riding in wet clothes. The patient was a member of parliament for a southern constituency, young, previously healthy, temperate, and free from any constitutional taint. The disease was of a chronic character from the beginning, and commenced with the usual symptoms, namely: scanty, dark-coloured, and highly albuminous urine, and dropsy beginning in the feet and ankles, gradually increasing and ultimately becoming general and severe. Unfortunately the malady was aggravated at the commencement by the injudicious administration of turpentine. After the disease was fully developed, the patient removed to London, to obtain further medical advice, and availed himself of the professional skill of a distinguished London physician, of great knowledge and extensive experience in renal affections, who attended him in consultation with a surgeon for a period of two months, and during this time prescribed in turn almost every remedy, both diaphoric and diuretic, including amongst the latter the external application of digitalis to the abdomen by means of a poultice. But all these measures completely failed to make any impression, or to increase the quantity or improve the quality of the urine; and unfortunately the dropsy kept increasing, and the condition of the patient progressed from bad to worse; until at last it was deemed expedient to have recourse to tapping, which was performed by a puncture above each ankle, and a considerable quantity of the dropsical fluid withdrawn; but the relief was only temporary and palliative; no increase in quantity or improvement in the condition of the urine, or any amelioration whatever of the disease, followed the operation. It will be observed, therefore, that, so far as the most approved ordinary methods of treatment were concerned, the case was hopeless. In the month of January of the present year I saw the patient, in consultation with a medical friend of his, who had not been attending him, but who felt extremely anxious about his condition. At this period the urine was very scanty and highly albuminous; and there was great anasarca of the entire limbs and lower half of the body, with ascites. But no complication existed.

The patient was now placed under the skim-milk treatment, in the usual manner; but never more than 5 pints were taken daily. The urine soon began to increase in quantity, and continued to augment until the eighth day of the treatment, when, on visiting him, I found that during the previous twenty-four hours he had voided 100 ozs. or 5 wine-pints of urine, and that the quantity of albumen was sensibly diminished, while the dropsy had so greatly subsided that the patient could walk for the first time from one room to another. From this time onwards the dropsy continued gradually to subside, and at last completely disappeared. The skim-milk treatment was strictly persevered in for nearly three months, during which time no other food was taken. In addition to the skim-milk, acetate of potash, in twenty-grain doses in water, was prescribed thrice daily; but, as this produced dyspeptic symptoms, it was discontinued for a while and then recommenced; but, as it again disagreed, it was given up, and the citrate of potash prescribed instead. Near the end of April, the patient, being convalescent, went to Brighton to recruit his strength, and afterwards started to spend the summer in visiting the shores of the Mediterranean in a yacht, much to the improvement of his general health. This case would have been rapidly cured if the skim-milk treatment had been begun early in the disease, when the turpentine was prescribed.

In the third chapter of the present work I have already laid down rules for the administration of the skim-milk treatment, to which I must refer for information as to its application in Bright's disease. I will only add that to ensure success it should be most scrupulously and strictly followed. The skim-milk should be taken exclusively until either the albumen has disappeared from the urine altogether, or is very considerably reduced, and the dropsy removed. Then, as a middle course, curd should be added to the skim-milk regimen. Afterwards, when the patient is sufficiently convalescent, a mixed diet may be prescribed; but the skim-milk must at the same time be continued for a considerable period. When a change is made, it is better, at first, to allow a little brown bread thrice daily, and after the lapse of a few days, a little lean beef-steak or mutton chop, with green vegetables or a little well-cooked potato. But great care should be taken in restricting the daily quantity of solid food to a moderate amount. A return to the ordinary diet of the patient should be slow and gradual, in order to keep down the quantity of nitrogenous matter requiring to be eliminated by the kidneys, so that they may not be excited to over-action, which may result in inflammation. Fatty articles of diet should, for some time, be scrupulously avoided, and light farinaceous substances consumed instead.

With regard to the use of medicinal substances I may add that I have been in the habit of prescribing such as seemed to me to be required by the special conditions of particular cases; some have needed this supplemental aid, while others have recovered without it.

I have very often prescribed a diuretic as an adjunct to the skim-milk, with the view of increasing the diuretic action of the latter; and the diuretic which I have found to be the most valuable in this respect is the acetate of potash, or the bitartrate; but I prefer the latter. I must observe, however, that I have never failed to obtain profuse diuresis when the skim-milk was prescribed alone.

In a few desperate cases, in which uræmic coma, or death by asphyxia from dropsy, was imminent, I have given a full dose of croton oil or elaterium with an excellent result.

I shall now proceed to give the details of some cases to illustrate the effect of the treatment.

Case I.—*Bright's Disease of Five Months' Standing; Second Stage; Complete Recovery.*

P. M., aged fifty-five, a labourer on the highways, and consequently much exposed to wet and cold, especially in winter and spring. Previous to his illness, he suffered much from want of rest, for a lengthened period, in attending his wife before her death. He was always temperate in his habits, and had enjoyed good health until the commencement of his present illness, in the beginning of April 1868, when a dropsical swelling appeared in both feet and ankles, gradually increasing and extending upwards during the summer months, until, at the end of August, the trunk, face, and upper extremities became so œdematous, and the abdomen so ascitical, that he was compelled to give up work. During the whole of this period the urine was scanty.

On the 25th of September (about five months after the first appearance of the dropsy) he entered the Sunderland Infirmary, under my care. At this time the dropsy was general and excessive, especially in the lower extremities, penis, and scrotum; the latter were enormously swollen; the ascites was also considerable. The urine was scanty, highly albuminous, and the specific gravity 1010°; it formed, on standing, a scanty flocculent deposit, containing fatty and hyaline tube-casts. He was suffering much from cephalalgia and nausea, indicative of uræmia. His countenance was pale, pasty, and puffy.

The skim-milk diet was prescribed. Five pints of carefully skimmed milk were ordered as a daily allowance, in divided doses of a tumblerful, at intervals of about two hours, commencing in the morning at eight o'clock. Every other article of diet was strictly prohibited. A diuretic, composed of twenty grains of acetate of potash and twenty minims of tincture of digitalis in an ounce of water, to be given thrice daily, was also prescribed. This treatment was strictly continued for a fortnight with the following result. During the first twenty-four hours 5 pints of urine were voided; this increased flow continued daily, the specific gravity being 1010°, and the albumen gradually diminishing. The dropsy showed a marked decrease from day to day. At the end of the fortnight there was not a trace of albumen left in the urine, and the dropsy had entirely disappeared, and did not again return. The daily quantity of urine was now reduced to 3 pints, but its density had risen to 1015°.

At this period (October 12) the diuretic was withdrawn, and a tonic prescribed, consisting of $1\frac{1}{2}$ grain of sulphate of iron and 3 grains of sulphate of quinine, in mixture, thrice daily. The same quantity of milk was continued daily, but ordered to be taken in equal quantities at four meals, with an interval of four hours between each, and a moderate quantity of brown bread was allowed to each meal. This treatment was continued without change for a month. The urine remained stationary at 3 pints daily, free from albumen, but with its density raised to 1020°. The patient's strength, previously much reduced, rapidly increased, he gathered flesh, and his countenance became clear and ruddy.

On the 9th of November the daily allowance of skim-milk was reduced to 4 pints, taken at three meals with brown bread; while half-a-pound of beef or mutton, with potatoes and brown bread, was allowed for dinner. The tonic was continued. The specific gravity of the urine, now quite healthy, rose to 1025°.

On the 28th of November he was dismissed cured. Shortly afterwards he resumed his occupation; and continued perfectly well up to the 10th of March following, when last seen by me.

In the following case iodide of potassium and iodine were prescribed on account of the lead-poisoning, with which the renal disease was complicated.

CASE II.—*Lead-Poisoning and Bright's Disease, with Anasarca and Epileptic Coma; Recovery.*

J. S., aged forty-six years, a plumber, who had been much engaged in casting lead during the previous seven years; in this occupation he frequently suffered much from the fumes arising from the melted lead, which always affected his gums and loosened his teeth. The symptoms of lead-poisoning commenced about six years ago, and first showed themselves in pains in the legs and head, commencing in the occiput and extending over the cranium; the pain in the head had been continuous and severe, accompanied with great sleeplessness. During the whole period he suffered much from colicky pains in the abdomen and obstinate constipation, also from discharges of blood from the bowels, which continued more or less for several weeks, and then subsided for a period, to return again. With these symptoms there was great loss of flesh and strength, his weight having fallen from 14 to 9 stone; he suffered much from feebleness in the forearms and wrists, with emaciation of the extensor muscles. About four months before I examined him, he became gradually affected with loss of sensation on the left side of the body, face, and extremities, and shortly afterwards with attacks of convulsions accompanied with loss of consciousness, recurring at first every other day, and then not oftener than twice a week. He had been under medical treatment on several occasions during his illness.

In March 1869 this patient consulted me at the Sunderland Dispensary. I found him suffering from extensive anæsthesia of the left side and extremities, severe pain in the head, and sleeplessness. The epileptiform seizures had continued up to this time. There was loss of appetite, and great feebleness. A characteristic blue line on the gums was well marked. He also complained much of constipation. There was slight œdema about the ankles. The urine was scanty, and highly albuminous. With the view of eliminating the lead from the system, the following mixture was prescribed:— Iodide of potassium, 3 drachms; tincture of iodine, 3 drachms; tincture of cinchona, $1\frac{1}{2}$ oz.; infusion of calumba, $10\frac{1}{2}$ oz.: two tablespoonsful to be taken three times a day. An ounce of sulphate of magnesia was also ordered to be taken in the morning occasionally. The diet to be of the ordinary kind, but nutritious. Under this treatment he improved somewhat as to the symptoms referable to the nervous system; but the œdema of the feet and legs gradually increased until the 14th of May, when he presented himself, suffering from general dropsy. There was great œdema of the lower extremities and scrotum; so that he was almost unable to walk. There was also much puffiness of the hands, forearms, and face; the urine was scanty, high-coloured, very albuminous, sp. gr. 1015°, and deposited great quantities of fatty and hyaline casts of the uriniferous tubes. The epileptiform seizures were very frequent and severe, and the anæsthesia of the left side had become more complete.

A thorough change was now made in the treatment. The patient was placed on an exclusively skim-milk diet; 6 pints, warmed, were allowed daily, and acetate of potash in doses of 20 grains in water, thrice daily, was substituted for the iodide-of-potassium mixture. He began to pass at once about 6 pints of urine daily, and the anasarca gradually subsided. This treatment was continued for six weeks, and by the end of this period the fits became much less frequent, and the cephalalgia much less severe. The patient was now allowed, *in addition* to the milk diet, bread in the morning, and butcher meat to dinner; and in the course of three weeks afterwards he resumed his work, but not amongst lead. Sensation gradually returned to the left side, and the albumen at length disappeared altogether from the urine. His health and strength gradually improved up to the beginning of October, when the epileptiform seizures ceased entirely, as well as the cephalalgia, and sensation was restored to the left side; the anasarca had never returned, and he had gained 1 st. 3 lb. in weight. From the commencement of the treatment the albumen in the urine diminished gradually and slowly, but finally disappeared *at the end of five months*.

I saw this patient on the 17th of December following, when he continued quite well. He had up to that date continued to take large quantities of skim-milk daily, with butcher meat to dinner, and bread thrice daily.

In this case it would be difficult to decide whether the epileptiform seizures and paralysis of sensation on the left side were the result of the *centric* action of lead as a poison on the nervous system, or of uræmia, or of both. It seems probable that they were due to lead, from their appearance before the renal affection was well developed, and their persistence after it had been relieved. But from the co-existence of the two disorders they may have possessed a mixed character. Pure *renal epileptic coma* is a most fatal and formidable affection, generally destroying life after a few seizures.

I may add to the above report that I saw this patient for another ailment in February 1871, fifteen months after his recovery from Bright's disease, and that at this date his urine continued quite free from albumen.

The following case is an example of the necessity of pursuing the treatment rigidly, and of the mischief so liable to accrue from clandestine indulgence in injurious articles of food. The patient was an extremely ignorant man, and, as he afterwards confessed with contrition, frequently violated the rules he was requested to observe in relation to his diet. In this manner he brought on two separate attacks of renal inflammation after he had been relieved of the dropsy, which at first threatened death by asphyxia.

Case III.—*Bright's Disease: Inflammatory Form; Second Stage; Intense General Dropsy; Ascites and Hydrothorax.*

W. M——, aged thirty-one, a labourer in a ship-building yard. He had been generally healthy, and of temperate habits. In July 1868 he had a severe attack of diarrhœa, which confined him to his bed and to the house for a month; at the end of which time he resumed work, greatly reduced in strength. In the early part of October he suffered severely from want of rest, in nursing his wife nightly, prior to her death. On the 13th of October he first observed a swelling in his feet and legs, and also that his urine was scanty and dark-coloured. This swelling gradually increased in the lower extremities, and then the abdomen became tense and enlarged; while simultaneously the trunk, face, and upper extremities assumed a swollen, puffy appearance.

The patient's condition gradually grew worse; and on the 17th of November he was admitted into the Sunderland Infirmary, under my care. On admission his condition was as follows:—Feet, legs, thighs, scrotum, and penis enormously swollen and œdematous; there was also much œdema of the trunk, face, and upper extremities. The abdominal cavity was distended with fluid, and there was also a considerable amount of fluid in the cavity of the right pleura. Moist râles were audible over both lungs; and there was much cough, with a thin mucous expectoration. The patient suffered severely from dyspnœa at night, when in the recumbent position and on exertion. Pulse very feeble, but heart's sounds normal. Urine scanty and high-coloured, specific gravity 1025°, and highly albuminous; it deposited fatty tube-casts, and epithelium containing fat-granules. The patient weighed 11 st. 2 lb.

The skim-milk diet was ordered—five pints daily, taken warmed, at four meals, with an interval of four hours between each: every other article of food was prohibited. Also a diuretic, composed of twenty grains of acetate of potash and twenty minims of tincture of digitalis, in mixture, thrice daily.

During the first twenty-four hours no less than six pints of urine (specific gravity 1010°) was passed. This large quantity continued to be voided daily, and a rapidly progressing diminution of the dropsy was at the same time observable up to November 26 —nine days after the commencement of the treatment—when not a trace of it remained, either externally or internally. On this day the patient was weighed by the assistant house-surgeon and myself, in the presence of the pupils, and his weight was ascertained to have been reduced in this short period to 9 st. 6 lb.; *he having lost* 24 *lb. of fluid in nine days.* The urine still contained albumen, but in much smaller quantity.

Nov. 27*th.*—At this date, to satisfy the cravings of the patient, I allowed a moderate quantity of brown bread to each meal. But unfortunately, as he afterwards confessed, not being content with his diet, and thinking that he was out of danger and that I was starving him, he, secretly, partook freely of various other articles of diet given him by other patients, while the milk was to some extent discarded. The result was that the urine rapidly diminished in quantity, even to so little as a pint in twenty-four hours, highly albuminous and of high specific gravity; while the dropsy reappeared and rapidly increased, so that at the end of a fortnight his condition was nearly as bad as when admitted.

Dec. 11th.—The skim-milk diet was begun *de novo*, and every other kind of food strictly forbidden, even bread. The danger of disobeying this order was fully explained to the patient. The daily quantity of urine suddenly rose to five and six pints, varying in density from 1010° to 1015°, but still containing a considerable quantity of albumen. This increased flow lasted up to the 23rd, nearly two weeks, at the end of which time the ascites and all the œdema had disappeared a second time, except a little about the feet and ankles; the urine now became reduced in quantity to about three pints daily, and continued for some days to bear a definite relation to the quantity of fluid ingested (due allowance being made for the water exhaled by the lungs and skin daily).

After the 23rd, however, the quantity of urine gradually diminished, with an increase (relative) of albumen and of specific gravity. With this change the dropsy returned, and kept rapidly increasing.

31st.—The quantity of urine during the previous twenty-four hours, 2½ pints, highly albuminous, sp. gr. 1020°. For a few days previously the urine had been much the same, though sometimes less in quantity and of greater density—as high as 1035°. There was great dyspnœa. Half a drachm of bitartrate of potash every four hours, instead of the acetate, was ordered.

