A text-book of pharmacology, therapeutics and materia medica / by T. Lauder Brunton ; adapted to the United States Pharmacopoeia by Francis H. Williams.

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the British Homœopathic Congress at Norwich, says, with regard to the action of quinine in ague, that 'it was this very instance of successful empirical treatment, of specific medicinal action, that led Hahnemann first to investigate the actions of drugs on the healthy human frame, and thus to lay the foundation of the most complete and lucid system of scientific therapeutics that the world has yet seen.' But I have shown in the body of this work (p. 52) that, although Hahnemann's observations were in all probability perfectly correct, the conclusions he drew from them were utterly erroneous.

But there is another side to the question which I think it is only fair to consider also. While Hahnemann's theory was certainly bad, there can, I think, be little doubt that he, like Paracelsus and Priessnitz, has done good service to medical practice. Paracelsus gathered information from shepherds, wise women, and quacks of all sorts, and thereby obtained a knowledge of popular remedies, not generally employed by the profession, but which were nevertheless useful.

Priessnitz did not invent the use of cold water as a remedy, for it was known nearly eighteen hundred years before his time. Musa saved the life of Augustus by the cold bath, but, not knowing exactly how and when to employ it, he killed the nephew of the Emperor by it, and such failures brought the treatment by water into discredit. Priessnitz revived it, and now in the use of cold sponging, wet packs, baths and douches we have a powerful means of treating fever and curing disease.

Hahnemann also did good, and the system which he founded has done great service by teaching us the curative power of unaided Nature, the use of diet and regimen in treating disease, and the more than inutility, the actual hurtfulness, of powerful drugs in many instances. The physician is bound to do the very utmost he can for his patient, and his very anxiety has frequently led him to do harm. He has been afraid to leave the cure of disease to Nature, and by the administration of powerful drugs has frequently injured instead of benefited his patient. The use of infinitesimal doses which could not affect the body of the patient one way or the other, but kept the mind of both patient and physician easy, and allowed the *vis medicatrix naturæ* free scope, has helped us to a more perfect knowledge of the natural course of disease. The use of infinitesimal doses has also led to much care being bestowed by those who use them upon diet and regimen. When a physician administered a large dose

of tartar emetic or of salts and senna, he knew that his remedies would produce vomiting or purgation respectively with considerable certainty, whatever the diet or regimen of the patient might be; but the case was quite different with infinitesimal doses. If a patient was being treated with *carbo vegetabilis* in the thirtieth dilution, the utmost care was necessary in regard to his diet, for if he happened to eat a single piece of burned toast at breakfast, he would consume at the one meal as much vegetable charcoal as would, when properly diluted, have served him for medicine during the remainder of his natural life.

Moreover, the homœopathic practice of giving only one drug has tended greatly to diminish the practice of polypharmacy, and the tinctures, powders, and globules they employ show us a good example in regard to the administration of remedies in an agreeable form. But, although this mode of practice may be employed by homœopaths, it is not homœopathic. We are not homœopaths because we use a single drug at a time and give half an ounce of infusion of digitalis to a patient suffering from heart-disease without thinking it necessary to mix it with broom, squill, or spirit of nitrous ether. Nor are we homœopaths because we use 1–50th of a grain of digitalin instead of the infusion of digitalis. Nor are we homœopaths even if we get a manufacturing chemist to make up the digitalin into a globule with a quarter of a grain of sugar of milk instead of with five grains of extract of liquorice. Nor do we become homœopaths merely because we may employ a small dose instead of a large one, and begin with ten drops of the infusion of digitalis instead of half an ounce.

It is not the use of a single drug at a time, of a small dose, of a globule, nor even, as we have already seen, of a drug which may produce symptoms similar to those of the disease, that constitutes homœopathy. The essence of homœopathy, as established by Hahnemann, lies in the infinitesimal dose and the universal application of the rule *similia similibus curantur*. But the infinitesimal doses are so absurd that I believe they have been discarded by many homœopaths. To such men all that remains of homœopathy is the universality of the rule *similia similibus curantur*, and the only difference between them and rational practitioners lies in the fact that the latter regard the rule as only of partial application. At first sight this difference may seem to be only slight, but it is not so in reality; for while the rational practitioner, refusing to be bound by any 'pathy,' whether it be allopathy, antipathy, or homœopathy, seeks to

trace each symptom back to the pathological change which caused it, and, by a knowledge of the action of drugs on each tissue and organ of the body, to counteract these pathological changes, the homœopath professes to be in possession of a rule which will enable him to select the proper remedy in each case by a consideration of the symptoms, without reference to the pathological condition. He may thus dispense with anatomy, physiology, pathology, and pharmacology. All that is necessary is a list of morbid symptoms on the one hand, and a list of the symptoms produced in healthy men by various drugs on the other.

It is the falsity of the claim which homœopathy makes to be in possession, if not of the universal panacea, at least of the only true rule of practice, that makes homœopathy a system of quackery; yet this arrogant claim constitutes the essence of the system, and the man who, leaving Hahnemann and going back to Hippocrates, regards the rule *similia similibus curantur* as only of partial and not of universal application, has no longer any right to call himself a homœopath.

Yet we hear some leading homœopaths say, 'We do not claim any exclusiveness for our method,'[1] and then complain that they are excommunicated by the medical profession. If they have renounced the errors of Hahnemann's system, they ought not to retain its name, but frankly acknowledge their error and return to rational medicine, of which Hippocrates is regarded as the father. As a medical man is bound to do his utmost for the good of his patient, it is obvious that, although he may employ baths or packs as a mode of treatment, he cannot, without becoming untrue to his profession, throw aside all other means of treatment and become a hydropath; nor can he consult on equal terms with those who, either through ignorance or wilful blindness, deny the use of other means of cure and limit themselves to the application of water. What is true of hydropathy is true of homœopathy. I dislike controversy extremely, and should not have taken up so much of the preface with controversial matter had I not been forced to defend myself by the attacks which certain homœopaths have made upon me.

I may now turn to the pleasanter task of acknowledging my indebtedness to many friends who have helped me in the preparation of this edition. In addition to some of those who helped me with former editions, I have to thank Dr. Hughlings

[1] Preface by Richard Hughes to *The Medical Treatment of our Time*. London: Unwin Brothers, Ludgate Hill.

Jackson for assistance in the construction of the diagram which illustrates his views of the nervous system; Mr. W. H. Jessop and Mr. Tweedy for much aid and many suggestions in revising the section on diseases of the eye; and I am especially grateful to my friend, Dr. Thin, who has greatly added to the value of the book by writing an account of the uses of various remedies in skin diseases. I am indebted to Mr. Whitehead, Dr. Halliburton, and especially to Dr. Sidney Martin, for their assistance in passing this edition through the press. To Dr. Martin I am also indebted for many valuable suggestions, and for such an amount of help that, but for him, the preparation of this edition would certainly have been delayed for many months.

T. LAUDER BRUNTON.

March, 1887.

PREFACE

TO

THE FIRST EDITION.

Some apology is required for the long delay in the appearance of this work, for a number of years have now elapsed since it was advertised as being in the press. More than fifteen years ago, I had a work on *Materia Medica* completely written out and ready for the printer. Some time afterwards, all the arrangements had been made for its publication, and in the course of a few weeks it was to have been issued from the press. Just as I was about to send it to the printer, however, I asked for a little delay in order that I might make some improvements and remove some redundancies, for the work as it then stood was considerably larger than the present one.

As I went through it, I found so many unsatisfactory statements and uncertainties regarding the mode of action of drugs, which I thought I could decide by a few experiments, that I wished for a little time in order that those doubtful points might be settled; but as I went on the labour grew, other engagements became pressing, and longer and longer delay was required. From greater experience as a teacher and examiner also, I came to the conclusion that the plan of the work might be altered with advantage; and so finally the whole manuscript was thrown aside, and the book entirely re-written.

In the original work I discussed the physiological and therapeutical actions of each drug separately, in the same way as in the third part of the present work, though on a much more extended scale. I found, however, that this plan necessitated a good deal of repetition regarding the experimental methods by which the action of the drugs had been ascertained.

Moreover, the physician does not want to know only what the actions of any one drug are; he rather requires a knowledge of

classes of drugs, and of the manner in which the actions of the individual members of a class differ from each other. He requires, in fact, a knowledge of the ways in which the various functions of the body can be influenced by drugs both in health and disease, in order that he may restore health to his patients.

It has appeared to me, therefore, better to devote a complete section of the work to a discussion of the methods by which the action of drugs is determined; to the manner in which each function of the body can be modified by drugs; and to the general *rationale* of the use of drugs in disease, *i.e.* to devote a section to general pharmacology and general therapeutics.

Considerable experience both in teaching and examining has shown me that students sometimes find a difficulty in applying physiology to pharmacology and therapeutics, and I find that many others are, like myself, apt to forget those parts of physiology which they are not constantly studying. I have therefore thought it well, for the sake both of students and practitioners, to give a short account of the normal functions of the different parts of the body, before proceeding to discuss the alterations which are produced in them by drugs, or which they undergo in disease. In the case of the heart and the kidneys also, where the action of drugs is complicated and difficult, I have found it necessary to enter a little more fully into the physiology of these organs than is done in the ordinary text-books.

I have found that a similar difficulty occurs with pathology as with physiology, and I have therefore occasionally discussed pathological questions when I have thought that by doing so I could render the action of drugs in disease more intelligible, and thus aid the student of rational therapeutics.

In the second part of the work on general pharmacy, I have classed together the various pharmaceutical preparations, and given lists of them for reference. It is by no means my intention that these should be learned by heart by any student, and indeed I think it is well to take this opportunity of protesting against the injustice of the demands which are sometimes made upon the memories of students.

It is probable that the majority of the best and most successful practitioners would be very much puzzled if they were required to state the exact quantity of every ingredient in each pill or each ointment that they prescribe, or the exact quantity of the crude drug from which the infusions or tinctures which they use have been made. They know the action of the pill or ointment, they

know the action of the infusion or tincture, and they do not trouble themselves about details which are only useful to the chemist who is making up the preparation.

It is very greatly to be regretted, for it is a stumbling-block in the way of true progress, that students who have afterwards to become medical practitioners and not pharmaceutical chemists, should be asked at examinations the quantities of crude drugs from which particular preparations are made—quantities which even the manufacturing chemist himself would never dream of carrying in his memory, but would obtain by reference to his books whenever he required them. As the late Professor Sharpey used very truly to say, 'You may as well require of a medical student a knowledge of the whole art of cutlery before you set him to dissect.' Medical science is now advancing in every direction, and unless we cut off some of the less useful kinds of information, which medical students were formerly obliged to acquire, it becomes impossible for them to learn all that is truly valuable. In Materia Medica we now oblige them to learn the physiological action of drugs, a subject regarding which, until quite recently, little or nothing was known, and to oblige them to learn all this, in addition to what they were formerly expected to know, is to treat them as Pharaoh treated the Israelites, and compel them to make the same number of bricks, while giving them no straw.

I am so much impressed with the necessity of lessening the amount of unnecessary work sometimes required as a preparation for examinations, that at first I omitted from this book all reference to the composition of pharmaceutical preparations. But as it is intended not only as a text-book for students, but also for the use of practitioners, I afterwards considered that it might be convenient to have the composition of some pharmaceutical preparations, at least, for the purpose of reference. I have omitted the composition of such preparations as are like to be got ready-made from a chemist, but have inserted the composition of infusions which often need to be prepared when required. I have also given the composition of various compound pills, but only for the purpose of reference.

In consequence of this change in the plan of the work while it was passing through the press, the preparations of rhubarb have been omitted from their proper place at page 924, and are to be found at page 1005.

In the preparation of this work I have to acknowledge my

obligations to the admirable works of Bartholow, Binz, Buchheim, Dujardin-Beaumetz, Edes, Husemann, Nothnagel and Rossbach, Ringer, Schmiedeberg, and H. C. Wood. Messrs. Chapman, Soutter, Spencer, Spry,[1] Steinthal, Stubbs, Walsh,[1] Wells, and Wright for the excellent notes they took of my lectures; to Dr. D'Arcy Power for the verification of references; to Dr. Mitchell Bruce, Mr. T. W. Shore, and Mr. H. W. Gardner for much kind assistance in the preparation of the work, and to Prof. Matthew Hay, of Aberdeen, whose criticisms and suggestions have been invaluable. To Dr. Francis H. Williams, of Boston, Mass., I am indebted for the adaptation of this work to the United States Pharmacopœia, which by tending to familiarise medical men on each side of the Atlantic with the preparations employed in both countries may, I trust, tend to facilitate the introduction of an International Pharmacopœia.

T. LAUDER BRUNTON.

March, 1885.

[1] These names were inadvertently omitted in the preface to the first edition, but were mentioned in the preface to the second.

Articles and Preparations included in the British Pharmacopœia of 1885, which were not in that of 1867 nor in the 'Additions' of 1874.

Acidum Boricum.
Acidum Carbolicum Liquefactum.
Acidum Chromicum.
Acidum Hydrobromicum Dilutum.
Acidum Lacticum.
Acidum Lacticum Dilutum.
Acidum Meconicum.
Acidum Oleicum.
Acidum Phosphoricum Concentratum.
Acidum Salicylicum.
Alcohol Ethylicum.
Aloin.
Anisi Fructus.
Anisi Stellati Fructus.
Apomorphinæ Hydrochloras.
Aqua Anisi.
Argenti et Potassii Nitras.
Arsenii Iodidum.
Bismuthi Citras.
Bismuthi et Ammonii Citras.
Butyl-Chloral Hydras.
Caffeina.
Caffeinæ Citras.
Calamina Preparata.
Calcii Sulphas.
Calx Sulphurata.
Chrysarobinum.
Cimicifugæ Rhizoma.
Cinchonidinæ Sulphas.
Cinchoninæ Sulphas.
Coca.
Cocainæ Hydrochloras.
Codeina.
Collodium Vesicans.
Cupri Nitras.
Elaterinum.
Ergotinum.
Extractum Belladonnæ Alcoholicum.
Extractum Cascaræ Sagradæ.
Extractum Cascaræ Sagradæ Liquidum.
Extractum Cimicifugæ Liquidum.
Extractum Cocæ Liquidum.
Extractum Gelsemii Alcoholicum.
Extractum Jaborandi.
Extractum Rhamni Frangulæ.
Extractum Rhamni Frangulæ Liquidum.
Extractum Taraxaci Liquidum.
Gelsemium.
Glycerinum Aluminis.
Glycerinum Plumbi Subacetatis.
Glycerinum Tragacanthæ.
Infusum Jaborandi.
Injectio Apomorphinæ Hypodermica.
Injectio Ergotini Hypodermica.
Iodoformum.
Jaborandi.
Lamellæ Atropinæ.
Lamellæ Cocainæ.
Lamellæ Physostigminæ.
Liquor Acidi Chromici.
Liquor Ammonii Acetatis Fortior.
Liquor Ammonii Citratis Fortior.
Liquor Arsenii et Hydrargyri Iodidi.
Liquor Calcii Chloridi.
Liquor Ferri Acetatis.
Liquor Ferri Acetatis Fortior.
Liquor Ferri Dialysatus.
Liquor Morphinæ Bimeconatis.
Liquor Sodii Ethylatis.
Lupulinum.
Menthol.
Morphinæ Sulphas.
Oleatum Hydrargyri.
Oleatum Zinci.
Oleo-Resina Cubebæ.
Oleum Eucalypti.
Oleum Pini Sylvestris.
Oleum Santali.

Paraffinum Durum.
Paraffinum Molle.
Physostigmina.
Pilocarpinæ Hydrochloras.
Potassii Cyanidum.
Quininæ Hydrochloras.
Rhamni Frangulæ Cortex.
Rhamni Purshiani Cortex.
Salicinum.
Sodii Bromidum.
Sodii Iodidum.
Sodii Salicylas.
Sodii Sulphis.
Sodii Sulphocarbolas.
Sodium.
Spiritus Ætheris Compositus.
Spiritus Cinnamomi.
Staphisagriæ Semina.
Suppositoria Iodoformi.
Tabellæ Nitroglycerini.
Thymol.
Tinctura Chloroformi et Morphinæ.
Tinctura Cimicifugæ.
Tinctura Gelsemii.
Tinctura Jaborandi.
Tinctura Podophylli.
Trochisci Acidi Benzoici.
Trochisci Santonini.
Unguentum Acidi Borici.
Unguentum Acidi Carbolici.
Unguentum Acidi Salicylici.
Unguentum Calaminæ.
Unguentum Chrysarobini.
Unguentum Eucalypti.
Unguentum Hydrargyri Nitratis Dilutum.
Unguentum Iodoformi.
Unguentum Staphisagriæ.
Unguentum Zinci Oleati.
Vapor Olei Pini Sylvestris.
Zinci Sulphocarbolas.

Articles and Preparations included in the British Pharmacopœia of 1867 or in the 'Additions' of 1874, but omitted in the British Pharmacopœia of 1885.

Areca.
Cadmii Iodidum.
Castoreum.
Decoctum Ulmi.
Digitalinum.
Dulcamara.
Enema Tabaci.
Ferri Iodidum.
Ferri Oxidum Magneticum.
Ferri Peroxidum Humidum.
Hydrargyri Iodidum Viride.
Infusum Dulcamaræ.
Liquor Atropiæ.
Mistura Gentianæ.
Pilula Quiniæ.
Rhamni Succus.
Sodæ Acetas.
Stramonii Folia.
Syrupus Rhamni.
Tinctura Castorei.
Ulmi Cortex.
Unguentum Cadmii Iodidi.

Articles and Preparations the Names of which have been altered.

Former Names, 1867 or 1874.	Present Names, 1885.
Aconitia	Aconitina.
Albumen Ovi	Ovi Albumen.
Ammoniæ Benzoas	Ammonii Benzoas.
Ammoniæ Carbonas	Ammonii Carbonas.
Ammoniæ Nitras	Ammonii Nitras.
Ammoniæ Phosphas	Ammonii Phosphas.
Arnicæ Radix	Arnicæ Rhizoma.

Former Names, 1867 or 1874.	Present Names, 1885.
Assafœtida	Asafœtida.
Atropia	Atropina.
Atropiæ Sulphas	Atropinæ Sulphas.
Berberiæ Sulphas	Beberinæ Sulphas
Calcis Carbonas Præcipitata	Calcii Carbonas Precipitata.
Calcis Hydras	Calcii Hydras.
Calcis Hypophosphis	Calcii Hydrophosphis.
Calcis Phosphas	Calcii Phosphas.
Calx Chlorata	Calx Chlorinata.
Canellæ Albæ Cortex	Canellæ Cortex.
Cardamomum	Cardamomi Semina.
Cataplasma Sodæ Chloratæ	Cataplasma Sodæ Chlorinatæ.
Catechu Pallidum	Catechu.
Cinchonæ Flavæ Cortex	Cinchonæ Cortex.
Cinchonæ Pallidæ Cortex	Cinchonæ Cortex.
Decoctum Cinchonæ Flavæ	Decoctum Cinchonæ [Rubræ].
Ecbalii Fructus	Ecballii Fructus.
Emplastrum Cerati Saponis	Emplastrum Saponis Fuscum.
Enema Assafœtidæ	Enema Asafœtidæ.
Enema Magnesiæ Sulphatis	Enema Magnesii Sulphatis.
Extractum Cinchonæ Flavæ Liquidum	Extractum Cinchonæ [Rubræ] Liquidum.
Ferri et Ammoniæ Citras	Ferri et Ammonii Citras.
Ferri et Quiniæ Citras	Ferri et Quininæ Citras.
Hydrargyri Sulphas	Hydrargyri Persulphas.
Infusum Cinchonæ Flavæ	Infusum Cinchonæ [Rubræ] Acidum.
Liquor Ammoniæ Acetatis	Liquor Ammonii Acetatis.
Liquor Ammoniæ Citratis	Liquor Ammonii Citratis.
Liquor Atropiæ Sulphatis	Liquor Atropinæ Sulphatis.
Liquor Bismuthi et Ammoniæ Citratis	Liquor Bismuthi et Ammonii Citratis.
Liquor Calcis Chloratæ	Liquor Calcis Chlorinatæ.
Liquor Magnesiæ Carbonatis	Liquor Magnesii Carbonatis.
Liquor Magnesiæ Citratis	Liquor Magnesii Citratis.
Liquor Morphiæ Acetatis	Liquor Morphinæ Acetatis.
Liquor Morphiæ Hydrochloratis	Liquor Morphinæ Hydrochloratis.
Liquor Potassæ Permanganatis	Liquor Potassii Permanganatis.
Liquor Sodæ Arseniatis	Liquor Sodii Arseniatis.
Liquor Sodæ Chloratæ	Liquor Sodæ Chlorinatæ.
Liquor Strychniæ	Liquor Strychninæ Hydrochloratis.
Lithiæ Carbonas	Lithii Carbonas.
Lithiæ Citras	Lithii Citras.
Magnesia	Magnesia Ponderosa.
Magnesiæ Carbonas	Magnesii Carbonas Ponderosa.
Magnesiæ Carbonas Levis	Magnesii Carbonas Levis.
Magnesiæ Sulphas	Magnesii Sulphas.
Morphiæ Acetas	Morphinæ Acetas.
Morphiæ Hydrochloras	Morphinæ Hydrochloras.
Physostigmatis Faba	Phosostigmatis Semen.
Pilula Aloes et Assafœtidæ	Pilula Aloes et Asafœtidæ.
Pilula Assafœtidæ Composita	Pilula Asafœtidæ Composita.
Podophylli Radix	Podophylli Rhizoma.
Potassæ Acetas	Potassii Acetas.
Potassæ Bicarbonas	Potassii Bicarbonas.
Potassæ Bichromas	Potassii Bichromas.