Jan. 12*th*, 1869.—The dropsy had daily gained ground since previous report. Hydrothorax in right pleural cavity again superadded to the ascites. Urine highly albuminous; sp. gr. 1018°. Dyspnœa much increased.

19*th*.—Dropsy still increasing; great dyspnœa; urine less than one pint, sp. gr. 1035.° During the previous week the urine varied daily in quantity from 3½ to less than 1 pint, and in specific gravity from 1011° to 1035°; highly albuminous. The following diuretic was prescribed: tincture of digitalis, twenty minims; tincture of squill, twenty minims: infusion of scoparius, one ounce: every six hours.

23*rd*.—No improvement in the dropsy; urine highly albuminous; daily quantity since previous date below a pint and a half; specific gravity suddenly fallen to 1012.° Patient very drowsy, and sleeps a great deal.

27*th*.—Drowsiness and inclination to sleep much increased, with headache, dimness of vision, and confusion of intellect; urgent dyspnœa; pulse feeble;

tongue dry; œdema, ascites, and hydrothorax increased. Urine as scanty as ever; specific gravity 1010°.

The patient's condition now seemed almost hopeless, and death approaching, either by *renal epileptic coma* or by asphyxia, resulting from the dropsy. Accordingly a drastic purgative, consisting of three drops of croton oil in a colocynth pill, and ten grains of hyoscyamus, was ordered immediately. The diuretic of digitalis, squill, and scoparius, under whose administration the specific gravity of the urine had fallen so remarkably, was withdrawn, and half-drachm doses of acetate of potash, in water, every four hours, prescribed instead.

28*th*.—The croton oil had acted very freely, about seven pints of fluid having passed from the bowels, and about a pint of urine was voided. The head-symptoms and the breathing were very much relieved.

During the next ten days the urine continued to be as albuminous and scanty as ever; but its specific gravity again rose, varying from day to day from 1030° to 1043°. The acetate of potash was continued, and four drops of croton oil, as before, every other day. By this means a very large quantity of fluid was drained from the bowels, and the dropsy very considerably diminished, especially the thoracic and abdominal. The cerebral symptons speedily disappeared. The quantity of skim-milk was now reduced to four pints daily, and half-a-pound of lean beef or mutton allowed, with a little rice, for dinner.

Feb. 7th.—Hydrothorax gone; ascites and œdema of the lower extremities much reduced. Urine a pint and a quarter; sp. gr. 1033°, highly albuminous. The acetate of potash withdrawn, and the bitartrate of potash (mixed with equal parts of treacle: a teaspoonful to be taken every three hours) prescribed instead. The patient being very feeble, six ounces of gin daily was also ordered.

10*th.*—Urine a pint and a half; sp. gr. 1035°, highly albuminous. Dropsy much the same as before. Four drops of croton oil were ordered in pill as before.

13*th.*—Erysipelatous inflammation of the skin of the posterior surface of both legs now broke out with great severity, accompanied with much pain and great increase of swelling, especially of the left leg, which became extremely tense. The urine continued much the same. The dose of croton oil was now repeated, and every other day in addition for the following week. The patient was placed in bed, with his legs elevated very much above the level of the trunk, by which means the fluid gravitated into the abdomen and upper part of the thighs, and the tension of the legs was very much relieved. A lotion, consisting of two drachms of acetate of lead, with half a drachm of dilute acetic acid, in a pint of water, was applied, in the same manner as the water dressing, to the inflamed surfaces. No other alteration in the treatment was made, and in the space of a week the local inflammation was completely subdued.

23*rd*.—Much improved. Ascites very slight, and the œdema of the legs much diminished. Urine, two pints and a half; specific gravity 1030°. The patient began now to perspire freely. Acetate of potash continued to be administered as a diuretic, and occasionally a dose of four drops of croton oil was given, with the view of diminishing the dropsy. The milk diet was persevered in—five pints daily, with half-a-pound of lean butcher-meat, green vegetables, and a little bread, for dinner. He gradually improved up to the 27th of March, when his urine was five pints, the specific gravity 1017°, but still albuminous. For some days previously the urine had been increasing in quantity. The dropsy was now almost completely subdued, a little swelling in the feet and ankles only remaining.

From this period onwards the patient continued to improve in every respect, and rapidly regained both flesh and strength ; the dropsy kept away, but the urine continued albuminous. He remained in the infirmary until the beginning of June, when he was dismissed. Unfortunately he returned home to an unhealthy dwelling in the slums of the town, and to poverty and insufficient food : circumstances the most unfavourable to a continuance of his improved condition. I saw him last in the month of October following, in his own dwelling, and found that for several weeks his state had been getting worse ; he had lost much flesh and strength, although there was no œdema except below the knees ; he died a month afterwards from sheer exhaustion ; but not from coma nor from dropsy. How very different his fate would in all probability have been if, in the first instance, he could have been kept to a strict rule of treatment while in the infirmary ; and if in the second place he had been a person of affluence, and could have spent the summer and autumn in some congenial watering-place or climate, surrounded by everything necessary for his continued improvement. As it was, I felt assured that the milk diet, with which he had still persevered more or less, had kept him alive up to this period (twelve months), and had been instrumental in saving his life three times under the most desperate circumstances, aided by other remedies while in the hospital.

On the 7th of May, 1870, I was consulted by a surgeon in active general practice in a large town in the north of England. He had been suffering for some time from albuminuria, general indisposition, and unpleasant head symptoms, which he attributed to uræmia; his urine, when tested, gave a precipitate of one-sixth its bulk of albumen and tube-casts, and it was of low specific gravity. He informed me that during the previous week he had been examined in London by Sir W. Jenner, Dr. Hare, and Dr. Ramskill, and that they all agreed that he was suffering from renal disease. He also informed me that he had been advised by Dr. Ramskill to consult me as to whether the milk treatment would be likely to benefit his case. On assuring him that he would be able to attend to practice under this treatment, he began it on the 23rd of May, and on the 31st he wrote to me as follows:—'I commenced your treatment yesterday week, and since then I have taken *nothing* but skim-milk, with this one exception, I inadvertently sucked a small lozenge. I was very stout and had much difficulty in breathing; now I breathe easily and am less in girth by many inches. I have examined the urine and find the quantity of albumen very considerably diminished—nitric acid and heat only make it opalescent; there are no flakes. I am now more than satisfied with the good result that has taken place. I do not remember whether I told you that at times,] more especially before I went to London, I was so giddy that I could scarcely stand, and on one occasion fell down and could not save myself. I had much dyspepsia and a feeling as though I should burst after taking food. Now all this has gone and I am perfectly comfortable.'

It is needless to give the progress of this case from day to day; the patient persevered strictly with the treatment, and in four months was perfectly recovered. While under the treatment he followed his professional avocations with ease and comfort. On the 9th of February, 1871, six months after his recovery, he wrote to me as follows:—'As regards my present condition, I am, and have for months been, free from all trace of albumen, and the unpleasant symptoms I have mentioned have long since disappeared, and I am getting through more work better than I ever did before. In fact I am most fully occupied from morning till night every day.

I still take the milk, and in the same quantity as before; but I also take almost my usual diet.'

I need not add that this gentleman has become an enthusiastic advocate of the skim-milk treatment of Bright's disease. He has supplied me with the following report of a case of this affection which came under his observation, and in which he tried the remedy:—

'Mrs. L——, a married lady about thirty years of age, applied to me on the 22nd of June, 1870; she was suffering from Bright's disease in an advanced stage, and had been under treatment for several months. She was very anæmic, and her legs were much swollen; indigestion, with distressing flatulency, severe palpitation, difficult breathing, and great giddiness, so that it was with difficulty she could make her way across the room; and she had frequently much dimness of vision; the cramps in the legs at night gave her much trouble. The urine was scanty, of low specific gravity, and contained a good third of albumen. The microscope revealed many small as well as many large casts. There were also many pus cells and a quantity of epithelium and some oil globules. Although this was about as unpromising a case as I have met with, I commenced the skim-milk treatment at once;

and although the unfavourable symptoms were gradually reduced, the albumen did not entirely disappear till about the end of August. Since then I have frequently examined the urine, and found it free from albumen. The patient still continues the milk as an ordinary beverage, but she takes almost her usual diet; she is now, and has been for some time, as well as it is possible to be. The only precaution she takes is to guard against cold by being well wrapped up.'

I might introduce many more cases to prove the remarkable efficacy of this treatment of Bright's disease; but those already adduced appear to me to be amply sufficient for the purpose.

LONDON: PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET

Medical and *Surgical Works.*

LECTURES on the PRINCIPLES and PRACTICE of PHYSIC. By Sir THOMAS WATSON, Bart. M.D. Physician-in-Ordinary to the Queen. Fifth Edition, thoroughly revised. 2 vols. 8vo. price 36*s.*

The DIAGNOSIS, PATHOLOGY, and TREATMENT of DISEASES of WOMEN; including the Diagnosis of Pregnancy. By GRAILY HEWITT, M.D. &c. President of the Obstetrical Society of London. Second Edition, enlarged; with 116 Woodcuts. 8vo. 24*s.*

LECTURES on the DISEASES of INFANCY and CHILDHOOD. By CHARLES WEST, M.D. &c. Fifth Edition. 8vo. 16*s.*

On some DISORDERS of the NERVOUS SYSTEM in CHILDHOOD. Being the Lumleian Lectures delivered before the Royal College of Physicians in March 1871. By CHARLES WEST, M.D. Crown 8vo. 5*s.*

On the SURGICAL TREATMENT of CHILDREN'S DISEASES. By T. HOLMES, M.A. &c. late Surgeon to the Hospital for Sick Children. Second Edition, with 9 Plates and 112 Woodcuts. 8vo. 21*s.*

A SYSTEM of SURGERY, THEORETICAL and PRACTICAL, in Treatises by Various Authors. Edited by T. HOLMES, M.A. &c. Surgeon and Lecturer on Surgery at St. George's Hospital, and Surgeon-in-Chief to the Metropolitan Police. Second Edition, thoroughly revised, with numerous Illustrations. 5 vols. 8vo. £5 5*s.*

LECTURES on SURGICAL PATHOLOGY. By Sir JAMES PAGET, Bart. F.R.S. Third Edition, revised and re-edited by the Author and Professor W. TURNER, M.B. 8vo. with 131 Woodcuts, 21*s.*

COOPER'S DICTIONARY of PRACTICAL SURGERY and ENCYCLOPÆDIA of SURGICAL SCIENCE. New Edition, brought down to the present time. By S. A. LANE, Surgeon to St. Mary's Hospital, &c. assisted by various Eminent Surgeons. Vol. II. 8vo. completing the work. [*In the press.*

On CHRONIC BRONCHITIS, especially as connected with Gout, Emphysema, and Diseases of the Heart. By E. HEADLAM GREENHOW, M.D. F.R.C.P. &c. 8vo. 7*s.* 6*d.*

The CLIMATE of the SOUTH of FRANCE as SUITED to INVALIDS; with Notices of Mediterranean and other Winter Stations. By C. T. WILLIAMS, M.A. M.D. Oxon. Physician to the Hospital for Consumption at Brompton. Second Edition. Crown 8vo. 6*s.*

PULMONARY CONSUMPTION; its Nature, Varieties, and Treatment: with an Analysis of One Thousand Cases to exemplify its Duration. By C. J. B. WILLIAMS, M.D. F.R.S. and C. T. WILLIAMS, M.A. M.D. Oxon. Physicians to the Hospital for Consumption at Brompton. Post 8vo. 10*s.* 6*d.*

CLINICAL LECTURES on DISEASES of the LIVER, JAUNDICE, and ABDOMINAL DROPSY. By C. MURCHISON, M.D. Physician and Lecturer on the Practice of Medicine, Middlesex Hospital. Post 8vo. with 25 Woodcuts, 10*s.* 6*d.*

ANATOMY, DESCRIPTIVE and SURGICAL. By HENRY GRAY, F.R.S. With about 410 Woodcuts from Dissections. Fifth Edition, by T. HOLMES, M.A. Cantab. With a New Introduction by the Editor. Royal 8vo. 28*s.*

CLINICAL NOTES on DISEASES of the LARYNX, investigated and treated with the assistance of the Laryngoscope. By W. MARCET, M.D. F.R.S. Crown 8vo. with 5 Lithographs, 6*s.*

PHYSIOLOGICAL ANATOMY and PHYSIOLOGY of MAN. By the late R. B. TODD, M.D. F.R.S. and W. BOWMAN, F.R.S. of King's College. With numerous Illustrations. VOL. II. 8vo. 25*s.*

VOL. I. New Edition by Dr. LIONEL S. BEALE, F.R.S. in course of publication, with numerous Illustrations. PARTS I. and II. price 7*s.* 6*d.* each.

OUTLINES of PHYSIOLOGY, Human and Comparative. By JOHN MARSHALL, F.R.C.S. Professor of Surgery in University College, London, and Surgeon to the University College Hospital. 2 vols. crown 8vo. with 122 Woodcuts, 32*s.*

COPLAND'S DICTIONARY of PRACTICAL MEDICINE, abridged from the larger work, and throughout brought down to the present state of Medical Science. 8vo. 36*s.*

A MANUAL of MATERIA MEDICA and THERAPEUTICS, abridged from Dr. PEREIRA'S *Elements* by F. J. FARRE, M.D. assisted by R. BENTLEY, M.R.C.S. and by R. WARINGTON, F.R.S. 1 vol. 8vo. with 90 Woodcuts, 21*s.*

THOMSON'S CONSPECTUS of the BRITISH PHARMACOPŒIA. Twenty-fifth Edition, corrected by E. LLOYD BIRKETT, M.D. 18mo. 6*s.*

The DUBLIN PRACTICE of MIDWIFERY. By HENRY MAUNSELL, M.D. formerly Professor of Midwifery in the Royal College of Surgeons in Ireland. New Edition, enlarged and revised. Edited by T. M. MADDEN, Senior Assistant-Physician to the Dublin Lying-in Hospital. Fcp. 8vo. 5*s.*

NOTES on LYING-IN INSTITUTIONS; with a Proposal for Organising an Institution for Training Midwives and Midwifery Nurses. By FLORENCE NIGHTINGALE. With several Illustrations. 8vo. 7*s.* 6*d.*

NOTES on HOSPITALS. By FLORENCE NIGHTINGALE. Third Edition, enlarged; with 13 Plans. Post 4to. 18*s.*

GENERAL LIST OF WORKS

PUBLISHED BY

MESSRS. LONGMANS, GREEN, AND CO.

PATERNOSTER ROW, LONDON.

History, Politics, Historical Memoirs, &c.

The HISTORY of ENGLAND from the Fall of Wolsey to the Defeat of the Spanish Armada. By JAMES ANTHONY FROUDE, M.A. late Fellow of Exeter College, Oxford.
LIBRARY EDITION, 12 VOLS. 8vo. price £8 18*s*.
CABINET EDITION, in 12 vols. crown 8vo. price 72*s*. each.

The HISTORY of ENGLAND from the Accession of James II. By Lord MACAULAY.
LIBRARY EDITION, 5 vols. 8vo. £4.
CABINET EDITION, 8 vols. post 8vo. 48*s*.
PEOPLE'S EDITION, 4 vols. crown 8vo. 16*s*.

LORD MACAULAY'S WORKS. Complete and Uniform Library Edition. Edited by his Sister, Lady TREVELYAN. 8 vols. 8vo. with Portrait, price £5 5*s*. cloth, or £8 8*s*. bound in tree-calf by Rivière.

An ESSAY on the HISTORY of the ENGLISH GOVERNMENT and Constitution, from the Reign of Henry VII. to the Present Time. By JOHN EARL RUSSELL. Fourth Edition, revised. Crown 8vo. 6*s*.

SELECTIONS from SPEECHES of EARL RUSSELL, 1817 to 1841, and from Despatches, 1859 to 1865; with Introductions. 2 vols. 8vo. 28*s*.

VARIETIES of VICE-REGAL LIFE. By Sir WILLIAM DENISON, K.C.B. late Governor-General of the Australian Colonies, and Governor of Madras. With Two Maps. 2 vols. 8vo. 28*s*.