Former Names, 1867 or 1874.	Present Names, 1885.
Potassæ Carbonas	Potassii Carbonas.
Potassæ Chloras	Potassii Chloras.
Potassæ Citras	Potassii Citras.
Potassæ Nitras	Potassii Nitras.
Potassæ Permanganas	Potassii Permanganas.
Potassæ Prussias Flava	Potassii Ferrocyanidum.
Potassæ Sulphas	Potassii Sulphas.
Potassæ Tartras	Potassii Tartras.
Potassæ Tartras Acida	Potassii Tartras Acida.
Quiniæ Sulphas	Quininæ Sulphas.
Serpentariæ Radix	Serpentariæ Rhizoma.
Sodæ Arsenias	Sodii Arsenias.
Sodæ Bicarbonas	Sodii Bicarbonas.
Sodæ Carbonas	Sodii Carbonas.
Sodæ Carbonas Exsiccata	Sodii Carbonas Exsiccata.
Sodæ Citro-tartras Effervescens	Sodii Citro-tartras Effervescens.
Sodæ Hypophosphis	Sodii Hypophosphis.
Sodæ Nitras	Sodii Nitras.
Sodæ Phosphas	Sodii Phosphas.
Sodæ Sulphas	Sodii Sulphas.
Sodæ Valerianas	Sodii Valerianas.
Strychnia	Strychnina.
Suppositoria Morphiæ	Suppositoria Morphinæ.
Suppositoria Morphiæ cum Sapone	Suppositoria Morphinæ cum Sapone.
Tinctura Assafœtidæ	Tinctura Asafœtidæ.
Tinctura Quiniæ	Tinctura Quininæ.
Tinctura Quiniæ Ammoniata	Tinctura Quininæ Ammoniata.
Trochisci Morphiæ	Trochisci Morphinæ.
Trochisci Morphiæ et Ipecacuanhæ	Trochisci Morphinæ et Ipecacuanhæ.
Trochisci Potassæ Chloratis	Trochisci Potassii Chloratis.
Trochisci Sodæ Bicarbonatis	Trochisci Sodii Bicarbonatis.
Unguentum Aconitiæ	Unguentum Aconitinæ.
Unguentum Atropiæ	Unguentum Atropinæ.
Unguentum Veratriæ	Unguentum Veratrinæ.
Valerianæ Radix	Valerianæ Rhizoma.
Vapor Coniæ	Vapor Coninæ.
Veratria	Veratrina.
Veratri Viridis Radix	Veratri Viridis Rhizoma.
Vinum Quiniæ	Vinum Quininæ.

Substitutions.

Antimonium Nigrum Purificatum	*for*	Antimonium Nigrum.
Cinchonæ Rubræ Cortex (in preparations)	,,	Cinchonæ Flavæ Cortex. / Cinchonæ Pallidæ Cortex.
Pulvis Elaterini Compositus	,,	Pulvis Elaterii Compositus.
Tinctura Cinchonæ [Rubræ]	,,	Tinctura Cinchonæ Flavæ.
Unguentum Glycerini Plumbi Subacetatis	,,	Unguentum Plumbi Subacetatis Compositum.

Preparations the Composition of which has been altered.

(*Minor alterations are not included.*)

Acidum Sulphurosum.
Alumen.
Antimonium Sulphuratum.
Extractum Cinchonæ Liquidum.
Infusum Cinchonæ Acidum.
Injectio Morphinæ Hypodermica.
Liquor Epispasticus.
Liquor Iodi.
Oleum Phosphoratum.
Pilula Phosphori.
Pulvis Glycyrrhizæ Compositus.
Tinctura Quininæ.
Unguentum Hydrargyri Ammoniati.
The fatty basis of the four suppositories of B.P. 1867 is now oil of theobroma only.
In some of the ointments paraffins have been substituted for lard.
Scammony Resin has been substituted for Scammony in most preparations of Scammony.

The strengths of the following preparations have been altered from 1 *in* 109 *to* 1 *in* 100.

Liquor Arsenicalis.
Liquor Arsenici Hydrochloricus.
Liquor Atropinæ Sulphatis.
Liquor Morphinæ Acetatis.
Liquor Morphinæ Hydrochloratis.
Liquor Potassii Permanganatis.
Liquor Sodii Arseniatis.
Liquor Strychninæ Hydrochloratis.

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INTRODUCTION.

By **Materia Medica** we understand a knowledge of the remedies employed in medicine. This knowledge may be subdivided into several divisions: Materia Medica proper, Pharmacy, Pharmacology, and Therapeutics.

By **Materia Medica proper** we mean an acquaintance with the remedies used in medicine, the places whence they come, the crude substances, plants or animals which yield them, the methods by which they are obtained, and the means of distinguishing their goodness or purity, or of detecting fraudulent adulteration.

By **Pharmacy** we mean the methods by which drugs are prepared and combined for administration.

By **Pharmacology** we mean a knowledge of the mode of action of drugs upon the body generally, and upon its various parts. It is of comparatively recent growth, but is now one of the most important subdivisions of Materia Medica.

By **Therapeutics** we understand a knowledge of the uses of medicines in disease.

Therapeutics may be either *empirical* or *rational*. By **empirical** we mean that drugs are tried haphazard, or with little knowledge of their action in some cases, and, being found successful, are again administered in other cases which seem to be similar.

Perhaps the best example of the empirical use of a remedy is that of quinine in ague. We do not know with certainty what the pathological conditions are in this disease, nor how quinine acts upon them; all we know is that it has proved useful in cases of ague before, and therefore we give it again.

Rational therapeutics consists in the administration of a drug because we know the pathological conditions occurring in the disease, and know also that the pharmacological action of the drug is such as to render it probable that it will remove or counteract these conditions.

Rational therapeutics is the highest branch of medicine. Its advance is necessarily slow, because it is based upon pathology on the one hand and pharmacology on the other, and both of these rest upon physiology, which in its turn rests upon physics and chemistry. It is only with the development of the

fundamental sciences that those which rest upon them can grow; and when we consider that chemistry as a science is not much more than a hundred years old, and when we see the advances it has already made, we cannot but be hopeful for the future of therapeutics.

Occasionally we hear the question asked, 'What is the use of knowing the action of all sorts of drugs upon the different parts of the animal body, and what is the use of knowing the alterations in the muscles, vessels, or nerves which occur under pathological conditions, seeing that in many instances such a knowledge cannot be utilised for the treatment of disease?' As well might we ask, on seeing a half-built bridge, 'What is the use of laying the foundations and building the piers, seeing no one can walk across from one end to the other?'

As an example of rational therapeutics, we may take the use of nitrite of amyl in certain forms of angina pectoris. The obvious symptoms in this disease are intense pain in the region of the heart, and fear of impending death. Sphygmographic tracings of the pulse taken during this condition show that the tension within the heart and vessels begins to increase as the pain comes on, and reaches such a height that the heart can barely empty itself. Observations on animals have shown that nitrite of amyl lessens the tension of the blood in the vessels; and we therefore give it in angina pectoris with the expectation that it will diminish the tension and remove the pain, and we find that it succeeds.

But this example shows us only the first stage of rational therapeutics. We have removed by a remedy the pathological condition which immediately gives rise to the pain and danger of the patient, but the antecedent alterations of the heart, bloodvessels, and nervous system, which led to the occurrence of the pain, are unaltered by the remedy. In order that our therapeutics should be completely successful, we must seek still further for something which will restore the circulation and nervous system to its normal condition and bring the patient back to a state of perfect health.

Sometimes we are able to do this. For example, we occasionally meet with a kind of pain in the cardiac region which closely resembles angina pectoris, and is probably a form of it. Acting on the general principle that pain is due to irritation somewhere, though not necessarily at the place where the pain is felt, we seek for the irritant. We find swelling and tenderness over the sternum at the junction of the manubrium and the body, and we look upon this as the irritant which is exciting the cardiac pains. Judging this swelling to be syphilitic, we give iodide of potassium; the swelling subsides, and the angina-like pain completely disappears.

But sometimes it is impossible to remove the cause of the

disease, and all that we can do is to alleviate symptoms. The organic changes which have occurred in the course of the disease may be so great that we can hardly hope that any remedy will ever be discovered sufficiently powerful to remove them. We must therefore try to prevent them.

Preventive medicine, or **prophylaxis**, is daily becoming more important, and, possibly before the end of this century, medical men will be employed more to prevent people from becoming ill than to cure them when disease has become fairly established.

This may at least be the case in regard to the contagious and infectious diseases, which attack people as it were by accident, and are totally unconnected with their ordinary work or pleasure. It is too much to hope that other diseases which depend upon hereditary tendencies, overwork, or over-indulgence, will disappear, for there can be little doubt that men in the future will, as in the past, knowingly sacrifice, not only their health, but their life, to ambition, duty, or pleasure.

The advance of this branch of medicine has been greatly aided by the recent increase in our knowledge of the life-history of microbes and their action in causing disease. Our power to prevent disease will become greater when we know accurately the action of various drugs in destroying these microbes or preventing their growth.

Pharmacology has made such rapid advances of late years that it is exceedingly difficult for many men who are engaged in practice to understand thoroughly either the methods by which it is studied, or its results. Many students also, although they may be able to pass a good examination in physiology, find it difficult to apply their physiological knowledge to pharmacology; and therefore in discussing the action of drugs upon the various functions of the body, I have sometimes entered more fully into the physiology of those functions than may seem to some at all either necessary or advisable.

In discussing pharmacological questions, we are accustomed to speak of the **action** of a drug on the body or on its various parts; but we must remember the effect produced is not due to a one-sided action—that what we actually mean is the **re-action** between the drug and the various parts of the body.

In some instances we know that the drug itself is changed in the body, as well as the function of the body modified by the drug; and even in those cases where the drug itself is eliminated from the body apparently unaltered, it is probable that it has entered into various chemical combinations within the body while circulating in the blood or present in the tissues.

SECTION I.

GENERAL PHARMACOLOGY AND THERAPEUTICS.

TABLE OF ELEMENTS—*continued.*

Element	Symbol	Valency or Atomicity	Atomic Weight, B.P.	Atomic Weight, U.S. P.	Atomic Weight very accurately determined
*Tin (Stannum) .	Sn . .	II. & IV.	118·0	117·7	117·698
Titanium . .	Ti . .	IV.	49·8	48·0	49·846
Tungsten . .	W . .	VI.	184·0	183·6	183·61
Uranium . .	U . .	IV. & VI.	240·0	238·5	239·8
Vanadium . .	V . .	III. & V.	51·3	51·3	51·256
Ytterbium . .	Yb. .	—	172·8	172·7	172·761
Yttrium . .	Y . .	IV.	89·8	89·8	89·816
*Zinc . .	Zn .	II.	65·0	64·9	64·9045
Zirconium . .	Zr. .	IV.	90·0	90·0	89·367

Nature of the Elements.

Considerable additions have been made to the number of elements during late years. The reason of this is that the spectroscope has indicated the presence of metals previously unknown, and by the use of proper means they have been obtained in a separate condition. These substances are termed elements because we do not at present know how to split them up in such a manner as to prove that they are compounds. But it is not improbable that they are compounds, just as we now know that potash and soda are compounds; although before Sir Humphry Davy split them up into oxygen and a metal they were supposed to be elements. Indeed, recently much evidence has been brought to show that the substances which we call elements are really compounds.

It is from an examination of the spectroscopic character of the elements at different degrees of temperature that Lockyer has been able to obtain sufficient data to justify the definite formulation of the **hypothesis** that all the **elements** we know are really compounds, or, to speak perhaps more precisely, are really **different forms** of aggregation of one kind **of matter.**[1] According to this hypothesis the matter of which the universe is composed was at one time equally distributed through space, and uniform in kind. The atoms then coalesced in various groups of two, three, or more; and these, again grouping themselves together still further, formed aggregates of more and more complex composition. These aggregates are, it is supposed, the elements with which we are acquainted. Most of those complex molecules are perfectly stable at ordinary temperatures; and so their composition remains constant under the conditions usual at the surface of this earth.

But when they are subjected to increased temperatures in the laboratory, rising from that of the Bunsen lamp to the electric arc, and then to the electric spark or to still higher temperatures in the sun, their spectroscopic appearances give evidence of decomposition into simpler molecules. When the elements are subjected to cold and pressure the molecules which compose them come closer together, and we get them forming a solid substance. Heat tends, by communicating vibrations to them, to shake the molecules further apart, and to produce a liquid condition. Still greater heat shakes the molecules further apart still, and produces a gaseous condition.

In all those conditions the molecules of the element become more complex by reduction of temperature or increase of pressure, and simpler by increase in temperature or reduction in pressure.[2] Exceedingly great heat or electricity appears to shake apart still further the constituents of the element, so as to resolve it into simpler combinations of the elementary substance of which, according to the hypothesis, it is composed.

This shaking apart of the component elements is known to exist in com-

[1] Lockyer, *Phil. Trans.* 1874, p. 492 *et seq.*

[2] According to another hypothesis, bodies are supposed to have molecules of one degree of complexity, and the difference between solid, liquid, and gaseous bodies is

Element	Atomic Weight	Difference	Element	Atomic Weight	Difference	Element	Atomic Weight	Difference	Element	Atomic Weight	Difference
H	1		K	39	3·5	Y	89·8	2·4	Ce	141	2
Li	7	6	Ca	40	1	Zr	90	0·2	Di	145·4	3·6
Gor }	9	2	Ti	49·8	9·8	Nb	94	4	Ta	182	36·6
Be }			V	51·3	1·5	Mo	95·5	1·5	W	184	2
B	11	2	Cr	52·5	1·2	Rh	104	8·5	Ir	192·7	8·7
C	12	1	Mn	55	2·5	Ru	104·2	0·2	Pt	195	2·3
N	14	2	Fe	56	1	Pd	105·7	1·5	Au	196·5	1·5
O	16	2	Ni	58	2	Ag	108	2·3	Os	198·5	2
Fl	19	3	Co	58·9	0·9	Cd	111·8	3·8	Hg	200	1·5
Na	23	4	Cu	63·4	4·5	Sn	118	6·2	Tl	203·7	3·7
Mg	24	1	Zn	65	1·6	Sb	120	2	Pb	207	4
Al	27	3	As	75	10	I	127	7	Bi	209	3
Si	28	1	Se	78·8	3·8	Te	128	1	Th	233	24
P	31	3	Br	80	1·2	Cs	133	5	U	240	7
S	32	1	Rb	85·3	5·3	Ba	137	4			
Cl	35·5	3·5	Sr	87·4	2·1	La	139	2			

From this it will be seen that the atomic weights of the different elements form a series, the members of which in most cases differ from one another by 1, 2, 3, or 4. There are few exceptions in which the differences are much greater, and these probably represent blanks which may yet be filled up as our knowledge of the elements increases. This mode of classification, however, reminds us of the Linnæan system in plants, and is artificial rather than natural. In it, the elements which are placed close together possess very different properties, whereas those which are separated from each other present considerable resemblances.

NEWLAND'S TABLE.

Member of a Group having Lowest Equivalent	One immediately above the preceding	Difference	
		H = I	O = I
Magnesium . 24	Calcium . . 40	16	1
Oxygen . . 16	Sulphur . . 32	16	1
Lithium . . 7	Sodium . . 23	16	1
Carbon . . 12	Silicon . . 28	16	1
Fluorine . . 19	Chlorine . . 35·5	16·5	1·031
Nitrogen . . 14	Phosphorus . 31	17	1·062
Lowest term of Triad	Highest term of Triad		
Lithium . . 7	Potassium . 39	32	2
Magnesium . 24	Cadmium . 112	88	5·5
Molybdenum . 96	Tungsten . 184	88	5·5
Phosphorus . 31	Antimony . 120	89	5·687
Chlorine . . 35·5	Iodine . . 127	91·5	5·718
Potassium . 39	Cæsium . . 141	102	5·875
Sulphur . . 32	Tellurium . 128	96	6·062
Calcium . . 40	Barium . . 137	97	6·062

physical conditions, and especially in the solubility of the compound. Thus the chloride of silver is inert so long as it remains in the form of a chloride, because it is insoluble. It thus differs much from the corrosive chloride of zinc, while if we were to compare the action of the nitrate of silver and zinc we should find considerable similarity.

Another cause of difference is the different **proportion of the acid to the base.**

Thus the proportion of sodium (Na=23) to the acid radical in the following sodium salts is as follows: in the hydrate as 23 to 18; in the bicarbonate as 23 to 61; in the sulphate as 23 to 96; in the benzoate as 23 to 121; in the salicylate as 23 to 137.

In this connection, too, the degree of **saturation of the acid** by the base must be considered. If, for example, the acid is not saturated, part of the action of the compound is due to its acid chemical properties; and if, on the other hand, a weak acid be combined with a strong base, this action is partly due to the alkaline chemical property.

Relation between Physiological Action and Chemical Constitution.

An immense step has been made of late years in our knowledge of the relation between chemical constitution and physiological action by the discoveries of Crum-Brown, Fraser, and Schroff, who have shown that by modifying artificially the chemical constitution of a drug it is possible to modify also its physiological action. And not only so, but they have shown that similar modifications in the chemical constitution of various drugs induce similar modifications in the action of their derivatives; thus they have found that by introducing methyl into the molecule of strychnine, brucine, and thebaine, the convulsive action exerted by these substances on the spinal cord was changed into a paralysing one exerted on the ends of the motor nerves. Other alkaloids, also, which do not exhibit a convulsive action, nevertheless exhibit a paralysing one when their constitution is altered by means of methyl; thus methyl-codeine, methyl-morphine, methyl-nicotine, methyl-atropine, methyl-quinine, methyl-veratrine, and several others, all exhibit this paralysing action (p. 150).

As a general rule, most of the compound radicals formed by the union of amidogen with the radicals of the marsh-gas series possess a paralysing action on motor nerves.

The subject of the connection between chemical constitution and physiological action is the most important one in pharmacology, and we shall have to return to it in considering the actions of various groups of organic substances.

and then cause them to inhale nitrite of amyl, we find that the small vessels have become widened and allow the blood to pass easily out of the arterial system into the veins, so that the pressure sinks considerably in the rabbit, whereas it sinks only slightly in the dog. The action seems at first sight different; but when we examine it more closely, we find that the heart of the dog is no longer beating slowly, but very quickly, so as to keep up the pressure, notwithstanding the rapid flow of the blood through the widened vessels, while the heart of the rabbit was going so fast before that it could not go much more quickly. If we cut the vagi in the dog, so that the heart goes as quickly as in the rabbit before it begins to inhale, the blood-pressure sinks during the inhalation, just as it does in the rabbit.[1]

One of the most marked differences between the action of a drug upon lower animals and upon man is to be found in the effect of morphine upon frogs and upon pigeons. In frogs it causes convulsions; on pigeons, even in large doses, it produces no apparent effect. But although its effects are not appreciable to the eye, they exist nevertheless, and on applying the thermometer it is found that morphine lowers the temperature of pigeons many degrees. On comparing the effect of the drug on frogs with its effect on man, we see that in the frog the cerebral hemispheres are very slightly developed indeed as compared with man, and in the latter the effects of the drug upon the spinal cord are usually completely concealed by the narcotic effect of the drug upon the brain. In children, however, and in some races of man where the cerebral hemispheres are less developed than in Europeans, the convulsant action of morphine manifests itself. Occasionally we find individuals who are almost proof against the action of morphine, and who take large doses of it without any apparent effect. Whether in these persons it lowers the temperature as it does in pigeons is a point which remains to be ascertained.

By means of experiments upon animals, then, we are able to ascertain the action of drugs upon those organs of the body which are alike in man and animals; and the very differences which exist between the various sorts of animals, help us to understand the action of drugs more thoroughly.

Erroneous Deductions from Experiments.—A great fault —and one which is only too common in the works of experimental pharmacologists—is that of drawing **general conclusions** from **limited data.**

One experimenter tries the effect of a drug, let us say tartar emetic, upon rabbits. He finds that they do not vomit, and instead of drawing the only warrantable conclusion, viz. that tartar

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[1] Lauder Brunton, 'Action of Nitrite of Amyl on the Circulation,' *Journal of Anatomy and Physiology*, vol. v. p. 95.

then to swell up and become motionless. This effect appears to be due to the solution altering the quantity of water which the protoplasm contains.

Weaker saline solutions, on the contrary, quicken their movements, and, instead of causing them to shrivel, make them swell up at once. Chloride of sodium, chloride, bromide, and chlorate of potassium, as well as alum, all have this effect.

Acids in minute quantities cause contraction both of the body and of the vesicle. The ciliary motion is at first quickened and then retarded; the rate of contraction of the vesicle is at once diminished.

Moderate quantities cause coagulation of the protoplasm with swelling and liquefaction after death.

Strong acids at once destroy the protoplasm.

Alkalies in minute quantities cause swelling of the protoplasm, dilatation and slowness of the contractile vesicle.