On PARLIAMENTARY GOVERNMENT in ENGLAND: Its Origin, Development, and Practical Operation. By ALPHEUS TODD, Librarian of the Legislative Assembly of Canada. 2 vols. 8vo. price £1 17*s*.

A HISTORICAL ACCOUNT of the NEUTRALITY of GREAT BRITAIN DURING the AMERICAN CIVIL WAR. By MOUNTAGUE BERNARD, M.A. Chichele Professor of International Law and Diplomacy in the University of Oxford. Royal 8vo. 16*s*.

The CONSTITUTIONAL HISTORY of ENGLAND, since the Accession of George III. 1760—1860. By Sir THOMAS ERSKINE MAY, C.B. Second Edition. 2 vols. 8vo. 33*s*.

The HISTORY of ENGLAND, from the Earliest Times to the Year 1866. By C. D. YONGE, Regius Professor of Modern History in the Queen's University, Belfast. New Edition. Crown 8vo. price 7*s.* 6*d.*

The OXFORD REFORMERS of 1498—John Colet, Erasmus, and Thomas More; being a History of their Fellow-work. By FREDERIC SEEBOHM. Second Edition, enlarged. 8vo. 14*s.*

A HISTORY of WALES, derived from Authentic Sources. By JANE WILLIAMS, Ysgafell. 8vo. 14*s.*

LECTURES on the HISTORY of ENGLAND, from the earliest Times to the Death of King Edward II. By WILLIAM LONGMAN. With Maps and Illustrations. 8vo. 15*s.*

The HISTORY of the LIFE and TIMES of EDWARD the THIRD. By WILLIAM LONGMAN. With 9 Maps, 8 Plates, and 16 Woodcuts. 2 vols. 8vo. 28*s.*

The OVERTHROW of the GERMANIC CONFEDERATION by PRUSSIA in 1866. By Sir ALEXANDER MALET, Bart. K.C.B. With 5 Maps. 8vo. 18*s.*

The MILITARY RESOURCES of PRUSSIA and FRANCE, and RECENT CHANGES in the ART of WAR. By Lieut.-Col. CHESNEY, R.E. and HENRY REEVE, D.C.L. Crown 8vo. price 7*s.* 6*d.*

WATERLOO LECTURES: a Study of the Campaign of 1815. By Colonel CHARLES C. CHESNEY, R.E. late Professor of Military Art and History in the Staff College. New Edition. 8vo. with Map, 10*s.* 6*d.*

STAFF COLLEGE ESSAYS. By Lieutenant EVELYN BARING, Royal Artillery. 8vo. with 2 Maps, 8*s.* 6*d.*

DEMOCRACY in AMERICA. By ALEXIS DE TOCQUEVILLE. Translated by HENRY REEVE. 2 vols. 8vo. 21*s.*

HISTORY of the REFORMATION in EUROPE in the Time of Calvin. By J. H. MERLE D'AUBIGNÉ, D.D. VOLS. I. and II. 8vo. 28*s.* VOL. III. 12*s.* VOL. IV. 16*s.* VOL. V. price 16*s.*

CHAPTERS from FRENCH HISTORY; St. Louis, Joan of Arc, Henri IV. with Sketches of the Intermediate Periods. By J. H. GURNEY, M.A. New Edition. Fcp. 8vo. 6*s.* 6*d.*

MEMOIR of POPE SIXTUS the FIFTH. By Baron HUBNER. Translated from the Original in French, with the Author's sanction, by HUBERT E. H. JERNINGHAM. 2 vols. 8vo. [*In preparation.*

IGNATIUS LOYOLA and the EARLY JESUITS. By STEWART ROSE. New Edition, nearly ready.

The HISTORY of GREECE. By C. THIRLWALL, D.D. Lord Bishop of St. David's. 8 vols. fcp. 8vo. price 28*s.*

GREEK HISTORY from Themistocles to Alexander, in a Series of Lives from Plutarch. Revised and arranged by A. H. CLOUGH. New Edition. Fcp. with 44 Woodcuts, 6*s.*

CRITICAL HISTORY of the LANGUAGE and LITERATURE of Ancient Greece. By WILLIAM MURE, of Caldwell. 5 vols. 8vo. £3 9*s.*

The TALE of the GREAT PERSIAN WAR, from the Histories of Herodotus. By GEORGE W. COX, M.A. New Edition. Fcp. 3*s.* 6*d.*

HISTORY of the LITERATURE of ANCIENT GREECE. By Professor K. O. MÜLLER. Translated by the Right Hon. Sir GEORGE CORNEWALL LEWIS, Bart. and by J. W. DONALDSON, D.D. 3 vols. 8vo. 21*s*.

HISTORY of the CITY of ROME from its Foundation to the Sixteenth Century of the Christian Era. By THOMAS H. DYER, LL.D. 8vo. with 2 Maps, 15*s*.

The HISTORY of ROME. By WILLIAM IHNE. English Edition translated and revised by the Author. VOLS. I. and II. 8vo. price 30*s*.

HISTORY of the ROMANS under the EMPIRE. By the Very Rev. C. MERIVALE, D.C.L. Dean of Ely. 8 vols. post 8vo. 48*s*.

The FALL of the ROMAN REPUBLIC; a Short History of the Last Century of the Commonwealth. By the same Author. 12mo. 7*s*. 6*d*.

A STUDENT'S MANUAL of the HISTORY of INDIA, from the Earliest Period to the Present. By Colonel MEADOWS TAYLOR, M.R.A.S M.R.I.A. Crown 8vo. with Maps, 7*s*. 6*d*.

The HISTORY of INDIA, from the Earliest Period to the close of Lord Dalhousie's Administration. By JOHN CLARK MARSHMAN. 3 vols. crown 8vo. 22*s*. 6*d*.

INDIAN POLITY: a View of the System of Administration in India By Lieutenant-Colonel GEORGE CHESNEY, Fellow of the University of Calcutta. New Edition, revised; with Map. 8vo. price 21*s*.

HOME POLITICS; being a consideration of the Causes of the Growth of Trade in relation to Labour, Pauperism, and Emigration. By DANIEL. GRANT. 8vo. 7*s*.

REALITIES of IRISH LIFE. By W. STEUART TRENCH, Land Agent in Ireland to the Marquess of Lansdowne, the Marquess of Bath, and Lord Digby. Fifth Edition. Crown 8vo. price 6*s*.

The STUDENT'S MANUAL of the HISTORY of IRELAND. By MARY F. CUSACK, Author of the 'Illustrated History of Ireland, from the Earliest Period to the Year of Catholic Emancipation.' Crown 8vo. price 6*s*.

CRITICAL and HISTORICAL ESSAYS contributed to the *Edinburgh Review*. By the Right Hon. LORD MACAULAY.

CABINET EDITION, 4 vols. post 8vo. 24*s*. LIBRARY EDITION, 3 vols. 8vo. 36*s*.
PEOPLE'S EDITION, 2 vols. crown 8vo. 8*s*. STUDENT'S EDITION, 1 vol. cr. 8vo. 6*s*

HISTORY of EUROPEAN MORALS, from Augustus to Charlemagne. By W. E. H. LECKY, M.A. Second Edition. 2 vols. 8vo. price 28*s*.

HISTORY of the RISE and INFLUENCE of the SPIRIT of RATIONALISM in EUROPE. By W. E. H. LECKY, M.A. Cabinet Edition being the Fourth. 2 vols. crown 8vo. price 16*s*.

GOD in HISTORY; or, the Progress of Man's Faith in the Moral Order of the World. By Baron BUNSEN. Translated by SUSANNA WINKWORTH; with a Preface by Dean STANLEY. 3 vols. 8vo. price 42*s*.

The HISTORY of PHILOSOPHY, from Thales to Comte. By GEORGE HENRY LEWES. Third Edition. 2 vols. 8vo. 30*s*.

The MYTHOLOGY of the ARYAN NATIONS. By GEORGE W. COX, M.A. late Scholar of Trinity College, Oxford, Joint-Editor, with the late Professor Brande, of the Fourth Edition of 'The Dictionary of Science, Literature, and Art,' Author of 'Tales of Ancient Greece,' &c. 2 vols. 8vo. 28*s*.

HISTORY of CIVILISATION in England and France, Spain and Scotland. By Henry Thomas Buckle. New Edition of the entire Work, with a complete Index. 3 vols. crown 8vo. 24*s.*

HISTORY of the CHRISTIAN CHURCH, from the Ascension of Christ to the Conversion of Constantine. By E. Burton, D.D. late Prof. of Divinity in the Univ. of Oxford. Eighth Edition. Fcp. 3*s.* 6*d.*

SKETCH of the HISTORY of the CHURCH of ENGLAND to the Revolution of 1688. By the Right Rev. T. V. Short, D.D. Lord Bishop of St. Asaph. Eighth Edition. Crown 8vo. 7*s.* 6*d.*

HISTORY of the EARLY CHURCH, from the First Preaching of the Gospel to the Council of Nicæa, A.D. 325. By Elizabeth M. Sewell, Author of 'Amy Herbert.' New Edition, with Questions. Fcp. 4*s.* 6*d.*

The ENGLISH REFORMATION. By F. C. Massingberd, M.A. Chancellor of Lincoln and Rector of South Ormsby. Fourth Edition, revised. Fcp. 8vo. 7*s.* 6*d.*

MAUNDER'S HISTORICAL TREASURY; comprising a General Introductory Outline of Universal History, and a series of Separate Histories. Latest Edition, revised and brought down to the Present Time by the Rev. George William Cox, M.A. Fcp. 6*s.* cloth, or 9*s.* 6*d.* calf.

HISTORICAL and CHRONOLOGICAL ENCYCLOPÆDIA; comprising Chronological Notices of all the Great Events of Universal History: Treaties, Alliances, Wars, Battles, &c.; Incidents in the Lives of Eminent Men and their Works, Scientific and Geographical Discoveries, Mechanical Inventions, and Social, Domestic, and Economical Improvements. By B. B. Woodward, B.A. and W. L. R. Cates. 1 vol. 8vo. [*In the press.*]

Biographical Works.

The LIFE of ISAMBARD KINGDOM BRUNEL, Civil Engineer. By Isambard Brunel, B.C.L. of Lincoln's Inn; Chancellor of the Diocese of Ely. With Portrait, Plates, and Woodcuts. 8vo. 21*s.*

The LIFE and LETTERS of FARADAY. By Dr. Bence Jones, Secretary of the Royal Institution. Second Edition, thoroughly revised. 2 vols. 8vo. with Portrait, and Eight Engravings on Wood, price 28*s.*

FARADAY as a DISCOVERER. By John Tyndall, LL.D. F.R.S. Professor of Natural Philosophy in the Royal Institution. New and Cheaper Edition, with Two Portraits. Fcp. 8vo. 3*s.* 6*d.*

The LIFE and LETTERS of the Rev. SYDNEY SMITH. Edited by his Daughter, Lady Holland, and Mrs. Austin. New Edition, complete in One Volume. Crown 8vo. price 6*s.*

SOME MEMORIALS of R. D. HAMPDEN, Bishop of Hereford. Edited by his Daughter, Henrietta Hampden. With Portrait. 8vo. price 12*s.*

A MEMOIR of G. E. L. COTTON, D.D. late Lord Bishop of Calcutta; with Selections from his Journals and Letters. Edited by Mrs. Cotton. With Portrait. 8vo. price 18*s.*

The LIFE and TRAVELS of GEORGE WHITEFIELD, M.A. By James Paterson Gledstone. 8vo. price 14*s.*

LIVES of the LORD CHANCELLORS and KEEPERS of the GREAT SEAL of IRELAND, from the Earliest Times to the Reign of Queen Victoria. By J. R. O'FLANAGAN, M.R.I.A. Barrister-at-Law. 2 vols. 8vo. 36*s.*

DICTIONARY of GENERAL BIOGRAPHY; containing Concise Memoirs and Notices of the most Eminent Persons of all Countries, from the Earliest Ages to the Present Time. Edited by W. L. R. CATES. 8vo. 21*s.*

LIVES of the TUDOR PRINCESSES, including Lady Jane Grey and her Sisters. By AGNES STRICKLAND, Author of 'Lives of the Queens of England.' Post 8vo. with Portrait, &c. 12*s.* 6*d.*

LIVES of the QUEENS of ENGLAND. By AGNES STRICKLAND. Library Edition, newly revised; with Portraits of every Queen, Autographs, and Vignettes. 8 vols. post 8vo. 7*s.* 6*d.* each.

MEMOIRS of BARON BUNSEN. Drawn chiefly from Family Papers by his Widow, FRANCES Baroness BUNSEN. Second Edition, abridged; with 2 Portraits and 4 Woodcuts. 2 vols. post 8vo. 21*s.*

The LETTERS of the Right Hon. Sir GEORGE CORNEWALL LEWIS, Bart. to various Friends. Edited by his Brother, the Rev. Canon Sir G. F. LEWIS, Bart. 8vo. with Portrait, price 14*s.*

LIFE of the DUKE of WELLINGTON. By the Rev. G. R. GLEIG, M.A. Popular Edition, carefully revised; with copious Additions. Crown 8vo. with Portrait, 5*s.*

HISTORY of MY RELIGIOUS OPINIONS. By J. H. NEWMAN, D.D. Being the Substance of Apologia pro Vitâ Suâ. Post 8vo. 6*s.*

The PONTIFICATE of PIUS the NINTH; being the Third Edition of 'Rome and its Ruler,' continued to the latest moment and greatly enlarged. By J. F. MAGUIRE, M.P. Post 8vo. with Portrait, 12*s.* 6*d.*

FATHER MATHEW: a Biography. By JOHN FRANCIS MAGUIRE, M.P. for Cork. Popular Edition, with Portrait. Crown 8vo. 3*s.* 6*d.*

FELIX MENDELSSOHN'S LETTERS from *Italy and Switzerland*, and *Letters from* 1833 *to* 1847, translated by Lady WALLACE. New Edition, with Portrait. 2 vols. crown 8vo. 5*s.* each.

MEMOIRS of SIR HENRY HAVELOCK, K.C.B. By JOHN CLARK MARSHMAN. Cabinet Edition, with Portrait. Crown 8vo. price 3*s.* 6*d.*

VICISSITUDES of FAMILIES. By Sir J. BERNARD BURKE, C.B. Ulster King of Arms. New Edition, remodelled and enlarged. 2 vols. crown 8vo. 21*s.*

THE EARLS of GRANARD: a Memoir of the Noble Family of Forbes. Written by Admiral the Hon. JOHN FORBES, and edited by GEORGE ARTHUR HASTINGS, present Earl of Granard, K.P. 8vo. 10*s.*

ESSAYS in ECCLESIASTICAL BIOGRAPHY. By the Right Hon. Sir J. STEPHEN, LL.D. Cabinet Edition, being the Fifth. Crown 8vo. 7*s.* 6*d.*

MAUNDER'S BIOGRAPHICAL TREASURY. Thirteenth Edition, reconstructed, thoroughly revised, and in great part rewritten; with about 1,000 additional Memoirs and Notices, by W. L. R. CATES. Fcp. 6*s.*

LETTERS and LIFE of FRANCIS BACON, including all his Occasional Works. Collected and edited, with a Commentary, by J. SPEDDING, Trin. Coll. Cantab. VOLS. I. and II. 8vo. 24*s.* VOLS. III. and IV. 24*s.* VOL. V. price 12*s.*

Criticism, Philosophy, Polity, &c.

The INSTITUTES of JUSTINIAN; with English Introduction, Translation, and Notes. By T. C. SANDARS, M.A. Barrister, late Fellow of Orie Coll. Oxon. New Edition. 8vo. 15*s.*

SOCRATES and the SOCRATIC SCHOOLS. Translated from the German of Dr. E. ZELLER, with the Author's approval, by the Rev. OSWALD J. REICHEL, B.C.L. and M.A. Crown 8vo. 8*s.* 6*d.*

The STOICS, EPICUREANS, and SCEPTICS. Translated from the German of Dr. E. ZELLER, with the Author's approval, by OSWALD J. REICHEL, B.C.L. and M.A. Crown 8vo. price 14*s.*

The ETHICS of ARISTOTLE, illustrated with Essays and Notes. By Sir A. GRANT, Bart. M.A. LL.D. Second Edition, revised and completed. 2 vols. 8vo. price 28*s.*

The NICOMACHEAN ETHICS of ARISTOTLE newly translated into English. By R. WILLIAMS, B.A. Fellow and late Lecturer of Merton College, and sometime Student of Christ Church, Oxford. 8vo. 12*s.*

ELEMENTS of LOGIC. By R. WHATELY, D.D. late Archbishop of Dublin. New Edition. 8vo. 10*s.* 6*d.* crown 8vo. 4*s.* 6*d.*

Elements of Rhetoric. By the same Author. New Edition. 8vo. 10*s.* 6*d.* crown 8vo. 4*s.* 6*d.*

English Synonymes. By E. JANE WHATELY. Edited by Archbishop WHATELY. 5th Edition. Fcp. 3*s.*

BACON'S ESSAYS with ANNOTATIONS. By R. WHATELY, D.D. late Archbishop of Dublin. Sixth Edition. 8vo. 10*s.* 6*d.*

LORD BACON'S WORKS, collected and edited by J. SPEDDING, M.A. R. L. ELLIS, M.A. and D. D. HEATH. New and Cheaper Edition. 7 vols. 8vo. price £3 13*s.* 6*d.*

The SUBJECTION of WOMEN. By JOHN STUART MILL. New Edition. Post 8vo. 5*s.*

On REPRESENTATIVE GOVERNMENT. By JOHN STUART MILL. Third Edition. 8vo. 9*s.* Crown 8vo. 2*s.*

On LIBERTY. By JOHN STUART MILL. Fourth Edition. Post 8vo. 7*s.* 6*d.* Crown 8vo. 1*s.* 4*d.*

Principles of Political Economy. By the same Author. Sixth Edition. 2 vols. 8vo. 30*s.* Or in 1 vol. crown 8vo. 5*s.*

A System of Logic, Ratiocinative and Inductive. By the same Author. Seventh Edition. Two vols. 8vo. 25*s.*

ANALYSIS of Mr. MILL'S SYSTEM of LOGIC. By W. STEBBING, M.A. Fellow of Worcester College, Oxford. New Edition. 12mo. 3*s.* 6*d.*

UTILITARIANISM. By JOHN STUART MILL. Third Edition. 8vo. 5*s.*

DISSERTATIONS and DISCUSSIONS, POLITICAL, PHILOSOPHICAL, and HISTORICAL. By JOHN STUART MILL. Second Edition, revised. 3 vols. 8vo. 36*s.*

EXAMINATION of Sir W. HAMILTON'S PHILOSOPHY, and of the Principal Philosophical Questions discussed in his Writings. By JOHN STUART MILL. Third Edition. 8vo. 16*s.*

An OUTLINE of the NECESSARY LAWS of THOUGHT: a Treatise on Pure and Applied Logic. By the Most Rev. WILLIAM, Lord Archbishop of York, D.D. F.R.S. Ninth Thousand. Crown 8vo. 5*s.* 6*d.*

The ELEMENTS of POLITICAL ECONOMY. By HENRY DUNNING MACLEOD, M.A. Barrister-at-Law. 8vo. 16*s.*

A Dictionary of Political Economy; Biographical, Bibliographical, Historical, and Practical. By the same Author. VOL. I. royal 8vo. 30*s.*

The ELECTION of REPRESENTATIVES, Parliamentary and Municipal; a Treatise. By THOMAS HARE, Barrister-at-Law. Third Edition, with Additions. Crown 8vo. 6*s.*

SPEECHES of the RIGHT HON. LORD MACAULAY, corrected by Himself. People's Edition, crown 8vo. 3*s.* 6*d.*

Lord Macaulay's Speeches on Parliamentary Reform in 1831 and 1832. 16mo. 1*s.*

INAUGURAL ADDRESS delivered to the University of St. Andrews. By JOHN STUART MILL. 8vo. 5*s.* People's Edition, crown 8vo. 1*s.*

A DICTIONARY of the ENGLISH LANGUAGE. By R. G. LATHAM, M.A. M.D. F.R.S. Founded on the Dictionary of Dr. SAMUEL JOHNSON, as edited by the Rev. H. J. TODD, with numerous Emendations and Additions. In Four Volumes, 4to. price £7.

THESAURUS of ENGLISH WORDS and PHRASES, classified and arranged so as to facilitate the Expression of Ideas, and assist in Literary Composition. By P. M. ROGET, M.D. New Edition. Crown 8vo. 10*s.* 6*d.*

LECTURES on the SCIENCE of LANGUAGE, delivered at the Royal Institution. By MAX MÜLLER, M.A. &c. Foreign Member of the French Institute. Sixth Edition. 2 vols. crown 8vo. price 16*s.*

CHAPTERS on LANGUAGE. By FREDERIC W. FARRAR, F.R.S. Head Master of Marlborough College. Crown 8vo. 8*s.* 6*d.*

WORD-GOSSIP; a Series of Familiar Essays on Words and their Peculiarities. By the Rev. W. L. BLACKLEY, M.A. Fcp. 8vo. 5*s.*

A BOOK ABOUT WORDS. By G. F. GRAHAM, Author of 'English, or the Art of Composition,' &c. Fcp. 8vo. price 3*s.* 6*d.*

The DEBATER; a Series of Complete Debates, Outlines of Debates, and Questions for Discussion. By F. ROWTON. Fcp. 6*s.*

MANUAL of ENGLISH LITERATURE, Historical and Critical. By THOMAS ARNOLD, M.A. Second Edition. Crown 8vo. price 7*s.* 6*d.*

SOUTHEY'S DOCTOR, complete in One Volume. Edited by the Rev. J. W. WARTER, B.D. Square crown 8vo. 12*s.* 6*d.*

HISTORICAL and CRITICAL COMMENTARY on the OLD TESTAMENT; with a New Translation. By M. M. KALISCH, Ph.D. VOL. I. *Genesis*, 8vo. 18*s.* or adapted for the General Reader, 12*s.* VOL. II. *Exodus*, 15*s.* or adapted for the General Reader, 12*s.* VOL. III. *Leviticus*, PART I. 15*s.* or adapted for the General Reader, 8*s.*

A HEBREW GRAMMAR, with EXERCISES. By M. M. KALISCH, Ph.D. PART I. *Outlines with Exercises*, 8vo. 12s. 6d. KEY, 5s. PART II. *Exceptional Forms and Constructions*, 12s. 6d.

A LATIN-ENGLISH DICTIONARY. By J. T. WHITE, D.D. of Corpus Christi College, and J. E. RIDDLE, M.A. of St. Edmund Hall, Oxford. Third Edition, revised. 2 vols. 4to. pp. 2,128, price 42s. cloth.

White's College Latin-English Dictionary (Intermediate Size), abridged for the use of University Students from the Parent Work (as above). Medium 8vo. pp. 1,048, price 18s. cloth.

White's Junior Student's Complete Latin-English and English-Latin Dictionary. New Edition. Square 12mo. pp. 1,058, price 12s.

Separately { The ENGLISH-LATIN DICTIONARY, price 5s. 6d.
The LATIN-ENGLISH DICTIONARY, price 7s. 6d.

An ENGLISH-GREEK LEXICON, containing all the Greek Words used by Writers of good authority. By C. D. YONGE, B.A. New Edition. 4to. 21s.

Mr. YONGE'S NEW LEXICON, English and Greek, abridged from his larger work (as above). Revised Edition. Square 12mo. 8s. 6d.

A GREEK-ENGLISH LEXICON. Compiled by H. G. LIDDELL, D.D. Dean of Christ Church, and R. SCOTT, D.D. Dean of Rochester. Sixth Edition. Crown 4to. price 36s.

A Lexicon, Greek and English, abridged from LIDDELL and SCOTT'S *Greek-English Lexicon*. Twelfth Edition. Square 12mo. 7s. 6d.

A SANSKRIT-ENGLISH DICTIONARY, the Sanskrit words printed both in the original Devanagari and in Roman Letters. Compiled by T. BENFEY, Prof. in the Univ. of Göttingen. 8vo. 52s. 6d.

WALKER'S PRONOUNCING DICTIONARY of the ENGLISH LANGUAGE. Thoroughly revised Editions, by B. H. SMART. 8vo. 12s. 16mo. 6s.

A PRACTICAL DICTIONARY of the FRENCH and ENGLISH LANGUAGES. By L. CONTANSEAU. Fourteenth Edition. Post 8vo. 10s. 6d.

Contanseau's Pocket Dictionary, French and English, abridged from the above by the Author. New Edition, revised. Square 18mo. 3s. 6d.

NEW PRACTICAL DICTIONARY of the GERMAN LANGUAGE; German-English and English-German. By the Rev. W. L. BLACKLEY, M.A. and Dr. CARL MARTIN FRIEDLÄNDER. Post 8vo. 7s. 6d.

The MASTERY of LANGUAGES; or, the Art of Speaking Foreign Tongues Idiomatically. By THOMAS PRENDERGAST, late of the Civil Service at Madras. Second Edition. 8vo. 6s.

Miscellaneous Works and *Popular Metaphysics.*

The ESSAYS and CONTRIBUTIONS of A. K. H. B., Author of 'The Recreations of a Country Parson.' Uniform Editions:—

Recreations of a Country Parson. By A. K. H. B. FIRST and SECOND SERIES, crown 8vo. 3s. 6d. each.

The COMMON-PLACE PHILOSOPHER in TOWN and COUNTRY. By A. K. H. B. Crown 8vo. price 3*s*. 6*d*.

Leisure Hours in Town; Essays Consolatory, Æsthetical, Moral, Social, and Domestic. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

The Autumn Holidays of a Country Parson; Essays contributed to *Fraser's Magazine* and to *Good Words*. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

The Graver Thoughts of a Country Parson. By A. K. H. B. First and Second Series, crown 8vo. 3*s*. 6*d*. each.

Critical Essays of a Country Parson, selected from Essays contributed to *Fraser's Magazine*. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

Sunday Afternoons at the Parish Church of a Scottish University City. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

Lessons of Middle Age; with some Account of various Cities and Men. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

Counsel and Comfort spoken from a City Pulpit. By A. K. H. B. Crown 8vo. price 3*s*. 6*d*.

Changed Aspects of Unchanged Truths; Memorials of St. Andrews Sundays. By A. K. H.B. Crown 8vo. 3*s*. 6*d*.

Present-day Thoughts; Memorials of St. Andrews Sundays. By A. K. H. B. Crown 8vo. 3*s*. 6*d*.

SHORT STUDIES on GREAT SUBJECTS. By James Anthony Froude, M.A. late Fellow of Exeter Coll. Oxford. Third Edition. 8vo. 12*s*. Second Series, nearly ready.

LORD MACAULAY'S MISCELLANEOUS WRITINGS:—

Library Edition. 2 vols. 8vo. Portrait, 21*s*.
People's Edition. 1 vol. crown 8vo. 4*s*. 6*d*.

The REV. SYDNEY SMITH'S MISCELLANEOUS WORKS; including his Contributions to the *Edinburgh Review*. Crown 8vo. 6*s*.

The Wit and Wisdom of the Rev. Sydney Smith: a Selection of the most memorable Passages in his Writings and Conversation. 16mo. 3*s*. 6*d*.

TRACES of HISTORY in the NAMES of PLACES; with a Vocabulary of the Roots out of which Names of Places in England and Wales are formed. By Flavell Edmunds. Crown 8vo. 7*s*. 6*d*.

The ECLIPSE of FAITH; or, a Visit to a Religious Sceptic. By Henry Rogers. Twelfth Edition. Fcp. 5*s*.

Defence of the Eclipse of Faith, by its Author; a rejoinder to Dr. Newman's *Reply*. Third Edition. Fcp. 3*s*. 6*d*.

Selections from the Correspondence of R. E. H. Greyson. By the same Author. Third Edition. Crown 8vo. 7*s*. 6*d*.

FAMILIES of SPEECH, Four Lectures delivered at the Royal Institution of Great Britain. By the Rev. F. W. Farrar, M.A. F.R.S. Head Master of Marlborough College. Post 8vo. with Two Maps, 5*s*. 6*d*.

CHIPS from a GERMAN WORKSHOP; being Essays on the Science of Religion, and on Mythology, Traditions, and Customs. By Max Müller, M.A. &c. Foreign Member of the French Institute. 3 vols. 8vo. £2.

ANALYSIS of the PHENOMENA of the HUMAN MIND. By JAMES MILL. A New Edition, with Notes, Illustrative and Critical, by ALEXANDER BAIN, ANDREW FINDLATER, and GEORGE GROTE. Edited, with additional Notes, by JOHN STUART MILL. 2 vols. 8vo. price 28*s.*

An INTRODUCTION to MENTAL PHILOSOPHY, on the Inductive Method. By J. D. MORELL, M.A. LL.D. 8vo. 12*s.*

ELEMENTS of PSYCHOLOGY, containing the Analysis of the Intellectual Powers. By the same Author. Post 8vo. 7*s.* 6*d.*

The SECRET of HEGEL: being the Hegelian System in Origin, Principle, Form, and Matter. By J. H. STIRLING. 2 vols. 8vo. 28*s.*

Sir William Hamilton; being the Philosophy of Perception: an Analysis. By the same Author. 8vo. 5*s.*

The SENSES and the INTELLECT. By ALEXANDER BAIN, M.D. Professor of Logic in the University of Aberdeen. Third Edition. 8vo. 15*s.*

The EMOTIONS and the WILL. By the same Author. New Edition, preparing for publication.

On the STUDY of CHARACTER, including an Estimate of Phrenology. By the same Author. New Edition, preparing for publication.

MENTAL and MORAL SCIENCE: a Compendium of Psychology and Ethics. By the same Author. Second Edition. Crown 8vo. 10*s.* 6*d.*

LOGIC, DEDUCTIVE and INDUCTIVE. By the same Author. In TWO PARTS, crown 8vo. 10*s.* 6*d.* Each Part may be had separately:—
PART I. *Deduction*, 4*s.* PART II. *Induction*, 6*s.* 6*d.*

TIME and SPACE; a Metaphysical Essay. By SHADWORTH H. HODGSON. (This work covers the whole ground of Speculative Philosophy.) 8vo. price 16*s.*

The Theory of Practice; an Ethical Inquiry. By the same Author. (This work, in conjunction with the foregoing, completes a system of Philosophy.) 2 vols. 8vo. price 24*s.*

STRONG AND FREE; or, First Steps towards Social Science. By the Author of 'My Life, and What shall I do with it?' 8vo. price 10*s.* 6*d.*

The PHILOSOPHY of NECESSITY; or, Natural Law as applicable to Mental, Moral, and Social Science. By CHARLES BRAY. Second Edition 8vo. 9*s.*

The Education of the Feelings and Affections. By the same Author. Third Edition. 8vo. 3*s.* 6*d.*

On Force, its Mental and Moral Correlates. By the same Author. 8vo. 5*s.*

A TREATISE on HUMAN NATURE; being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects. By DAVID HUME. Edited, with Notes, &c. by T. H. GREEN, Fellow, and T. H. GROSE, late Scholar, of Balliol College, Oxford. [*In the press.*

ESSAYS MORAL, POLITICAL, and LITERARY. By DAVID HUME. By the same Editors. [*In the press.*

Astronomy, Meteorology, Popular Geography, &c.