Moderate quantities at once arrest the movements, cause liquefaction of the protoplasm, and destroy its differentiation, the contractile vesicles and vacuoles disappearing. They then cause swelling, and finally solution.

In large quantities they produce immediate liquefaction of the whole body.

Other drugs appear to affect the protoplasm itself, and arrest its movements without producing any apparent change in it.

The most active are chlorine, bromine, corrosive sublimate, iodine, permanganate of potassium, and creasote.

Quinine is much less powerful than these, though it is much more so than most other organic alkaloids. Strychnine has only one-fourth the power of quinine.

Cobra poison at first greatly quickens the movements of infusoria and then arrests them, causing just before death a contraction of the protoplasm, which then expands to its ordinary size.

Relations of Motion and Oxidation.

All animals, from the lowest to the highest, evidence their life by motion at one time or another; and the energy required for this motion is maintained by processes of combustion.

The materials for this combustion, viz. oxygen, and fuel of some sort, or food, are derived from the external medium in which the animal lives; and in order to enable these substances to be available for each part of the animal body, we must have some kind of respiration and circulation going on in it.

In unicellular organisms, consisting of a single mass of protoplasm, the oxygen is derived from the water in which they swim, and both it and the nutritive material derived from the digestion

temporary condition of congestion due to a chill (p. 252), the microbes may begin to grow and cause great irritation.

Among the remedies useful in arresting colds we may recognise **antiseptics**, which destroy microbes, and also **sedatives**, which remove congestion.

Hay-fever has been treated by Binz with a watery solution of quinine in order to stop the growth of organisms in the nose. In some cases this treatment is successful. There is a form of cold sometimes known as influenza-cold. Like true influenza it is extremely infectious and is easily communicated, not only by one member of a family to another, but even by casual visitors. It sometimes begins as a cold in the head, passes down the throat to the trachea and bronchi, leading to severe bronchitis with much depression and occasionally also to gastro-intestinal catarrh. Sometimes it begins in the throat and spreads upwards into the nostrils and downwards into the air-passages. It may frequently be arrested or rendered less severe by the use of dilute carbolic acid applied to the nostrils in the form of spray or by a syringe or nasal douche when the cold begins in the head. When the cold begins in the throat it may be arrested by the use of a carbolic acid gargle, and such a gargle is also useful when the cold begins in the head and is spreading down the throat.

Inhalations of carbolic acid and ammonia appear to be frequently useful in arresting colds. It seems probable that their effect may be due partly to an antiseptic action and partly to their lessening congestion. Carbolic acid inhalations appear to be useful in whooping-cough, probably from an antiseptic action.

Camphor inhaled and also taken internally is useful in arresting colds, though it may be rather hard to give an explanation of its *modus operandi*.

The sedatives which remove congestion of the nasal mucous membrane may be either general or local. Amongst the local may be mentioned bismuth, bismuth and morphine, and cocaine; and amongst the general, preparations of opium, especially Dover's powder, and aconite.

Selection of Remedies in the Treatment of Cough.

Cough, as I have already said, is a reflex act which is performed by means of a reflex mechanism, and is adopted for the purpose of expelling foreign bodies from the air-passages. It is evident that, when the source of irritation may be removed by efforts at coughing, these efforts are useful, and require to be sustained rather than prevented; but if the irritant cannot be removed, the effort of coughing is injurious rather than beneficial, and the same is the case when the amount of effort is disproportionately great to the good that it effects. In these cases we must try to lessen the cough.

laxatives: such are oatmeal, brown bread, and bran biscuits. Articles of food which contain salts of vegetable acids and sugar in considerable quantity also act as laxatives. The chief laxatives are:—

Honey.	Tamarinds.	Sulphur.
Treacle.	Figs.	Magnesia.
Gingerbread.	Prunes.	Castor-oil (in small doses).
Manna.	Stewed apples.	
Cassia.		

Figs, raspberries, and strawberries, in addition to containing sugar and vegetable acids, have a number of small seeds which are absolutely indigestible, and these have probably a mechanical action in stimulating the bowel.

Simple purgatives also, when given in small doses, act as laxatives: such are carbonate of magnesium, magnesia, olive-oil, and sulphur.

Simple purgatives are more active than laxatives, and their administration is usually followed by one or more copious and somewhat liquid stools. Their action is sometimes accompanied by some irritation and griping. These are:—

Aloes.	Senna.
Rhubarb.	Castor-oil.
Rhamnus (various species), e.g. Frangula and Cascara Sagrada.	

Drastic purgatives are those which cause violent action of the bowels, usually accompanied by evidences of greatly increased peristaltic action, such as borborygmi. They cause irritation of the intestine, and when taken in large doses produce inflammation and symptoms of poisoning. These are:—

Elaterium.	Gamboge.
Colocynth.	Podophyllin.
Jalap.	Croton-oil.
Scammony.	

Saline purgatives consist of neutral salts of metals of the alkalies or alkaline earths. The more commonly employed are:—

Sulphate of potassium.	Bi-tartrate of potassium.
,, sodium.	Tartrate of potassium and sodium.
,, magnesium.	Citrate of magnesium.
Phosphate of sodium.	Sulpho-vinate of sodium.
Tartrate of potassium.	

Hydragogues are purgatives which excite a copious secretion from the intestinal mucous membrane and thus remove much

and a great improvement in the general condition of the patient. These two results were classed together as cause and effect, and the improvement was considered to be due to the removal of bile. It was then supposed that the bile was formed in the blood and

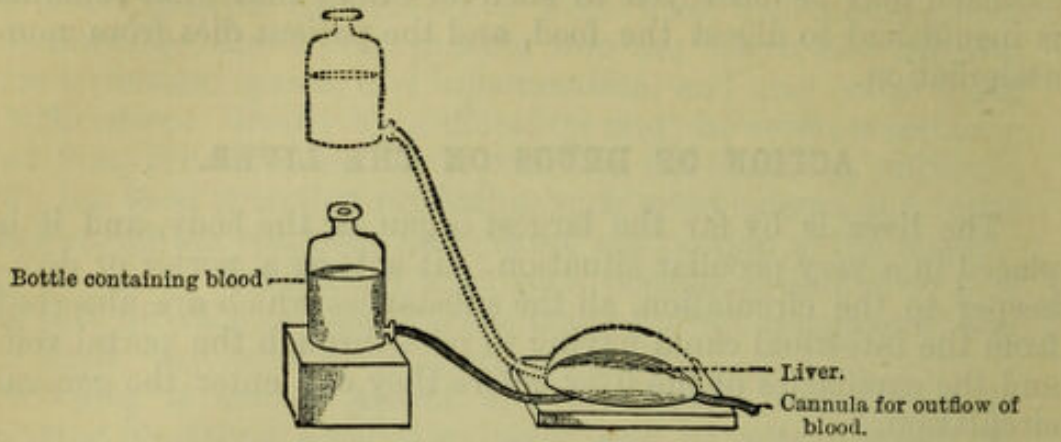


FIG. 142.—Diagram to show the effect of artificial circulation of blood through the liver, under different pressures. The continuous lines indicate the size of the liver, and the arrangement of the apparatus during circulation, under a low pressure. The dotted lines indicate the increased size of the liver, and the arrangement of the apparatus, under a high pressure.

simply excreted by the liver, and, therefore, the bilious-looking stools were ascribed to stimulation of the secreting function of the liver by the mercurials. Hepatic stimulants and cholagogues were therefore considered to be identical. We now know that the bile is formed in the liver and not simply excreted by it from the blood, and that bile formed in the liver may again be absorbed into the blood. Increased functional activity of the liver might thus lead to the presence of a greater instead of a less quantity of bile in the blood. Recent experiments have also shown that one of the most marked cholagogues which we know, viz. calomel, appears rather to diminish than to increase the actual secretion of bile, so that we are now obliged to distinguish between hepatic stimulants and cholagogues. **Hepatic stimulants** are drugs which increase the functional activity of the liver, and the amount of bile which it forms. **Cholagogues** are substances which remove bile from the body, possibly by acting rather on the intestines; they do not necessarily increase the secretion of bile, they may only prevent its re-absorption and thus diminish the quantity in the circulation. **Hepatic depressants** are drugs which lessen the quantity of bile secreted by the liver.

In relation to tissue-waste it is not to be forgotten that the products of the functional activity of one organ are not only poisonous to itself, but may be poisonous to other organs. Thus the waste products of muscular activity gradually poison the muscle and prevent its contraction, although as soon as they are washed out with salt solution the muscle recovers its power.

Lactic acid also, which is a product of muscular waste, is poisonous not only to muscle but to some extent to nerves, and

action in health. In my own experiments, however, I found that it acted as a very marked diureticeven in health, and the explanation of this discrepancy may possibly be that in my own case the blood-pressure was low, whereas in the others it was probably much higher; but I am uncertain regarding the true explanation, though I am certain of the fact.

By causing increased secretion of water through the kidneys diuretics may increase the concentration of the blood and thus produce thirst, or cause absorption of water from the intercellular tissue or serous cavities in dropsies. In my own experiments on digitalis I weighed all my food and measured all my drink for nearly six months, taking exactly the same quantity every day. After producing profuse diuresis by a large dose of digitaline (sixty milligrammes in two days), such thirst ensued that I was forced to take a quantity of water to allay it.[1]

Mode of Action of Diuretics.—From what has already been said, it is evident that diuretics may act in several ways. They may act:

A, on the **circulation** in the kidney, raising the pressure

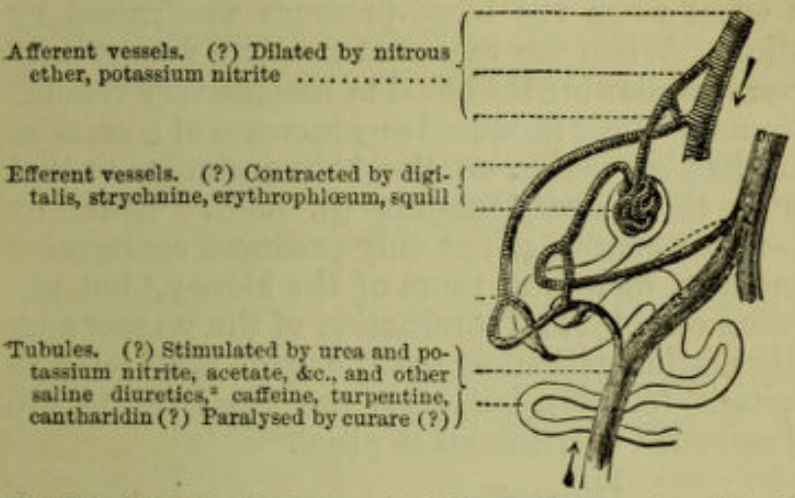


FIG. 152.—Diagram to show the parts of the secreting apparatus of the kidney which are probably affected by different diuretics.

in the glomeruli—(1) locally, (*a*) by contracting the efferent vessels, or the arterial twigs which pass directly to the capillary plexus; (*b*) by causing dilatation of the renal arteries, and thus increasing the supply of blood to the kidney. This they may do also in more ways than one, for they may either paralyse the vaso-motor nerves of the kidney, or act on vaso-dilating mechanisms. (2) they may raise the blood-pressure generally by causing the contraction of vessels in other parts of the body.

B. Other diuretics may act on the **secreting cells** of the tubules, and may increase both the amount of water and the amount of solids excreted by them.

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[1] The experiments were made in 1855, and published in part in my thesis on *Digitalis, with some Observations on Urine*. London: Churchill & Co., 1868.

[2] Munk, *Central. f. d. med. Wiss.*, No. 27, 1886.

In order to accomplish this, a flannel bag should be prepared, a convenient size being twelve inches by eight; this should be closed at three edges and open at the fourth; one side of it should be about one inch or one inch and a half longer than the other, as represented in the diagram (Fig. 157), and it is convenient also to have four tapes attached at the points which form the corners when the bag is closed, in order to keep the poultice in position. Besides this, another strip of flannel should be prepared of the same breadth as the length of the bag, and long enough to wrap round it once or oftener. Crushed linseed, bowl, and spoon should then be got together, and the spoon and bowl thoroughly heated by means of boiling water; the poultice should then be made with perfectly boiling water, and rather soft. As soon as it is ready it should be poured into the bag, previously warmed by holding it before the fire; the flap which is formed by the longest side of the bag should now be turned down and fastened in its place by a few long stitches with a needle and thread; it should then be quickly wrapped in the strip of flannel (also previously warmed), and fastened *in situ*, if necessary, by means of the tapes. It may be covered outside with a sheet of cotton wool.

Medicated Baths.

The addition of stimulating substances, such as **salt**, to the water, increases the stimulation to the skin, and the amount of after-reaction.

In **sea-bathing** the stimulating effect of the salt is further increased by the mechanical shock of the waves, and sometimes also by the friction of the fine sand of the beach. Sea-bathing also differs from baths in the fact that muscular exertion is combined with it, either in simply moving about and retaining one's footing, or still more in swimming.

Carbonic Acid Bath.—This is a saline bath, containing two to three per cent. of chloride of sodium, and not more than one per cent. of chloride of calcium, with varying proportions of free carbonic acid up to 3 grammes in the litre. It has been recommended for chronic heart-disease, both functional and organic, and is said to act as a cardiac tonic.[1]

Acid Bath.—This bath is made by mixing eight ounces of nitro-hydrochloric acid with a gallon of water at blood heat (98° F.) This is sometimes used as a foot-bath, but it is better applied as a compress. A flannel roller about a foot wide, and long enough to go twice round the body, should be soaked in the acidulated water, wrung thoroughly out, and rolled round the region of the liver; a piece of oil-silk, large enough to cover it

[1] Aug. Schott, *Berl. klin. Wochensch.*, No. 33, 1885.

likely to retain infective matter than any other part of the syringe, can be renewed each time that the instrument is employed. In order to prevent pain or inflammation being caused by the solution injected, care should be taken that its reaction is as nearly as possible neutral, and that the quantity should not be great. The smart which follows the injection is lessened by rubbing the finger gently over the part so as to distribute the fluid in the subcutaneous tissue. If it is necessary to employ such large quantities as half a drachm or a drachm, as may be the case with ergot, it is better not to inject the solution under the skin but into the substance of a muscle, such as the gluteus maximus.

Cicatrices are not apt to follow injection if the precautions already mentioned have been taken, and if the injections are not made too frequently at the same point.

Application of Drugs to the Eye

For inflammation of the lids, ointment is smeared between the edges.

Cold water is applied to the conjunctiva for its tonic action, by keeping the eyes open and then dipping the face into a basin of water.

Strong solutions like that of atropine are applied to the conjunctiva by dropping them into the outer canthus of the eye and allowing them to flow over the surface. If such a solution is to be applied frequently, it may be dropped into the inner canthus, and the head held so as to allow it to drop out of the outer canthus; for when the reverse procedure is employed the atropine may pass down the lacrimal duct, and being absorbed may produce its general effect upon the system and cause symptoms of poisoning.

Application of Drugs to the Ear.

Astringent solutions are usually applied to the auditory meatus, by injecting them in a gentle stream by means of a small syringe (Fig. 160).

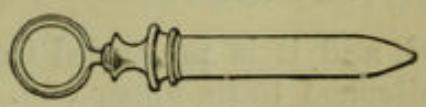


FIG. 160.—Vulcanite syringe for injecting solutions into the ear.

For the mode of injecting into the middle ear, special treatises on aural surgery must be consulted.

in coarse powder and 100 of boiling water. These are to be put into a vessel with a tight cover, and allowed to stand for two hours. The infusion is then strained, and enough water passed through the strainer to make the product weigh 100 parts.

All the infusions both of the B.P. and U.S.P. are strained, with the exception of the infusion of cusso or brayera.

B.P. (28). (Of all not specified 1–2 fl. oz.)	DOSE.	U.S.P. (5).	DOSE.
Infusum Anthemidis	1–4 fl. oz.	Infusum Brayeræ (Cusso)	10 oz.
„ Aurantii		„ Cinchonæ	2 oz.
„ „ Compositum		„ Digitalis [1]	½ oz.
„ Buchu	1–4 fl. oz.	„ Pruni Virginianæ	2–3 oz.
„ Calumbæ		„ Sennæ Compositum	4 fl. oz.
„ Caryophylli			
„ Cascarillæ			
„ Catechu			
„ Chiratæ			
„ Cinchonæ Acidum			
„ Cuspariæ			
„ Cusso (Brayera anthelmintica)	4–8 fl. oz.		
„ Digitalis	1–4 fl. dr.		
„ Ergotæ			
„ Gentianæ Compositum			
„ Jaborandi			
„ Krameriæ			
„ Lini			
„ Lupuli			
„ Maticæ			
„ Quassiæ			
„ Rhei			
„ Rosæ Acidum			
„ Senegæ			
„ Sennæ			
„ Serpentariæ			
„ Uvæ Ursi			
„ Valerianæ			

B.P. Injectiones Hypodermicæ. HYPODERMIC INJECTIONS.—These are strong solutions for subcutaneous injection (p. 475). As the solutions may become decomposed by keeping, they should be freshly prepared; and even the injection of morphine should not be kept long. Any solid particles should be removed by filtration (p. 476). The injections of apomorphine and of ergotin are simply made by dissolving these substances in camphor water and filtering if necessary. The injection of morphine is prepared by dissolving freshly-precipitated morphine in acetic acid and water. It is ten times as strong as the liquor and is rather stronger than the corresponding preparation in the B.P. of 1867, containing 1 grain in 10 minims, instead of 1 grain in 12 minims.

[1] This infusion is about twice the strength of the B.P. The dose is usually stated at ½ oz. twice a day, but in many cases this dose would probably prove too large, and it is safer to begin with a smaller dose, and gradually push it as the patient will stand it.

U.S.P.	DOSE.
Syrupus Rhei	1 fl. dr. (3·75 c.c.).
„ „ Aromaticus	1 fl. dr. (3·75 c.c.).
„ Rosæ	1 fl. dr. (3·75 c.c.).
„ Rubi	1–2 fl. dr. (3·75–7·5 c.c.).
„ „ Idæi	
„ Sarsaparillæ Compositus	½ fl. oz. (15 c.c.).
„ Scillæ	1 fl. dr. (3·75 c.c.).
„ „ Compositus	(Expectorant) 20–30m. (1·25–1·9 c.c.).
„ Senegæ	1–2 fl. dr. (3·75–7·5 c.c.).
„ Sennæ	1–4 fl. dr. (3·75–15 c.c.).
„ Tolutanus	
„ Zingiberis	1 fl. dr. (3·75 c.c.).

B.P. Tabellæ. Tablets of chocolate each weighing 2½ grains, containing an active substance. The only officinal ones are tablets of nitroglycerine, containing $\frac{1}{100}$th grain of pure nitroglycerine in each.

B.P.	DOSE.
Tabellæ Nitroglycerini	1 or two tablets.

Tincturæ. TINCTURES.—These are solutions of active principles in spirit. Rectified spirit, or alcohol, is used whenever the active principle is more soluble in strong than in dilute alcohol, as in the case of alkaloids, such as of veratrum viride; resins, such as asafœtida, benzoin, and Indian hemp; oils, such as those of cubebs, lavender, tolu, orange peel, larch bark, and ginger; and other substances, such as chloroform, acetate of iron, perchloride of iron, iodine, kino.

Aromatic spirit of ammonia is used in the ammoniated tincture of guaiac, of valerian, and of opium (B.P. and U.S.P.). In the case of guaiac and valerian the active principles have an acid character, and so ammonia tends to dissolve them more completely. In both of them, however, as well as in ammoniated tincture of opium, the ammonia has got a stimulating action of its own, which tends to aid the effect of the other substances.

Tinctures of fresh herbs (Tincturæ Herbarum recentium), when not otherwise directed, are, according to the U.S.P., to be prepared by macerating fifty parts of the fresh herb bruised or crushed in a hundred parts of alcohol for fourteen days, then expressing the liquid, and filtering.

B.P. (72).	DOSE.
	The usual dose is ½–2 fl. dr. unless otherwise mentioned.
Tinctura Aconiti	1–10 min.
„ Aloes	
„ Arnicæ	
„ Asafœtidæ	½–1 fluid drachm.
„ Aurantii	
„ „ Recentis	
„ Belladonnæ	5–20 min.
„ Benzoini Composita	½–1 fluid drachm.
„ Buchu	
„ Calumbæ	
„ Camphoræ Composita	15 min.–1 fluid drachm.
„ Cannabis Indicæ	5–20 min.

by the breath, and may give to it the peculiar disagreeable smell of rotten eggs. It is also excreted by the skin, so as to blacken any silver articles which may be worn about the person. The sulphides give rise to increased peristaltic action of the bowels, so that the motions become more frequent and softer; colicky pains are sometimes produced. The sulphides, after absorption into the blood, are excreted in the urine, chiefly as sulphates.

USES.—For its use in skin disease, *vide* p. 544. It has been applied by insufflation to the throat in diphtheria, in order to destroy the organisms present in the pharynx, in the same way as in the vine-disease. I have seen one case do very well under this treatment; but its general efficacy is by no means certain. Internally it is employed as a mild laxative in cases of constipation where active purgatives are inadmissible, as in pregnancy, in hæmorrhoids, fissure of the anus, and stricture or prolapsus of the rectum. It has been used also in cases of lead-poisoning, to prevent the reabsorption of the lead from the intestine.