OUTLINES of ASTRONOMY. By Sir J. F. W. HERSCHEL, Bart. M.A. Tenth Edition, revised; with 9 Plates and many Woodcuts. 8vo. 18*s.*

The SUN; RULER, LIGHT, FIRE, and LIFE of the PLANETARY SYSTEM. By RICHARD A. PROCTOR, B.A. F.R.A.S. With 10 Plates (7 coloured) and 107 Figures on Wood. Crown 8vo. 14*s.*

OTHER WORLDS THAN OURS; the Plurality of Worlds Studied under the Light of Recent Scientific Researches. By the same Author Second Edition, with 14 Illustrations. Crown 8vo. 10*s.* 6*d.*

SATURN and its SYSTEM. By the same Author. 8vo. with 14 Plates, 14*s.*

SCHALLEN'S SPECTRUM ANALYSIS, in its application to Terrestrial Substances and the Physical Constitution of the Heavenly Bodies. Translated by JANE and C. LASSELL; edited by W. HUGGINS, LL.D. F.R.S. Crown 8vo. with Illustrations. [*Nearly ready.*

CELESTIAL OBJECTS for COMMON TELESCOPES. By the Rev. T. W. WEBB, M.A. F.R.A.S. Second Edition, revised, with a large Map of the Moon, and several Woodcuts. 16mo. 7*s.* 6*d.*

NAVIGATION and NAUTICAL ASTRONOMY (Practical, Theoretical, Scientific) for the use of Students and Practical Men. By J. MERRIFIELD F.R.A.S and H. EVERS. 8vo. 14*s.*

DOVE'S LAW of STORMS, considered in connexion with the Ordinary Movements of the Atmosphere. Translated by R. H. SCOTT, M.A. T.C.D 8vo. 10*s.* 6*d.*

M'CULLOCH'S DICTIONARY, Geographical, Statistical, and Historical, of the various Countries, Places, and Principal Natural Objects in the World. New Edition, with the Statistical Information brought up to the latest returns by F. MARTIN. 4 vols. 8vo. with coloured Maps, £4 4*s.*

A GENERAL DICTIONARY of GEOGRAPHY, Descriptive, Physical, Statistical, and Historical: forming a complete Gazetteer of the World. By A. KEITH JOHNSTON, LL.D. F.R.G.S. Revised Edition. 8vo. 31*s.* 6*d.*

A MANUAL of GEOGRAPHY, Physical, Industrial, and Political. By W. HUGHES, F.R.G.S. With 6 Maps. Fcp. 7*s.* 6*d.*

The STATES of the RIVER PLATE: their Industries and Commerce. By WILFRID LATHAM, Buenos Ayres. Second Edition, revised. 8vo. 12*s.*

MAUNDER'S TREASURY of GEOGRAPHY, Physical, Historical, Descriptive, and Political. Edited by W. HUGHES, F.R.G.S. Revised Edition, with 7 Maps and 16 Plates. Fcp. 6*s.* cloth, or 9*s.* 6*d.* bound in calf

---

Natural History and *Popular Science.*

ELEMENTARY TREATISE on PHYSICS, Experimental and Applied. Translated and edited from GANOT'S *Éléments de Physique* (with the Author's sanction) by E. ATKINSON, Ph.D. F.C.S. New Edition, revised and enlarged; with a Coloured Plate and 620 Woodcuts. Post 8vo. 15*s.*

The ELEMENTS of PHYSICS or NATURAL PHILOSOPHY. By NEIL ARNOTT, M.D. F.R.S. Physician Extraordinary to the Queen. Sixth Edition, rewritten and completed. Two Parts, 8vo. 21*s.*

SOUND: a Course of Eight Lectures delivered at the Royal Institution of Great Britain. By JOHN TYNDALL, LL.D. F.R.S. New Edition, crown 8vo. with Portrait of *M. Chladni* and 169 Woodcuts, price 9*s.*

HEAT a MODE of MOTION. By Professor JOHN TYNDALL, LL.D. F.R.S. Fourth Edition. Crown 8vo. with Woodcuts, 10*s.* 6*d.*

RESEARCHES on DIAMAGNETISM and MAGNE-CRYSTALLIC ACTION; including the Question of Diamagnetic Polarity. By the same Author. With 6 Plates and many Woodcuts. 8vo. price 14*s.*

PROFESSOR TYNDALL'S ESSAYS on the USE and LIMIT of the IMAGINATION in SCIENCE. Being the Second Edition, with Additions, of his Discourse on the Scientific Use of the Imagination. 8vo. 3*s.*

NOTES of a COURSE of SEVEN LECTURES on ELECTRICAL PHENOMENA and THEORIES, delivered at the Royal Institution, A.D. 1870. By Professor TYNDALL. Crown 8vo. 1*s.* sewed, or 1*s.* 6*d.* cloth.

NOTES of a COURSE of NINE LECTURES on LIGHT delivered at the Royal Institution, A.D. 1869. By the same Author. Crown 8vo. price 1*s.* sewed, or 1*s.* 6*d.* cloth.

LIGHT: Its Influence on Life and Health. By FORBES WINSLOW, M.D. D.C.L. Oxon. (Hon.). Fcp. 8vo. 6*s.*

A TREATISE on ELECTRICITY, in Theory and Practice. By A. DE LA RIVE, Prof. in the Academy of Geneva. Translated by C. V. WALKER, F.R.S. 3 vols. 8vo. with Woodcuts, £3 13*s.*

The BEGINNING: its When and its How. By MUNGO PONTON, F.R.S.E. Post 8vo. with very numerous Illustrations, price 18*s.*

The FORCES of the UNIVERSE. By GEORGE BERWICK, M.D. Post 8vo. 5*s.*

The CORRELATION of PHYSICAL FORCES. By W. R. GROVE, Q.C. V.P.R.S. Fifth Edition, revised, and followed by a Discourse on Continuity. 8vo. 10*s.* 6*d.* The *Discourse on Continuity*, separately, 2*s.* 6*d.*

MANUAL of GEOLOGY. By S. HAUGHTON, M.D. F.R.S. Revised Edition, with 66 Woodcuts. Fcp. 7*s.* 6*d.*

VAN DER HOEVEN'S HANDBOOK of ZOOLOGY. Translated from the Second Dutch Edition by the Rev. W. CLARK, M.D. F.R.S. 2 vols. 8vo. with 24 Plates of Figures, 60*s.*

Professor OWEN'S LECTURES on the COMPARATIVE ANATOMY and Physiology of the Invertebrate Animals. Second Edition, with 235 Woodcuts. 8vo. 21*s.*

The COMPARATIVE ANATOMY and PHYSIOLOGY of the VERTE-brate Animals. By RICHARD OWEN, F.R.S. D.C.L. With 1,472 Woodcuts. 3 vols. 8vo. £3 13*s.* 6*d.*

The ORIGIN of CIVILISATION and the PRIMITIVE CONDITION of MAN; Mental and Social Condition of Savages. By Sir JOHN LUBBOCK, Bart. M.P. F.R.S. Second Edition, with 25 Woodcuts. 8vo. price 16*s.*

The PRIMITIVE INHABITANTS of SCANDINAVIA: containing a Description of the Implements, Dwellings, Tombs, and Mode of Living of the Savages in the North of Europe during the Stone Age. By SVEN NILSSON. With 16 Plates of Figures and 3 Woodcuts. 8vo. 18*s.*

BIBLE ANIMALS; being a Description of every Living Creature mentioned in the Scriptures, from the Ape to the Coral. By the Rev. J. G. WOOD, M.A. F.L.S. With about 100 Vignettes on Wood, 8vo. 21*s.*

HOMES WITHOUT HANDS: a Description of the Habitations of Animals, classed according to their Principle of Construction. By Rev. J. G. WOOD, M.A. F.L.S. With about 140 Vignettes on Wood, 8vo. 21*s.*

A FAMILIAR HISTORY of BIRDS. By E. STANLEY, D.D. F.R.S. late Lord Bishop of Norwich. Seventh Edition, with Woodcuts. Fcp. 3*s.* 6*d.*

The HARMONIES of NATURE and UNITY of CREATION. By Dr. GEORGE HARTWIG. 8vo. with numerous Illustrations, 18*s.*

The SEA and its LIVING WONDERS. By the same Author. Third (English) Edition. 8vo. with many Illustrations, 21*s.*

The TROPICAL WORLD. By Dr. GEO. HARTWIG. With 8 Chromoxylographs and 172 Woodcuts. 8vo. 21*s.*

The POLAR WORLD; a Popular Description of Man and Nature in the Arctic and Antarctic Regions of the Globe. By Dr. GEORGE HARTWIG. With 8 Chromoxylographs, 3 Maps, and 85 Woodcuts. 8vo. 21*s.*

KIRBY and SPENCE'S INTRODUCTION to ENTOMOLOGY, or Elements of the Natural History of Insects. 7th Edition. Crown 8vo. 5*s.*

MAUNDER'S TREASURY of NATURAL HISTORY, or Popular Dictionary of Zoology. Revised and corrected by T. S. COBBOLD, M.D. Fcp. with 900 Woodcuts, 6*s.* cloth, or 9*s.* 6*d.* bound in calf.

The TREASURY of BOTANY, or Popular Dictionary of the Vegetable Kingdom; including a Glossary of Botanical Terms. Edited by J. LINDLEY, F.R.S. and T. MOORE, F.L.S. assisted by eminent Contributors. With 274 Woodcuts and 20 Steel Plates. Two Parts, fcp. 12*s.* cloth, or 19*s.* calf.

The ELEMENTS of BOTANY for FAMILIES and SCHOOLS. Tenth Edition, revised by THOMAS MOORE, F.L.S. Fcp. with 154 Woodcuts, 2*s.* 6*d.*

The ROSE AMATEUR'S GUIDE. By THOMAS RIVERS. Ninth Edition. Fcp. 4*s.*

The BRITISH FLORA; comprising the Phænogamous or Flowering Plants and the Ferns. By Sir W. J. HOOKER, K.H. and G. A. WALKER-ARNOTT, LL.D. 12mo. with 12 Plates, 14*s.*

LOUDON'S ENCYCLOPÆDIA of PLANTS; comprising the Specific Character, Description, Culture, History, &c. of all the Plants found in Great Britain. With upwards of 12,000 Woodcuts. 8vo. 42*s.*

MAUNDER'S SCIENTIFIC and LITERARY TREASURY. New Edition, thoroughly revised and in great part re-written, with above 1,000 new Articles, by J. Y. JOHNSON, Corr. M.Z.S. Fcp. 6*s.* cloth, or 9*s.* 6*d.* calf.

A DICTIONARY of SCIENCE, LITERATURE, and ART. Fourth Edition, re-edited by W. T. BRANDE (the original Author), and GEORGE W. COX, M.A. assisted by contributors of eminent Scientific and Literary Acquirements. 3 vols. medium 8vo. price 63*s.* cloth.

Chemistry, Medicine, Surgery, and the *Allied Sciences.*

A DICTIONARY of CHEMISTRY and the Allied Branches of other Sciences. By HENRY WATTS, F.R.S. assisted by eminent Contributors. Complete in 5 vols. medium 8vo. £7 3*s.*

ELEMENTS of CHEMISTRY, Theoretical and Practical. By W. ALLEN MILLER, M.D. late Prof. of Chemistry, King's Coll. London. Fourth Edition. 3 vols. 8vo. £3. PART I. CHEMICAL PHYSICS, 15*s.* PART II. INORGANIC CHEMISTRY, 21*s.* PART III. ORGANIC CHEMISTRY, 24*s.*

A MANUAL of CHEMISTRY, Descriptive and Theoretical. By WILLIAM ODLING, M.B. F.R.S. PART I. 8vo. 9*s.* PART II. *just ready.*

OUTLINES of CHEMISTRY; or, Brief Notes of Chemical Facts. By WILLIAM ODLING, M.B. F.R.S. Crown 8vo. 7*s.* 6*d.*

A Course of Practical Chemistry, for the use of Medical Students. By the same Author. New Edition, with 70 Woodcuts. Crown 8vo. 7*s.* 6*d.*

Lectures on Animal Chemistry, delivered at the Royal College of Physicians in 1865. By the same Author. Crown 8vo 4*s.* 6*d.*

Lectures on the Chemical Changes of Carbon. Delivered at the Royal Institution of Great Britain. By the same Author. Crown 8vo. price 4*s.* 6*d.*

A TREATISE on MEDICAL ELECTRICITY, THEORETICAL and PRACTICAL; and its Use in the Treatment of Paralysis, Neuralgia, and other Diseases. BY JULIUS ALTHAUS, M.D. &c. Second Edition, revised and partly re-written. Post 8vo. with Plate and 2 Woodcuts, price 15*s.*

The DIAGNOSIS, PATHOLOGY, and TREATMENT of DISEASES of Women; including the Diagnosis of Pregnancy. By GRAILY HEWITT, M.D. Second Edition, enlarged; with 116 Woodcut Illustrations. 8vo. 24*s.*

LECTURES on the DISEASES of INFANCY and CHILDHOOD. By CHARLES WEST, M.D. &c. Fifth Edition, revised and enlarged. 8vo. 16*s.*

A SYSTEM of SURGERY, Theoretical and Practical. In Treatises by Various Authors. Edited by T. HOLMES, M.A. &c. Surgeon and Lecturer on Surgery at St. George's Hospital, and Surgeon-in-Chief to the Metropolitan Police. Second Edition, thoroughly revised, with numerous Illustrations. 5 vols. 8vo. £5 5*s.*

The SURGICAL TREATMENT of CHILDREN'S DISEASES. By T. HOLMES, M.A. &c. late Surgeon to the Hospital for Sick Children. Second Edition, with 9 Plates and 112 Woodcuts. 8vo. 21*s.*

LECTURES on the PRINCIPLES and PRACTICE of PHYSIC. By Sir THOMAS WATSON, Bart. M.D. New Edition in October.

LECTURES on SURGICAL PATHOLOGY. By JAMES PAGET, F.R.S. Third Edition, revised and re-edited by the Author and Professor W. TURNER, M.B. 8vo. with 131 Woodcuts, 21*s.*

COOPER'S DICTIONARY of PRACTICAL SURGERY and Encyclopædia of Surgical Science. New Edition, brought down to the present time. By S. A. LANE, Surgeon to St. Mary's Hospital, assisted by various Eminent Surgeons. VOL. II. 8vo. completing the work. [*In the press.*

On CHRONIC BRONCHITIS, especially as connected with GOUT, EMPHYSEMA, and DISEASES of the HEART. By E. HEADLAM GREENHOW, M.D. F.R.C.P. &c. 8vo. 7*s.* 6*d.*

The CLIMATE of the SOUTH of FRANCE as SUITED to INVALIDS; with Notices of Mediterranean and other Winter Stations. By C. T. WILLIAMS, M.A. M.D. Oxon. Assistant-Physician to the Hospital for Consumption at Brompton. Second Edition. Crown 8vo. 6*s.*

REPORTS on the PROGRESS of PRACTICAL and SCIENTIFIC MEDICINE in Different Parts of the World, from June 1868, to June 1869. Edited by HORACE DOBELL, M.D. assisted by numerous and distinguished Coadjutors. 8vo. 18*s.*

PULMONARY CONSUMPTION; its Nature, Treatment, and Duration exemplified by an Analysis of One Thousand Cases selected from upwards of Twenty Thousand. By C. J. B. WILLIAMS, M.D. F.R.S. and C. T. WILLIAMS, M.A. M.D. Oxon. [*Nearly ready.*

CLINICAL LECTURES on DISEASES of the LIVER, JAUNDICE, and ABDOMINAL DROPSY. By CHARLES MURCHISON, M.D. Post 8vo. with 25 Woodcuts, 10*s.* 6*d.*

ANATOMY, DESCRIPTIVE and SURGICAL. By HENRY GRAY, F.R.S. With about 400 Woodcuts from Dissections. Fifth Edition, by T. HOLMES, M.A. Cantab. with a new Introduction by the Editor. Royal 8vo. 28*s.*

CLINICAL NOTES on DISEASES of the LARYNX, investigated and treated with the assistance of the Laryngoscope. By W. MARCET, M.D. F.R.S. Crown 8vo. with 5 Lithographs, 6*s.*

OUTLINES of PHYSIOLOGY, Human and Comparative. By JOHN MARSHALL, F.R.C.S. Surgeon to the University College Hospital. 2 vols. crown 8vo. with 122 Woodcuts, 32*s.*

ESSAYS on PHYSIOLOGICAL SUBJECTS. By GILBERT W. CHILD, M.A. Second Edition, revised, with Woodcuts. Crown 8vo. 7*s.* 6*d.*

PHYSIOLOGICAL ANATOMY and PHYSIOLOGY of MAN. By the late R. B. TODD, M.D. F.R.S. and W. BOWMAN, F.R.S. of King's College. With numerous Illustrations. VOL. II. 8vo. 25*s.*

VOL. I. New Edition by Dr. LIONEL S. BEALE, F.R.S. in course of publication; PART I. with 8 Plates, 7*s.* 6*d.*

COPLAND'S DICTIONARY of PRACTICAL MEDICINE, abridged from the larger work and throughout brought down to the present State of Medical Science. 8vo. 36*s.*

REIMANN'S HANDBOOK of ANILINE and its DERIVATIVES; a Treatise on the Manufacture of Aniline and Aniline Colours. Edited by WILLIAM CROOKES, F.R.S. With 5 Woodcuts. 8vo. 10*s.* 6*d.*

On the MANUFACTURE of BEET-ROOT SUGAR in ENGLAND and IRELAND. By WILLIAM CROOKES, F.R.S. Crown 8vo. with 11 Woodcuts, 8*s.* 6*d.*

A MANUAL of MATERIA MEDICA and THERAPEUTICS, abridged from Dr. PEREIRA'S *Elements* by F. J. FARRE, M.D. assisted by R. BENTLEY, M.R.C.S. and by R. WARINGTON, F.R.S. 8vo. with 90 Woodcuts, 21*s.*

THOMSON'S CONSPECTUS of the BRITISH PHARMACOPŒIA. 25th Edition, corrected by E. LLOYD BIRKETT, M.D. 18mo. price 6*s.*

The Fine Arts, and *Illustrated Editions.*

IN FAIRYLAND; Pictures from the Elf-World. By RICHARD DOYLE. With a Poem by W. ALLINGHAM. With Sixteen Plates, containing Thirty-six Designs printed in Colours. Folio, 31*s.* 6*d.*

LIFE of JOHN GIBSON, R.A. SCULPTOR. Edited by Lady EASTLAKE. 8vo. 10*s.* 6*d.*

The LORD'S PRAYER ILLUSTRATED by F. R. PICKERSGILL, R.A. and HENRY ALFORD, D.D. Dean of Canterbury. Imp. 4to. price 21*s.* cloth.