It has been found useful in cases of sexual irritation arising from hæmorrhoidal congestion (p. 451), and also in the nervous excitement and other disturbances accompanying the menopause.

It exerts a beneficial action on the tissues in chronic rheumatism and gout, and is especially useful in the form of sulphurous waters. During its elimination by the lungs it is supposed to have a beneficial action on them, and it is consequently used in chronic bronchitis.

HALOGEN ELEMENTS.

Fluorine (Fl; 19 or 19·1). **Chlorine** (Cl; 35·5 or 35·4).
Bromine (Br; 80 or 79·75). **Iodine** (I; 127 or 126·53).

These substances form a series in which the atomic weights are nearly in the relation of 1, 2, 4, and 7 (*vide* also p. 16). They are distinguished by the activity of their chemical affinities and the number of compounds they form.

GENERAL SOURCE.—The name halogen (from ἅλς, the sea) has been given to the group, because its most important members, chlorine, bromine, and iodine, are derived from the sea; chlorine being obtained from sea-salt, bromine from sea-water, iodine from sea-weed.

GENERAL CHARACTERS.—They are all very volatile. At ordinary temperatures, chlorine is a gas, bromine a liquid, and iodine a solid, but both bromine and iodine give off vapour freely. On account of their active chemical affinities they unite directly with metals, as is seen in the officinal processes for the preparation of iodide of iron and green iodide of mercury. They have

a white precipitate which only dissolves in large excess, and with ammonia a white precipitate insoluble in excess. But if tartaric acid be present the precipitate dissolves in a slight excess of potash or soda, and with ammonia only a slight precipitate is formed.

GENERAL ACTIONS OF ANTIMONY.—Salts of antimony probably combine with **albumen**, but in alkaline solutions they form no precipitate. They only form precipitates in acid solutions, and they consequently appear to exert an irritant action only on those parts of the animal body where they meet with an acid secretion, such as the orifices of the sweat-glands and of the stomach. When applied to the **skin** the chloride of antimony destroys the cuticle, and acts as a powerful escharotic, producing a deep slough and a slowly healing sore.

The other preparations, however, instead of affecting the whole surface to which they are applied, produce inflammation in isolated spots, which, beginning with papules, proceeds to pustules resembling those of small-pox. A similar pustular irritation is sometimes noticed upon the fauces of persons who have been taking antimony for some time, or have been poisoned by it. When taken **internally, small doses** produce little more than a feeling of warmth in the stomach and slightly increased diaphoresis, but larger doses cause loss of appetite, nausea accompanied by enfeeblement of the circulation, and a feeling of great depression and weakness. Not only the secretion of sweat, but those of the mucous membranes, stomach, intestine, and respiratory passages, seem at the same time to be considerably increased. In still **larger doses** antimony produces vomiting, with great depression of the circulation, and relaxation both of the voluntary and involuntary muscles. In large and **poisonous doses** it causes gastro-enteritis, with profuse diarrhœa and extreme collapse. The pulse is small and quick, the surface cold, and covered with clammy perspiration. There is great weakness and severe cramps of the extremities, and the symptoms somewhat resemble those of Asiatic cholera. **Death** may occur in this condition. It is sometimes preceded by delirium and convulsions, and tonic or clonic convulsive spasms.

The **treatment** of antimonial poisoning consists in the administration of tannin, and in some readily accessible form. The most easily obtained is a strong infusion of tea, and the tannin is more readily extracted from this by the addition of a small quantity of bicarbonate of sodium. Infusions of oak bark or of cinchona may also be used if obtainable. Milk and mucilaginous drinks may also be used. A diffusible stimulant should be given to counteract the collapse.

The mode in which tartar emetic causes **vomiting** has given rise to considerable dispute. It acts as an emetic even when injected into the veins, as well as when given by the stomach, and

DOSE.—1 to 2 fl. dr. or more.

USE.—It is useful in anæmia both in children and adults, and may be given with cod-liver oil.

B.P. Mistura Ferri Aromatica.—This is a curious preparation containing tannate of iron in very small quantities. It is sometimes called Heberden's ink. It is usually said that iron and tannin are incompatible, and so they are in so far that they produce ink, but this preparation is said to be a very useful one.

Iron cannot be taken up in very large quantities, and its absorption is often prevented by the condition of the patient's stomach. This preparation has been put together evidently with the view of combining all the drugs which were likely to do good by themselves, and in total disregard of the chemical action which would take place among themselves.

PREPARATION.—By macerating pale cinchona bark (1 oz.), calumba root (½-oz.), cloves (¼-oz.), and fine iron wire (¼-oz.), in peppermint water (12 oz.) for three days, agitating occasionally; then filtering and adding as much peppermint water to the filtrate as will make the product measure 12½ fl. oz.; to this add compound tincture of cardamoms (3 fl. oz.) and tincture of orange peel (½ fl. oz.), and preserve the mixture in a well-stopped bottle. The pale cinchona bark contains tannin, which combines with the iron. Both it and calumba are gastric tonics, and the carminatives relieve flatulence.

DOSE.—1 to 2 fl. oz.

Ferri Sulphas, B. and U.S.P. SULPHATE OF IRON. $FeSO_4.7H_2O$; 277·9.

CHARACTERS.—In oblique rhombic prisms, of a pale greenish blue colour and styptic taste.

SOLUBILITY.—It is insoluble in rectified spirit, soluble in water.

REACTIONS.—The aqueous solution gives the reaction of a sulphate (p. 594) and of a ferrous salt (p. 736).

DOSE.—1 to 5 grains.

PREPARATIONS.

B.P.	U.S.P.
Ferri Sulphas Exsiccata.....	Ferri Sulphas Exsiccata.
Pilula Aloes et Ferri (*vide* p. 522) 1 part in 7.	

Ferri Sulphas Exsiccata, B.P.; Ferri Sulphas Exsiccatus, U.S.P. DRIED SULPHATE OF IRON. $FeSO_4.H_2O$; 169·9.

Prepared by heating sulphate. It is less apt to oxidise, and is well fitted for pills.

DOSE.—½ to 3 grains.

PREPARATION.

U.S.P.

Pilulæ Aloes et Ferri (*vide* p. 523).

Ferri Sulphas Granulata, B.P.; Ferri Sulphas Præcipitatus, U.S.P. GRANULATED SULPHATE OF IRON, B.P. PRECIPITATED SULPHATE OF IRON, U.S.P. $FeSO_4.7H_2O$; 277·9.

CHARACTERS AND TESTS.—In small granular crystals of a pale

USE.—As an antidote in poisoning by arsenic.

B.P. Ferri Peroxidum Hydratum. HYDRATED PEROXIDE OF IRON. $Fe_2O_3H_2O$ or $Fe_2O_2(HO)_2$.

CHARACTERS.—A reddish-brown powder, destitute of taste and not magnetic.

SOLUBILITY.—It dissolves completely, though slowly, with the aid of heat, in hydrochloric acid, diluted with half its volume of water.

REACTIONS.—The solution gives the reactions of a ferric salt only.

DOSE.—5 to 30 grains.

B.P. PREPARATION.

Emplastrum Ferri. IRON PLASTER.—Hydrated peroxide of iron in fine powder, Burgundy pitch, and lead plaster (1 part in 11).

USES.—Not astringent. Given in powder or electuary chiefly in cases of tic and neuralgia.

Iron plaster is often called 'strengthening plaster.' It forms a mechanical support to weak parts and keeps them warm. Used in pains or weakness across the loins in females, in rheumatic pains, as lumbago, weak joints, &c.

Ferrum Redactum, B. and U.S.P. REDUCED IRON.—Metallic iron, with a variable amount of magnetic oxide of iron.

CHARACTERS.—A fine greyish-black powder, strongly attracted by the magnet, and exhibiting metallic streaks when rubbed with firm pressure in a mortar.

SOLUBILITY.—It dissolves in hydrochloric acid with the evolution of hydrogen. ($Fe + 2HCl = FeCl_2 + H_2$.)

REACTIONS.—The solution gives a light blue precipitate with the yellow prussiate of potash.

IMPURITY.—Magnetic oxide.

TEST.—When ten grains are added to an aqueous solution of fifty grains of iodine and fifty grains of iodide of potassium ($Fe + I_2 = FeI_2$ which dissolves in KI), and digested in a small flask at a gentle heat, the reduced iron is converted into iodide and dissolved, and not more than five grains should be left undissolved, which should be entirely soluble in hydrochloric acid (oxide).

DOSE.—1 to 5 grains.

Trochisci Ferri Redacti, B.P. REDUCED IRON LOZENGES, B.P.—Each lozenge contains one grain of reduced iron.

DOSE.—1 to 6 lozenges.

USES.—This preparation is generally well borne even if the stomach be somewhat irritable. It has no astringent action. When dissolved by the gastric juice it evolves hydrogen, and if sulphur be present as an impurity eructations of sulphuretted hydrogen are produced.

U.S.P. Liquor Ferri Acetatis. SOLUTION OF ACETATE OF IRON.—An aqueous solution of ferric acetate [$Fe_2(C_2H_3O_2)_6$; 465·8]—containing 33 per cent. of the anhydrous salt. Sp. gr. 1·160.

PREPARATION.

Tinctura Ferri Acetatis (Solution of Acetate 50, Alcohol 30, Acetic Ether 2).

DOSE.—15 min. to 1 fl. dr.

USES.—It is used in diabetes, in rickets, and in nervous depression. It is frequently given along with the phosphates of calcium, potassium, and sodium, as the preparation usually called Parrish's Chemical Food, or with the phosphates of quinine and strychnine, as in Easton's Syrup.

U.S.P. Ferri Pyrophosphas. PYROPHOSPHATE OF IRON.

CHARACTERS.—Thin, apple-green, transparent scales, permanent in dry air when excluded from light, but turning dark on exposure to light. Odourless, having an acidulous, slightly saline taste, and a slightly acid reaction.

SOLUBILITY.—Very soluble in water.

REACTIONS.—When heated with solution of potassa in excess a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a white precipitate with test solution of nitrate of silver (difference from phosphates).

DOSE.—2 to 5 gr. (0·13 to 0·33 gm.).

USES.—Has no disagreeable taste, and is very soluble, so that it can be given in any form.

U.S.P. Ferri Hypophosphis. HYPOPHOSPHITE OF IRON.—$Fe_2(H_2PO_2)_6$; 501·8.

CHARACTERS.—A white or greyish-white powder, permanent in the air, odourless and nearly tasteless.

SOLUBILITY.—It is only slightly soluble in water, more readily so in presence of hypophosphorous acid, freely soluble in hydrochloric acid, or in solution of citrate of sodium, forming with the latter a green solution.