MATERIALS for a HISTORY of OIL PAINTING. By Sir CHARLES LOCKE EASTLAKE, sometime President of the Royal Academy. 2 vols. 8vo. price 30*s.*

HALF-HOUR LECTURES on the HISTORY and PRACTICE of the Fine and Ornamental Arts. By WILLIAM B. SCOTT. New Edition, revised by the Author; with 50 Woodcuts. Crown 8vo. 8*s.* 6*d.*

ALBERT DURER, HIS LIFE and WORKS; including Autobiographical Papers and Complete Catalogues. By WILLIAM B. SCOTT. With Six Etchings by the Author, and other Illustrations. 8vo. 16*s.*

SIX LECTURES on HARMONY, delivered at the Royal Institution of Great Britain in the Year 1867. By G. A. MACFARREN. With numerous engraved Musical Examples and Specimens. 8vo. 10*s.* 6*d.*

The CHORALE BOOK for ENGLAND: the Hymns translated by Miss C. WINKWORTH; the tunes arranged by Prof. W. S. BENNETT and OTTO GOLDSCHMIDT. Fcp. 4to. 12*s.* 6*d.*

The NEW TESTAMENT, illustrated with Wood Engravings after the Early Masters, chiefly of the Italian School. Crown 4to. 63*s.* cloth, gilt top; or £5 5*s.* elegantly bound in morocco.

LYRA GERMANICA; the Christian Year. Translated by CATHERINE WINKWORTH; with 125 Illustrations on Wood drawn by J. LEIGHTON, F.S.A. 4to. 21*s.*

LYRA GERMANICA; the Christian Life. Translated by CATHERINE WINKWORTH; with about 200 Woodcut Illustrations by J. LEIGHTON, F.S.A. and other Artists. 4to. 21*s.*

The LIFE of MAN SYMBOLISED by the MONTHS of the YEAR. Text selected by R. PIGOT; Illustrations on Wood from Original Designs by J. LEIGHTON, F.S.A. 4to. 42*s.*

CATS' and FARLIE'S MORAL EMBLEMS; with Aphorisms, Adages, and Proverbs of all Nations. 121 Illustrations on Wood by J. LEIGHTON, F.S.A. Text selected by R. PIGOT. Imperial 8vo. 31*s.* 6*d.*

SHAKSPEARE'S MIDSUMMER-NIGHT'S DREAM, illustrated with 24 Silhouettes or Shadow-Pictures by P. KONEWKA, engraved on Wood by A. VOGEL. Folio, 31*s.* 6*d.*

SACRED and LEGENDARY ART. By Mrs. JAMESON.

Legends of the Saints and Martyrs. Fifth Edition, with 19 Etchings and 187 Woodcuts. 2 vols. square crown 8vo. 31*s.* 6*d.*

Legends of the Monastic Orders. Third Edition, with 11 Etchings and 88 Woodcuts. 1 vol. square crown 8vo. 21*s.*

Legends of the Madonna. Third Edition, with 27 Etchings and 165 Woodcuts. 1 vol. square crown 8vo. 21*s.*

The History of Our Lord, with that of his Types and Precursors. Completed by Lady EASTLAKE. Revised Edition, with 31 Etchings and 281 Woodcuts. 2 vols. square crown 8vo. 42*s.*

The Useful Arts, Manufactures, &c.

HISTORY of the GOTHIC REVIVAL; an Attempt to shew how far the taste for Mediæval Architecture was retained in England during the last two centuries, and has been re-developed in the present. By CHARLES L. EASTLAKE, Architect. With many Illustrations. [*Nearly ready.*

GWILT'S ENCYCLOPÆDIA of ARCHITECTURE, with above 1,600 Engravings on Wood. Fifth Edition, revised and enlarged by WYATT PAPWORTH. 8vo. 52*s.* 6*d.*

A MANUAL of ARCHITECTURE: being a Concise History and Explanation of the principal Styles of European Architecture, Ancient, Mediæval, and Renaissance; with their chief variations. and a Glossary of Technical Terms. By THOMAS MITCHELL. Crown 8vo. with 150 Woodcuts, 10*s.* 6*d.*

ITALIAN SCULPTORS; being a History of Sculpture in Northern, Southern, and Eastern Italy. By C. C. PERKINS. With 30 Etchings and 13 Wood Engravings. Imperial 8vo. 42*s.*

TUSCAN SCULPTORS, their Lives, Works, and Times. With 45 Etchings and 28 Woodcuts from Original Drawings and Photographs. By the same Author. 2 vols. imperial 8vo. 63*s.*

HINTS on HOUSEHOLD TASTE in FURNITURE, UPHOLSTERY, and other Details. By CHARLES L. EASTLAKE, Architect. Second Edition, with about 90 Illustrations. Square crown 8vo. 18*s.*

The ENGINEER'S HANDBOOK; explaining the Principles which should guide the Young Engineer in the Construction of Machinery. By C. S. LOWNDES. Post 8vo. 5*s.*

PRINCIPLES of MECHANISM, designed for the Use of Students in the Universities, and for Engineering Students generally. By R. WILLIS, M.A. F.R.S. &c. Jacksonian Professor in the University of Cambridge. Second Edition, enlarged; with 374 Woodcuts. 8vo. 18*s.*

LATHES and TURNING, Simple, Mechanical, and ORNAMENTAL. By W. HENRY NORTHCOTT. With about 240 Illustrations on Steel and Wood. 8vo. 18*s.*

URE'S DICTIONARY of ARTS, MANUFACTURES, and MINES. Sixth Edition, chiefly rewritten and greatly enlarged by ROBERT HUNT, F.R.S. assisted by numerous Contributors eminent in Science and the Arts, and familiar with Manufactures. With above 2,000 Woodcuts. 3 vols. medium 8vo. price £4 14*s.* 6*d.*

HANDBOOK of PRACTICAL TELEGRAPHY, published with the sanction of the Chairman and Directors of the Electric and International Telegraph Company, and adopted by the Department of Telegraphs for India. By R. S. CULLEY. Fourth Edition, nearly ready.

ENCYCLOPÆDIA of CIVIL ENGINEERING, Historical, Theoretical, and Practical. By E. CRESY, C.E. With above 3,000 Woodcuts. 8vo. 42*s.*

TREATISE on MILLS and MILLWORK. By Sir W. FAIRBAIRN, F.R.S. New Edition, with 18 Plates and 322 Woodcuts. 2 vols. 8vo. 32*s.*

USEFUL INFORMATION for ENGINEERS. By the same Author. FIRST, SECOND, and THIRD SERIES, with many Plates and Woodcuts. 3 vols. crown 8vo. 10*s.* 6*d.* each.

The APPLICATION of CAST and WROUGHT IRON to Building Purposes. By Sir W. FAIRBAIRN, F.R.S. Fourth Edition, enlarged; with 6 Plates and 118 Woodcuts. 8vo. price 16*s.*

IRON SHIP BUILDING, its History and Progress, as comprised in a Series of Experimental Researches. By the same Author. With 4 Plates and 130 Woodcuts. 8vo. 18*s.*

A TREATISE on the STEAM ENGINE, in its various Applications to Mines, Mills, Steam Navigation, Railways and Agriculture. By J. BOURNE, C.E. Eighth Edition; with Portrait, 37 Plates, and 546 Woodcuts. 4to. 42*s.*

CATECHISM of the STEAM ENGINE, in its various Applications to Mines, Mills, Steam Navigation, Railways, and Agriculture. By the same Author. With 89 Woodcuts. Fcp. 6*s.*

HANDBOOK of the STEAM ENGINE. By the same Author, forming a KEY to the Catechism of the Steam Engine, with 67 Woodcuts. Fcp. 9*s.*

BOURNE'S RECENT IMPROVEMENTS in the STEAM ENGINE in its various applications to Mines, Mills, Steam Navigation, Railways, and Agriculture. Being a Supplement to the Author's 'Catechism of the Steam Engine.' By JOHN BOURNE, C.E. New Edition, including many New Examples; with 124 Woodcuts. Fcp. 8vo. 6*s.*

A TREATISE on the SCREW PROPELLER, SCREW VESSELS, and Screw Engines, as adapted for purposes of Peace and War; with Notices of other Methods of Propulsion, Tables of the Dimensions and Performance of Screw Steamers, and detailed Specifications of Ships and Engines. By J. BOURNE, C.E. New Edition, with 54 Plates and 287 Woodcuts. 4to. 63*s.*

EXAMPLES of MODERN STEAM, AIR, and GAS ENGINES of the most Approved Types, as employed for Pumping, for Driving Machinery, for Locomotion, and for Agriculture, minutely and practically described. By JOHN BOURNE, C.E. In course of publication in 24 Parts, price 2*s.* 6*d.* each, forming One volume 4to. with about 50 Plates and 400 Woodcuts.

A HISTORY of the MACHINE-WROUGHT HOSIERY and LACE Manufactures. By WILLIAM FELKIN, F.L.S. F.S.S. Royal 8vo. 21*s.*

PRACTICAL TREATISE on METALLURGY, adapted from the last German Edition of Professor KERL'S *Metallurgy* by W. CROOKES, F.R.S. &c. and E. RÖHRIG, Ph.D. M.E. With 625 Woodcuts. 3 vols. 8vo. price £4 19*s.*

MITCHELL'S MANUAL of PRACTICAL ASSAYING. Third Edition, for the most part re-written, with all the recent Discoveries incorporated, by W. CROOKES, F.R.S. With 188 Woodcuts. 8vo. 28*s.*

The ART of PERFUMERY; the History and Theory of Odours, and the Methods of Extracting the Aromas of Plants. By Dr. PIESSE, F.C.S. Third Edition, with 53 Woodcuts. Crown 8vo. 10*s.* 6*d.*

Chemical, Natural, and Physical Magic, for Juveniles during the Holidays. By the same Author. Third Edition, with 38 Woodcuts. Fcp. 6*s.*

LOUDON'S ENCYCLOPÆDIA of AGRICULTURE: comprising the Laying-out, Improvement, and Management of Landed Property, and the Cultivation and Economy of the Productions of Agriculture. With 1,100 Woodcuts. 8vo. 21*s.*

Loudon's Encyclopædia of Gardening: comprising the Theory and Practice of Horticulture, Floriculture, Arboriculture, and Landscape Gardening. With 1,000 Woodcuts. 8vo. 21*s.*

BAYLDON'S ART of VALUING RENTS and TILLAGES, and Claims of Tenants upon Quitting Farms, both at Michaelmas and Lady-Day. Eighth Edition, revised by J. C. MORTON. 8vo. 10*s.* 6*d.*

Religious and *Moral Works.*

CONSIDERATIONS on the REVISION of the ENGLISH NEW TESTAMENT. By C. J. ELLICOTT, D.D. Lord Bishop of Gloucester and Bristol. Post 8vo. price 5*s.* 6*d.*

An EXPOSITION of the 39 ARTICLES, Historical and Doctrinal. By E. HAROLD BROWNE, D.D. Lord Bishop of Ely. Seventh Edit. 8vo. 16*s.*

The LIFE and EPISTLES of ST. PAUL. By the Rev. W. J. CONYBEARE, M.A., and the Very Rev. J. S. HOWSON, D.D. Dean of Chester:—

LIBRARY EDITION, with all the Original Illustrations, Maps, Landscapes on Steel, Woodcuts, &c. 2 vols. 4to. 48*s.*

INTERMEDIATE EDITION, with a Selection of Maps, Plates, and Woodcuts. 2 vols. square crown 8vo. 31*s.* 6*d.*

STUDENT'S EDITION, revised and condensed, with 46 Illustrations and Maps. 1 vol. crown 8vo. price 9*s.*

The VOYAGE and SHIPWRECK of ST. PAUL; with Dissertations on the Life and Writings of St. Luke and the Ships and Navigation of the Ancients. By JAMES SMITH, F.R.S. Third Edition. Crown 8vo. 10*s.* 6*d.*

A CRITICAL and GRAMMATICAL COMMENTARY on ST. PAUL'S Epistles. By C. J. ELLICOTT, D.D. Lord Bishop of Gloucester & Bristol. 8vo.

Galatians, Fourth Edition, 8*s.* 6*d.*

Ephesians, Fourth Edition, 8*s.* 6*d.*

Pastoral Epistles, Fourth Edition, 10*s.* 6*d.*

Philippians, Colossians, and Philemon, Third Edition, 10*s.* 6*d.*

Thessalonians, Third Edition, 7*s.* 6*d.*

HISTORICAL LECTURES on the LIFE of OUR LORD JESUS CHRIST: being the Hulsean Lectures for 1859. By C. J. ELLICOTT, D.D. Lord Bishop of Gloucester and Bristol. Fifth Edition. 8vo. price 12*s.*

EVIDENCE of the TRUTH of the CHRISTIAN RELIGION derived from the Literal Fulfilment of Prophecy. By ALEXANDER KEITH, D.D 37th Edition, with numerous Plates, in square 8vo. 12*s.* 6*d.*; also the 39th Edition, in post 8vo. with 5 Plates, 6*s.*

History and Destiny of the World and Church, according to Scripture. By the same Author. Square 8vo. with 40 Illustrations, 10*s.*

An INTRODUCTION to the STUDY of the NEW TESTAMENT, Critical, Exegetical, and Theological. By the Rev. S. DAVIDSON, D.D. LL.D. 2 vols. 8vo. 30*s.*

HARTWELL HORNE'S INTRODUCTION to the CRITICAL STUDY and Knowledge of the Holy Scriptures, as last revised; with 4 Maps and 22 Woodcuts and Facsimiles. 4 vols. 8vo. 42*s.*

Horne's Compendious Introduction to the Study of the Bible. Re-edited by the Rev. JOHN AYRE, M.A. With Maps, &c. Post 8vo. 6*s.*

HISTORY of the KARAITE JEWS. By WILLIAM HARRIS RULE, D.D. Post 8vo. price 7*s.* 6*d.*

EWALD'S HISTORY of ISRAEL to the DEATH of MOSES. Translated from the German. Edited, with a Preface and an Appendix, by RUSSELL MARTINEAU, M.A. Second Edition. 2 vols. 8vo. 24*s.*

The HISTORY and LITERATURE of the ISRAELITES, according to the Old Testament and the Apocrypha. By C. DE ROTHSCHILD and A. DE ROTHSCHILD. Second Edition, revised. 2 vols. post 8vo. with Two Maps, price 12*s.* 6*d.*

The SEE of ROME in the MIDDLE AGES. By the Rev. OSWALD J. REICHEL, B.C.L. and M.A. 8vo. price 18*s.*

The EVIDENCE for the PAPACY, as derived from the Holy Scriptures and from Primitive Antiquity. By the Hon. COLIN LINDSAY. 8vo. price 12*s.* 6*d.*

The TREASURY of BIBLE KNOWLEDGE; being a Dictionary of the Books, Persons, Places, Events, and other matters of which mention is made in Holy Scripture. By Rev. J. AYRE, M.A. With Maps, 16 Plates, and numerous Woodcuts. Fcp. 8vo. price 6*s.* cloth, or 9*s.* 6*d.* neatly bound in calf.

The GREEK TESTAMENT; with Notes, Grammatical and Exegetical. By the Rev. W. WEBSTER, M.A. and the Rev. W. F. WILKINSON, M.A. 2 vols. 8vo. £2 4*s.*

EVERY DAY SCRIPTURE DIFFICULTIES explained and illustrated. By J. E. PRESCOTT, M.A. VOL. I. *Matthew* and *Mark*; VOL. II. *Luke* and *John*. 2 vols. 8vo. 9*s.* each.

The PENTATEUCH and BOOK of JOSHUA CRITICALLY EXAMINED. By the Right Rev. J. W. COLENSO, D.D. Lord Bishop of Natal. People's Edition, in 1 vol. crown 8vo. 6*s.* or in 5 Parts, 1*s.* each.

SIX SERMONS on the FOUR CARDINAL VIRTUES (Fortitude, Justice, Prudence, Temperance) in relation to the Public and Private Life of Catholics; with Preface and Appendices. By the Rev. ORBY SHIPLEY, M.A. Crown 8vo. with Frontispiece, price 7*s.* 6*d.*

The FORMATION of CHRISTENDOM. By T. W. ALLIES. PARTS I. and II. 8vo. price 12*s.* each Part.

ENGLAND and CHRISTENDOM. By ARCHBISHOP MANNING, D.D. Post 8vo. price 10*s.* 6*d.*

CHRISTENDOM'S DIVISIONS, PART I., a Philosophical Sketch of the Divisions of the Christian Family in East and West. By EDMUND S. FFOULKES. Post 8vo. price 7*s.* 6*d.*

Christendom's Divisions, PART II. Greeks and Latins, being a History of their Dissensions and Overtures for Peace down to the Reformation. By the same Author. Post 8vo. 15*s.*

The HIDDEN WISDOM of CHRIST and the KEY of KNOWLEDGE; or, History of the Apocrypha. By ERNEST DE BUNSEN. 2 vols. 8vo. 28*s.*

The KEYS of ST. PETER; or, the House of Rechab, connected with the History of Symbolism and Idolatry. By the same Author. 8vo. 14*s.*

The TYPES of GENESIS, briefly considered as Revealing the Development of Human Nature. By ANDREW JUKES. Second Edition. Crown 8vo. 7*s.* 6*d.*

The Second Death and the Restitution of All Things, with some Preliminary Remarks on the Nature and Inspiration of Holy Scripture. By the same Author. Second Edition. Crown 8vo. 3*s.* 6*d.*

A VIEW of the SCRIPTURE REVELATIONS CONCERNING a FUTURE STATE. By RICHARD WHATELY, D.D. late Archbishop of Dublin. Ninth Edition. Fcp. 8vo. 5*s.*

The POWER of the SOUL over the BODY. By GEORGE MOORE M.D. M.R.C.P.L. &c. Sixth Edition. Crown 8vo. 8*s.* 6*d.*

THOUGHTS for the AGE. By ELIZABETH M. SEWELL, Author of 'Amy Herbert' &c. Second Edition, revised. Fcp. 8vo. price 5*s.*

Passing Thoughts on Religion. By the same Author. Fcp. 8vo. 5*s.*

Self-Examination before Confirmation. By the same Author. 32mo. price 1*s.* 6*d.*

Readings for a Month Preparatory to Confirmation, from Writers of the Early and English Church. By the same Author. Fcp. 4*s.*

Readings for Every Day in Lent, compiled from the Writings of Bishop JEREMY TAYLOR. By the same Author. Fcp. 5*s.*

Preparation for the Holy Communion; the Devotions chiefly from the works of JEREMY TAYLOR. By the same Author. 32mo. 3*s.*

THOUGHTS for the HOLY WEEK for Young Persons. By the Author of 'Amy Herbert.' New Edition. Fcp. 8vo. 2*s.*

PRINCIPLES of EDUCATION Drawn from Nature and Revelation, and applied to Female Education in the Upper Classes. By the Author of 'Amy Herbert.' 2 vols. fcp. 12*s.* 6*d.*

The WIFE'S MANUAL; or, Prayers, Thoughts, and Songs on Several Occasions of a Matron's Life. By the Rev. W. CALVERT, M.A. Crown 8vo. price 10*s.* 6*d.*

SINGERS and SONGS of the CHURCH: being Biographical Sketches of the Hymn-Writers in all the principal Collections; with Notes on their Psalms and Hymns. By JOSIAH MILLER, M.A. Second Edition, enlarged. Post 8vo. price 10*s.* 6*d.*

LYRA GERMANICA, translated from the German by Miss C. WINKWORTH. FIRST SERIES, Hymns for the Sundays and Chief Festivals. SECOND SERIES, the Christian Life. Fcp. 3*s.* 6*d.* each SERIES.

'SPIRITUAL SONGS' for the SUNDAYS and HOLIDAYS throughout the Year. By J. S. B. MONSELL, LL.D. Vicar of Egham and Rural Dean. Fourth Edition, Sixth Thousand. Fcp. 4*s.* 6*d.*

The BEATITUDES: Abasement before God; Sorrow for Sin; Meekness of Spirit; Desire for Holiness; Gentleness; Purity of Heart; the Peacemakers; Sufferings for Christ. By the same. Third Edition. Fcp. 3*s.* 6*d.*

His PRESENCE—not his MEMORY, 1855. By the same Author, in Memory of his SON. Sixth Edition. 16mo. 1*s.*

LYRA EUCHARISTICA; Hymns and Verses on the Holy Communion, Ancient and Modern: with other Poems. Edited by the Rev. ORBY SHIPLEY, M.A. Second Edition. Fcp. 5*s.*

Lyra Messianica; Hymns and Verses on the Life of Christ, Ancient and Modern; with other Poems. By the same Editor. Second Edition, altered and enlarged. Fcp. 5*s.*

Lyra Mystica; Hymns and Verses on Sacred Subjects, Ancient and Modern. By the same Editor. Fcp. 5*s.*

The LIFE of MARGARET MARY HALLAHAN, better known in the religious world by the name of Mother Margaret. By her RELIGIOUS CHILDREN. Second Edition. 8vo. with Portrait, 10*s.*

ENDEAVOURS after the CHRISTIAN LIFE: Discourses. By JAMES MARTINEAU. Fourth Edition, carefully revised. Post 8vo. 7*s.* 6*d.*

INVOCATION of SAINTS and ANGELS, for the use of Members of the English Church. Edited by the Rev. ORBY SHIPLEY. 24mo. 3*s.* 6*d.*

WHATELY'S INTRODUCTORY LESSONS on the CHRISTIAN Evidences. 18mo. 6*d.*

FOUR DISCOURSES of CHRYSOSTOM, chiefly on the Parable of the Rich Man and Lazarus. Translated by F. ALLEN, B.A. Crown 8vo. 3*s.* 6*d.*

BISHOP JEREMY TAYLOR'S ENTIRE WORKS. With Life by BISHOP HEBER. Revised and corrected by the Rev. C. P. EDEN, 10 vols. price £5 5*s.*

Travels, Voyages, &c.

The PLAYGROUND of EUROPE. By LESLIE STEPHEN, late President of the Alpine Club. With 4 Illustrations engraved on Wood by E. Whymper. Crown 8vo. price 10*s.* 6*d.*

CADORE; or, TITIAN'S COUNTRY. By JOSIAH GILBERT, one of the Authors of 'The Dolomite Mountains.' With Map, Facsimile, and 40 Illustrations. Imperial 8vo. 31*s.* 6*d.*

NARRATIVE of the EUPHRATES EXPEDITION carried on by Order of the British Government during the years 1835–1837. By General F. R. CHESNEY, F.R.S. With Maps, Plates, and Woodcuts. 8vo. 24*s.*

TRAVELS in the CENTRAL CAUCASUS and BASHAN. Including Visits to Ararat and Tabreez and Ascents of Kazbek and Elbruz. By D. W. FRESHFIELD. Square crown 8vo. with Maps, &c. 18*s.*

PICTURES in TYROL and Elsewhere. From a Family Sketch-Book. By the Authoress of 'A Voyage en Zigzag,' &c. Second Edition. Small 4to. with numerous Illustrations, 21*s.*

HOW WE SPENT the SUMMER; or, a Voyage en Zigzag in Switzerland and Tyrol with some Members of the ALPINE CLUB. From the Sketch-Book of one of the Party. In oblong 4to. with 300 Illustrations, 15*s.*

BEATEN TRACKS; or, Pen and Pencil Sketches in Italy. By the Authoress of 'A Voyage en Zigzag.' With 42 Plates, containing about 200 Sketches from Drawings made on the Spot. 8vo. 16*s.*

MAP of the CHAIN of MONT BLANC, from an actual Survey in 1863—1864. By A. ADAMS-REILLY, F.R.G.S. M.A.C. Published under the Authority of the Alpine Club. In Chromolithography on extra stout drawing-paper 28in. × 17in. price 10*s.* or mounted on canvas in a folding case, 12*s.* 6*d.*

WESTWARD by RAIL; the New Route to the East. By W. F. RAE. With Map shewing the Lines of Rail between the Atlantic and the Pacific, and Sections of the Railway. Post 8vo. price 10*s.* 6*d.*

HISTORY of DISCOVERY in our AUSTRALASIAN COLONIES, Australia, Tasmania, and New Zealand, from the Earliest Date to the Present Day. By WILLIAM HOWITT. 2 vols. 8vo. with 3 Maps, 20*s.*

The CAPITAL of the TYCOON; a Narrative of a Three Years' Residence in Japan. By Sir RUTHERFORD ALCOCK, K.C.B. 2 vols. 8vo. with numerous Illustrations 42*s.*

ZIGZAGGING AMONGST DOLOMITES. By the Author of 'How we Spent the Summer, or a Voyage en Zigzag in Switzerland and Tyrol.' With upwards of 300 Illustrations by the Author. Oblong 4to. price 15*s.*

The DOLOMITE MOUNTAINS; Excursions through Tyrol, Carinthia, Carniola, and Friuli, 1861-1863. By J. GILBERT and G. C. CHURCHILL, F.R.G.S. With numerous Illustrations. Square crown 8vo. 21*s.*

GUIDE to the PYRENEES, for the use of Mountaineers. By CHARLES PACKE. 2nd Edition, with Map and Illustrations. Cr. 8vo. 7*s.* 6*d.*

The ALPINE GUIDE. By JOHN BALL, M.R.I.A. late President of the Alpine Club. Thoroughly Revised Editions, in Three Volumes, post 8vo. with Maps and other Illustrations:—

GUIDE to the WESTERN ALPS, including Mont Blanc, Monte Rosa, Zermatt, &c. Price 6*s.* 6*d.*

GUIDE to the CENTRAL ALPS, including all the Oberland District. Price 7*s.* 6*d.*

GUIDE to the EASTERN ALPS, price 10*s.* 6*d.*

Introduction on Alpine Travelling in General, and on the Geology of the Alps, price 1*s.* Each of the Three Volumes or Parts of the *Alpine Guide* may be had with this INTRODUCTION prefixed, price 1*s.* extra.

The HIGH ALPS WITHOUT GUIDES. By the Rev. A. G. GIRDLESTONE, M.A. late Demy in Natural Science, Magdalen College, Oxford. With Frontispiece and 2 Maps. Square crown 8vo. price 7*s.* 6*d.*

NARRATIVE of a SPRING TOUR in PORTUGAL. By A. C. SMITH, M.A. Ch. Ch. Oxon. Rector of Yatesbury. Post 8vo. price 6*s.* 6*d.*

ENGLAND to DELHI; a Narrative of Indian Travel. By JOHN MATHESON, Glasgow. With Map and 82 Woodcut Illustrations. 4to. 31*s.* 6*d.*

MEMORIALS of LONDON and LONDON LIFE in the 13th, 14th, and 15th Centuries; being a Series of Extracts, Local, Social, and Political, from the Archives of the City of London, A.D. 1276-1419. Selected, translated, and edited by H. T. RILEY, M.A. Royal 8vo. 21*s.*

COMMENTARIES on the HISTORY, CONSTITUTION, and CHARTERED FRANCHISES of the CITY of LONDON. By GEORGE NORTON, formerly one of the Common Pleaders of the City of London. Third Edition. 8vo. 14*s.*

The NORTHERN HEIGHTS of LONDON; or, Historical Associations of Hampstead, Highgate, Muswell Hill, Hornsey, and Islington. By WILLIAM HOWITT. With about 40 Woodcuts. Square crown 8vo. 21*s.*

VISITS to REMARKABLE PLACES: Old Halls, Battle-Fields, and Stones Illustrative of Striking Passages in English History and Poetry. By WILLIAM HOWITT. 2 vols. square crown 8vo. with Woodcuts, 25*s.*

The RURAL LIFE of ENGLAND. By the same Author. With Woodcuts by Bewick and Williams. Medium 8vo. 12*s.* 6*d.*

ROMA SOTTERRANEA; or, an Account of the Roman Catacombs, especially of the Cemetery of San Callisto. Compiled from the Works of Commendatore G. B. DE ROSSI by the Rev. J. S. NORTHCOTE, D.D. and the Rev. W. B. BROWNLOW. With numerous Illustrations. 8vo. 31*s.* 6*d.*

PILGRIMAGES in the PYRENEES and LANDES. By DENYS SHYNE LAWLOR. Crown 8vo. with Frontispiece and Vignette, price 15*s.*

Works of *Fiction.*

LOTHAIR. By the Right Hon. B. DISRAELI, M.P. Cabinet Edition (the Eighth), complete in One Volume, with a Portrait of the Author, and a New General Preface. Crown 8vo. price 6*s.*—By the Same Author, Cabinet Editions, revised, uniform with the above :—

- CONINGSBY, 6*s.*
- SYBIL, 6*s.*
- TANCRED, 6*s.*
- VENETIA, 6*s.*
- HENRIETTA TEMPLE, 6*s.*
- CONTARINI FLEMING AND RISE OF ISKANDER, 6*s.*
- ALROY; IXION; THE INFERNAL MARRIAGE; AND POPANILLA Price 6*s.*
- YOUNG DUKE AND COUNT ALARCOS, 6*s.*
- VIVIAN GREY, 6*s.*

The MODERN NOVELIST'S LIBRARY. Each Work, in crown 8vo. complete in a Single Volume :—

MELVILLE'S GLADIATORS, 2*s.* boards; 2*s.* 6*d.* cloth.
——— GOOD FOR NOTHING, 2*s.* boards; 2*s.* 6*d.* cloth.
——— HOLMBY HOUSE, 2*s.* boards; 2*s.* 6*d.* cloth.
——— INTERPRETER, 2*s.* boards; 2*s.* 6*d.* cloth.
——— QUEEN'S MARIES, 2*s.* boards; 2*s.* 6*d.* cloth.
TROLLOPE'S WARDEN, 1*s.* 6*d.* boards; 2*s.* cloth.
——— BARCHESTER TOWERS, 2*s.* boards; 2*s.* 6*d.* cloth.
BRAMLEY-MOORE'S SIX SISTERS *of the* VALLEYS, 2*s.* boards; 2*s.* 6*d.* cloth.

IERNE; a Tale. By W. STEUART TRENCH, Author of 'Realities of Irish Life.' Second Edition. 2 vols. post 8vo. price 21*s.*

THREE WEDDINGS. By the Author of 'Dorothy,' 'De Cressy,' &c. Fcp. 8vo. price 5*s.*

STORIES and TALES by ELIZABETH M. SEWELL, Author of 'Amy Herbert,' Cabinet Edition, each work complete in a single Volume:—

- AMY HERBERT, 2*s.* 6*d.*
- GERTRUDE, 2*s.* 6*d.*
- EARL'S DAUGHTER, 2*s.* 6*d.*
- EXPERIENCE *of* LIFE, 2*s.* 6*d.*
- CLEVE HALL, 3*s.* 6*d.*
- IVORS, 3*s.* 6*d.*
- KATHARINE ASHTON, 3*s.* 6*d.*
- MARGARET PERCIVAL, 5*s.*
- LANETON PARSONAGE, 4*s.* 6*d.*
- URSULA, 4*s.* 6*d.*

STORIES and TALES. By E. M. SEWELL. Comprising:—Amy Herbert; Gertrude; The Earl's Daughter; The Experience of Life; Cleve Hall; Ivors; Katharine Ashton; Margaret Percival; Laneton Parsonage; *and* Ursula. The Ten Works, complete in Eight Volumes, crown 8vo. bound in leather, and contained in a Box, price 42*s.*

A Glimpse of the World. By the Author of 'Amy Herbert.' Fcp. 7*s.* 6*d.*

The Journal of a Home Life. By the same Author. Post 8vo. 9*s.* 6*d.*

After Life; a Sequel to 'The Journal of a Home Life.' Price 10*s.* 6*d.*

UNCLE PETER'S FAIRY TALE for the NINETEENTH CENTURY. Edited by E. M. SEWELL, Author of 'Amy Herbert,' &c. Fcp. 8vo. 7*s.* 6*d.*

THE GIANT; A Witch's Story for English Boys. By the same Author and Editor. Fcp. 8vo. price 5*s.*

WONDERFUL STORIES from NORWAY, SWEDEN, and ICELAND. Adapted and arranged by JULIA GODDARD. With an Introductory Essay by the Rev. G. W. COX, M.A. and Six Woodcut Illustrations from Designs by W. J. Weigand. Square post 8vo. 6*s.*

A VISIT to MY DISCONTENTED COUSIN. Reprinted, with some Additions, from *Fraser's Magazine.* Crown 8vo. price 7*s.* 6*d.*

BECKER'S GALLUS; or, Roman Scenes of the Time of Augustus: with Notes and Excursuses. New Edition. Post 8vo. 7*s.* 6*d.*

BECKER'S CHARICLES; a Tale illustrative of Private Life among the Ancient Greeks: with Notes and Excursuses. New Edition. Post 8vo. 7*s.* 6*d.*

NOVELS and TALES by G. J. WHYTE MELVILLE :—

The GLADIATORS, 5*s.*
DIGBY GRAND, 5*s.*
KATE COVENTRY, 5*s.*
GENERAL BOUNCE, 5*s.*
HOLMBY HOUSE, 5*s.*
GOOD *for* NOTHING, 6*s.*
The QUEEN'S MARIES, 6*s.*
The INTERPRETER, 5*s.*

TALES of ANCIENT GREECE. By GEORGE W. COX, M.A. late Scholar of Trin. Coll. Oxon. Being a Collective Edition of the Author's Classical Stories and Tales, complete in One Volume. Crown 8vo. 6*s.* 6*d.*

A MANUAL of MYTHOLOGY, in the form of Question and Answer. By the same Author. Fcp. 3*s.*

OUR CHILDREN'S STORY, by one of their Gossips. By the Author of 'Voyage en Zigzag,' 'Pictures in Tyrol,' &c. Small 4to. with Sixty Illustrations by the Author, price 10*s.* 6*d.*

Poetry and *The Drama.*

THOMAS MOORE'S POETICAL WORKS, the only Editions containing the Author's last Copyright Additions :—

CABINET EDITION, 10 vols. fcp. 8vo. price 35*s.*
SHAMROCK EDITION, crown 8vo. price 3*s.* 6*d.*
RUBY EDITION, crown 8vo. with Portrait, price 6*s.*
LIBRARY EDITION, medium 8vo. Portrait and Vignette, 14*s.*
PEOPLE'S EDITION, square crown 8vo. with Portrait, &c. 10*s.* 6*d.*

MOORE'S IRISH MELODIES, Maclise's Edition, with 161 Steel Plates from Original Drawings. Super-royal 8vo. 31*s.* 6*d.*

Miniature Edition of Moore's Irish Melodies with Maclise's Designs (as above) reduced in Lithography. Imp. 16mo. 10*s.* 6*d.*

MOORE'S LALLA ROOKH. Tenniel's Edition, with 68 Wood Engravings from original Drawings and other Illustrations. Fcp. 4to. 21*s.*

SOUTHEY'S POETICAL WORKS, with the Author's last Corrections and copyright Additions. Library Edition, in 1 vol. medium 8vo. with Portrait and Vignette, 14*s.*

LAYS of ANCIENT ROME; with *Ivry* and the *Armada.* By the Right Hon. LORD MACAULAY. 16mo. 4*s.* 6*d.*

Lord Macaulay's Lays of Ancient Rome. With 90 Illustrations on Wood, from the Antique, from Drawings by G. SCHARF. Fcp. 4to. 21*s.*

Miniature Edition of Lord Macaulay's Lays of Ancient Rome, with the Illustrations (as above) reduced in Lithography. Imp. 16mo. 10*s.* 6*d.*

GOLDSMITH'S POETICAL WORKS, with Wood Engravings from Designs by Members of the ETCHING CLUB. Imperial 16mo. 7*s.* 6*d.*

POEMS OF BYGONE YEARS. Edited by the Author of 'Amy Herbert,' &c. Fcp. 8vo. price 5*s.*

POEMS. By JEAN INGELOW. Fifteenth Edition. Fcp. 8vo. 5*s.*

POEMS by Jean Ingelow. With nearly 100 Illustrations by Eminent Artists, engraved on Wood by the Brothers DALZIEL. Fcp. 4to. 21*s.*

MOPSA the FAIRY. By Jean Ingelow. Pp. 256, with Eight Illustrations engraved on Wood. Fcp. 8vo. 6*s.*

A STORY of DOOM, and other Poems. By Jean Ingelow. Third Edition. Fcp. 5*s.*

The STORY of SIR RICHARD WHITTINGTON, Thrice Lord Mayor of London, A.D. 1397, 1406-7, and 1419. Written in Verse and Illustrated by E. Carr. With Ornamental Borders &c. on Wood, and 11 Copper-Plates Royal 4to. 21*s.*

WORKS by EDWARD YARDLEY:—

Fantastic Stories. Fcp. 3*s.* 6*d.*
Melusine and other Poems. Fcp. 5*s.*
Horace's Odes, translated into English Verse. Crown 8vo. 6*s.*
Supplementary Stories and Poems. Fcp. 3*s.* 6*d.*

GLAPHYRA, and OTHER POEMS By Francis Reynolds, Author of 'Alice Rushton, and other Poems.' 16mo. price 5*s.*

BOWDLER'S FAMILY SHAKSPEARE, cheaper Genuine Editions: Medium 8vo. large type, with 36 Woodcuts, price 14*s.* Cabinet Edition, with the same Illustrations, 6 vols. fcp. 3*s.* 6*d.* each.

HORATII OPERA, Pocket Edition, with carefully corrected Text, Marginal References, and Introduction. Edited by the Rev. J. E. Yonge, M.A. Square 18mo. 4*s.* 6*d.*

HORATII OPERA. Library Edition, with Marginal References and English Notes. Edited by the Rev. J. E. Yonge. 8vo. 21*s.*

The ÆNEID of VIRGIL Translated into English Verse. By John Conington, M.A. New Edition. Crown 8vo. 9*s.*

ARUNDINES CAMI, sive Musarum Cantabrigiensium Lusus canori. Collegit atque edidit H. Drury, M.A. Editio Sexta, curavit H. J. Hodgson, M.A. Crown 8vo. 7*s.* 6*d.*

HUNTING SONGS and MISCELLANEOUS VERSES. By R. E. Egerton Warburton. Second Edition. Fcp. 8vo. 5*s.*

The SILVER STORE collected from Mediæval Christian and Jewish Mines. By the Rev. Sabine Baring-Gould, M.A. Crown 8vo. 3*s.* 6*d.*

Rural Sports, &c.

ENCYCLOPÆDIA of RURAL SPORTS; a complete Account, Historical, Practical, and Descriptive, of Hunting, Shooting, Fishing, Racing, and all other Rural and Athletic Sports and Pastimes. By D. P. Blaine. With above 600 Woodcuts (20 from Designs by John Leech). 8vo. 21*s.*

The DEAD SHOT, or Sportsman's Complete Guide; a Treatise on the Use of the Gun, Dog-breaking, Pigeon-shooting, &c. By Marksman. Revised Edition. Fcp. 8vo. with Plates, 5*s.*

The FLY-FISHER'S ENTOMOLOGY. By Alfred Ronalds. With coloured Representations of the Natural and Artificial Insect. Sixth Edition; with 20 coloured Plates. 8vo. 14*s.*

A BOOK on ANGLING; a complete Treatise on the Art of Angling in every branch. By Francis Francis. Second Edition, with Portrait and 15 other Plates, plain and coloured. Post 8vo. 15*s.*

The BOOK of the ROACH. By GREVILLE FENNELL, of 'The Field.' Fcp. 8vo. price 2*s.* 6*d.*

WILCOCKS'S SEA-FISHERMAN; comprising the Chief Methods of Hook and Line Fishing in the British and other Seas, a Glance at Nets, and Remarks on Boats and Boating. Second Edition, enlarged; with 80 Woodcuts. Post 8vo. 12*s.* 6*d.*

HORSES and STABLES. By Colonel F. FITZWYGRAM, XV. the King's Hussars. With Twenty-four Plates of Illustrations, containing very numerous Figures engraved on Wood. 8vo. 15*s.*

The HORSE'S FOOT, and HOW to KEEP IT SOUND. By W. MILES, Esq. Ninth Edition, with Illustrations. Imperial 8vo. 12*s.* 6*d.*

A PLAIN TREATISE on HORSE-SHOEING. By the same Author. Sixth Edition. Post 8vo. with Illustrations, 2*s.* 6*d.*

STABLES and STABLE-FITTINGS. By the same. Imp. 8vo. with 13 Plates, 15*s.*

REMARKS on HORSES' TEETH, addressed to Purchasers. By the same. Post 8vo. 1*s.* 6*d.*

ROBBINS'S CAVALRY CATECHISM, or Instructions on Cavalry Exercise and Field Movements, Brigade Movements, Out-post Duty, Cavalry supporting Artillery, Artillery attached to Cavalry. 12mo. 5*s.*

BLAINE'S VETERINARY ART; a Treatise on the Anatomy, Physiology, and Curative Treatment of the Diseases of the Horse, Neat Cattle and Sheep. Seventh Edition, revised and enlarged by C. STEEL, M.R.C.V.S.L. 8vo. with Plates and Woodcuts, 18*s.*

The HORSE: with a Treatise on Draught. By WILLIAM YOUATT. New Edition, revised and enlarged. 8vo. with numerous Woodcuts, 12*s.* 6*d.*

The Dog. By the same Author. 8vo. with numerous Woodcuts, 6*s.*

The DOG in HEALTH and DISEASE. By STONEHENGE. With 70 Wood Engravings. Square crown 8vo. 10*s.* 6*d.*

The GREYHOUND. By STONEHENGE. Revised Edition, with 24 Portraits of Greyhounds. Square crown 8vo. 10*s.* 6*d.*

The OX; his Diseases and their Treatment: with an Essay on Parturition in the Cow. By J. R. DOBSON. Crown 8vo. with Illustrations, 7*s.* 6*d.*

Commerce, Navigation, and *Mercantile Affairs.*

The ELEMENTS of BANKING. By HENRY DUNNING MACLEOD, M.A. Barrister-at-Law. Post 8vo. [*Nearly ready.*

The THEORY and PRACTICE of BANKING. By the same Author Second Edition, entirely remodelled. 2 vols. 8vo. 30*s.*

A DICTIONARY, Practical, Theoretical, and Historical, of Commerce and Commercial Navigation. By J. R. M'CULLOCH, Esq. New and thoroughly revised Edition. 8vo. price 63*s.* cloth, or 70*s.* half-bd. in russia.

The LAW of NATIONS Considered as Independent Political Communities. By Sir TRAVERS TWISS, D.C.L. 2 vols. 8vo. 30*s.*, or separately, PART I. *Peace*, 12*s.* PART II. *War*, 18*s.*

Works of *Utility* and *General Information.*

The CABINET LAWYER; a Popular Digest of the Laws of England, Civil, Criminal, and Constitutional: intended for Practical Use and General Information. Twenty-third Edition, corrected and brought up to the Present Date. Fcp. 8vo. price 7*s.* 6*d.*

PEWTNER'S COMPREHENSIVE SPECIFIER; A Guide to the Practical Specification of every kind of Building-Artificers' Work; with Forms of Building Conditions and Agreements, an Appendix, Foot-Notes, and a copious Index. Edited by W. YOUNG, Architect. Crown 8vo. price 6*s.*

The LAW RELATING to BENEFIT BUILDING SOCIETIES; with Practical Observations on the Act and all the Cases decided thereon; also a Form of Rules and Forms of Mortgages. By W. TIDD PRATT, Barrister. Second Edition. Fcp. 3*s.* 6*d.*

COLLIERIES and COLLIERS: a Handbook of the Law and Leading Cases relating thereto. By J. C. FOWLER, of the Inner Temple, Barrister, Stipendiary Magistrate for the District of Merthyr Tydfil and Aberdare. Second Edition. Fcp. 8vo. 7*s.* 6*d.*

The MATERNAL MANAGEMENT of CHILDREN in HEALTH and Disease. By THOMAS BULL, M.D. Fcp. 5*s.*

HINTS to MOTHERS on the MANAGEMENT of their HEALTH during the Period of Pregnancy and in the Lying-in Room. By the late THOMAS BULL, M.D. Fcp. 5*s.*

NOTES on HOSPITALS. By FLORENCE NIGHTINGALE. Third Edition, enlarged; with 13 Plans. Post 4to. 18*s.*

CHESS OPENINGS. By F. W. LONGMAN, Balliol College, Oxford. Fcp. 8vo. 2*s.* 6*d.*

A PRACTICAL TREATISE on BREWING; with Formulæ for Public Brewers, and Instructions for Private Families. By W. BLACK. 8vo. 10*s.* 6*d.*

MODERN COOKERY for PRIVATE FAMILIES, reduced to a System of Easy Practice in a Series of carefully-tested Receipts. By ELIZA ACTON. Newly revised and enlarged Edition; with 8 Plates of Figures and 150 Woodcuts. Fcp. 6*s.*

WILLICH'S POPULAR TABLES, for ascertaining, according to the Carlisle Table of Mortality, the value of Lifehold, Leasehold, and Church Property, Renewal Fines, Reversions, &c. Also Interest, Legacy, Succession Duty, and various other useful Tables. Seventh Edition, edited by MONTAGUE MARRIOTT, Barrister-at-Law. Post 8vo. price 10*s.*

COULTHART'S DECIMAL INTEREST TABLES at 24 Different Rates not exceeding 5 per Cent. Calculated for the use of Bankers. To which are added Commission Tables at One-Eighth and One-Fourth per Cent. 8vo. price 15*s.*

MAUNDER'S TREASURY of KNOWLEDGE and LIBRARY of Reference: comprising an English Dictionary and Grammar, Universal Gazetteer, Classical Dictionary, Chronology, Law Dictionary, a Synopsis of the Peerage, useful Tables, &c. Revised Edition. Fcp. 8vo. price 6*s.*

INDEX

LONDON: PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET

66