REACTIONS.—When strongly heated in a dry test-tube, the salt evolves a spontaneously inflammable gas (phosphoretted hydrogen), and on ignition leaves behind ferric pyrophosphate. The salt is readily oxidised by nitric acid or other oxidising agents. It should be completely soluble in acetic acid (absence of ferric phosphate). This solution, when mixed with test-solution of oxalate of ammonium, should not afford a white precipitate soluble in hydrochloric acid (absence of calcium).

DOSE.—5 to 10 grains in pill, more generally given in syrup.

USES.—In nervous debility with anæmia, and also in phthisis.

U.S.P. Ferri Valerianas. VALERIANATE OF IRON.—$Fe_2(C_5H_9O_2)_6$; 717·8.

CHARACTERS.—A dark tile-red amorphous powder, permanent in dry air, having a faint odour of valerianic acid, and a mildly styptic taste.

SOLUBILITY.—Insoluble in cold water, but readily soluble in alcohol.

REACTIONS.—Boiling water decomposes it, setting free the valerianic acid and leaving ferric hydrate. When slowly heated the salt parts with its acid without fusing, but when rapidly heated it fuses and gives off inflammable vapours having the odour of butyric acid.

DOSE.—1 grain or more.

USES.—In hysteria with anæmia.

circulates over the surface, and is cooled down more and more until its temperature becomes so much reduced as to be incompatible with life, and the patient is frozen to death. The dangerous effects of alcohol under such circumstances are well known to the lumberers in Canada, and to Arctic voyagers, who dread alcohol, and generally avoid it altogether. The utility of this selfsame action of alcohol is very evident when a person comes from the cold atmosphere into a warm room; for here the individual may still remain cold, although in front of a fire, as the contraction of the surface vessels now continues, and the blood is no longer able to convey warmth to the interior, just as it was formerly unable to convey the cold. If alcohol be now taken, and the vessels dilated, the blood is allowed to circulate in the surface, soon becomes warm, and thus diffuses the warmth equally through the body.

In considering the action of alcohol upon the **nervous system**, one must distinguish between the effect it produces upon the various nerve-centres by increasing the circulation through them, and the effect of the alcohol on the nervous structures themselves. By increasing the circulation it may stimulate the functions of all the nerve-centres, and render them, for the time being, capable of greater activity. It may thus enable its consumer to think more clearly, to express himself more fluently, or to perform feats of greater bodily activity than usual, but its action on the nerve-centres themselves is a paralysing one.

The mode of action of alcohol on the circulation has not been well ascertained; but it seems probable that in considering it we must take into account both its direct action upon the circulatory apparatus itself and its reflex action upon that through other organs. Thus it is not improbable that even from the mouth it exercises an influence over the **cranial circulation** (p. 193). Although we have no experiments on the effect of irritation of the branches of the fifth nerve on the cranial circulation, yet individuals of all nations, when desiring to think more accurately, are accustomed to irritate some branch of this nerve, either by scratching the head, rubbing the forehead or chin, striking the nose or taking snuff. Chewing sweet or pungent substances has a similar effect in enabling some persons to think more clearly, while, under similar circumstances, alcohol is sipped by others. From the stomach it probably stimulates the heart and vascular system reflexly, and thus increases both the cranial and the general circulation. When given in very large doses, as when a bottle of whiskey has been drunk at a draught, the reflex action on the heart has been so great that death has occurred immediately from shock.

Its action upon the **nervous tissues** themselves seems to be one of progressive paralysis, affecting them in the inverse order of their development, the highest centres being affected first,

(2) Mechanical interference with the respiratory movements may occur from unwary pressure upon the chest, interfering with the thoracic movements. The most common cause of this is the weight of the patient's own body, when any operation upon the back requires him to be laid upon his face. In such cases, special watch should be kept upon the respiratory movements. Mechanical interference with respiration may occur in old people who have lost their teeth. The flaccid lips and the alæ nasi are in them drawn inwards at each inspiration, and acting as valves prevent the entrance of air into the trachea. In such cases the mouth should be opened by the fingers (Esmarch).

Stoppage of the respiration may occur from the patient spasmodically holding his breath during the stage of excitement, but this usually soon passes off if the anæsthetic be pushed. The struggling is less if the anæsthetic be given gradually. (3) Paralysis of the respiratory centre takes place when the drug is pushed too far. It may sometimes occur suddenly, after a fresh quantity of chloroform has been poured upon the cloth used in administration. If the respiration ceases the administration of chloroform should be discontinued, and the patient roused by flicking the cheeks and breast with a wet towel. The tongue should be drawn forwards with forceps and artificial respiration begun if necessary. As a rule the patient can be restored with comparative ease by means of artificial respiration, provided the heart continues to beat, but on rare occasions even the prolonged use of this means does not induce any further voluntary respiratory movement. The easiest way of performing artificial respiration is to press the sternum forcibly inwards, and allow it to return to its normal position by its own elasticity. The pressure should be exercised synchronously with the operator's own respiration. Each time the sternum is depressed the ends of the fingers may be pressed under the cartilages of the ribs on the left side, so as to stimulate the heart mechanically also.

Stoppage of the heart may occur suddenly, and may take place while respiration is still going on. It is usually ascribed to the chloroform, and no doubt concentrated chloroform vapour inhaled into the lungs may arrest the heart. Very commonly, however, it is reflex, and when death occurs in such a case it is to be attributed to the want of chloroform rather than to its excess. It is worthy of note that in the greater number of the cases recorded as deaths from chloroform, the statement is made that the quantity administered was very small, and that anæsthesia was incomplete. Before anæsthetics were used at all, death from shock during operation was by no means uncommon, and no doubt it still occurs during imperfect anæsthesia, although complete anæsthesia tends to prevent it. The operations in which death during chloroform chiefly occurs are short and comparatively slight, though painful, such as extraction of teeth, and

dioxybenzene cause convulsions in frogs, and trioxybenzene causes jerkings, though of a slighter character.

All the members of the pyridine and chinoline series destroy life, either by exhaustive convulsions or by gradual paralysis of the respiratory centres.[1] The members of the pyridine series—pyridine, picoline, lutidine, etc.—have an action similar in kind, but differing in degree, the lethal power increasing as one ascends in the series. The higher members of the pyridine series have an action like that of the lower members of the chinoline series, but are more liable to cause death by asphyxia than the chinolines, and have more than twice their lethal power.

In ascending the chinoline series, a change occurs in the physiological action of its members, the lower ones acting chiefly on the sensory centres of the brain and reflex centres of the cord, destroying voluntary and reflex movement; while the higher act chiefly on the motor centres, first as irritants causing violent convulsions, and afterwards producing paralysis.

'On comparing the action of such compounds as chinoline (C_9H_7N) with parvoline, etc. ($C_9H_{13}N$), or collidine ($C_8H_{11}N$) with coniine ($C_8H_{15}N$), or dipyridine ($C_{10}H_{10}N_2$) with nicotine ($C_{10}H_{14}N_2$), it is observed that the physiological activity of the substance is, apart from chemical structure, greatest in those bases containing the larger amount of hydrogen. Further, when the bases of the pyridine series are doubled by condensation, as in dipyridine, parapicoline, etc., they become not only more active physiologically, but have a different action from that of the simple bases.'[2]

As alterations in the physiological action of the carbon compounds of this group can be effected by slightly changing their chemical composition, several attempts have been recently made to obtain artificial alkaloids which should possess a strong antipyretic action without depressing the heart or causing sickness. Antipyrin, one of the most recent introductions, appears to be the best as yet, but further attempts in this direction may be still more successful.

U.S.P. Acidum Carbolicum Crudum. CRUDE CARBOLIC ACID.

CHARACTERS.—A nearly colourless or reddish-brown liquid of a strongly empyreumatic and disagreeable odour, having a benumbing, blanching, and caustic effect on the skin or mucous membrane, and a neutral reaction.

REACTIONS AND TESTS.—Bromine water produces in an aqueous solution of carbolic or cresylic acid a white flocculent precipitate. Crude carbolic acid should not dissolve in less than 15 parts of water at 15° C. (59° F.), nor should the solution have an alkaline reaction (absence of alkalis). If 50 volumes of crude carbolic acid be diluted with warm water to measure 1,000 volumes, the mixture well shaken, cooled, and allowed to separate, the amount of undissolved impurities should not exceed 5 volumes or 10 per cent. by volume of the crude acid.

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[1] McKendrick and Dewar, 'On the Physiological Action of the Chinoline and Pyridine Bases,' *Proc. Roy. Soc.*, 1874, p. 432. [2] McKendrick and Dewar, *op. cit.*

black teas are powerful **cerebral stimulants.** They render the mental faculties more active and tend to prevent sleep. Green tea is much more powerful than black, and its admixture with black is sometimes the cause of **sleeplessness** in persons who have thus taken it unconsciously. In some persons it produces giddiness, restlessness, and such severe muscular trembling that the hand shakes violently. A quantity of tea eaten by a horse caused great excitement, and probably anæsthesia, as the animal killed itself by dashing its head against a stone. Both green and black teas are apt to cause **indigestion.** This is probably due, in some measure at least, to the tannin they contain. Tea mixed with gastric juice lessens its power of digesting fresh meat, but not of digesting smoked meat. This is probably due to the tannin hardening the soft fibre of fresh meat, but leaving the comparatively hard fibre of dried meat, ham, &c. unchanged. To avoid getting much tannin it is advisable not to let the tea stand long on the leaves, but pour it off quickly, so that the volatile oil which gives the aroma only is extracted.

USE.—As a cerebral stimulant to relieve drowsiness and headache.

Caffeina, B. and U.S.P. CAFFEINE (THEINE (?), GUARANINE). $C_8H_{10}N_4O_2.H_2O$; 112.

An alkaloid (B.P.), or proximate principle of feeble alkaloidal power (U.S.P.), generally prepared from the dried leaves of *Camellia Thea*, or from the dried seeds of *Coffea arabica* (Nat. Ord., *Rubiaceæ*); or from the Guarana, and occurring also in other plants.

CHARACTERS.—Colourless, silky, inodorous, acicular crystals.

PREPARATION.—By evaporating aqueous infusions from which astringent and colouring matters have been removed.

SOLUBILITY.—Soluble in 80 parts of cold water, the solution having a faintly bitter taste and being neutral to litmus. More soluble in boiling water and in rectified spirit, and very soluble in chloroform; sparingly soluble in ether.

REACTIONS.—Above 212° F. they melt and volatilise without decomposition. Treated with a crystal of chlorate of potassium and a few drops of hydrochloric acid, and the mixture evaporated to dryness in a porcelain dish, a reddish residue results, which becomes purple when moistened with ammonia. In an aqueous solution of the alkaloid, tannic acid gives a white precipitate, soluble in excess of the reagent.

DOSE.—1 to 5 grains.

	PREPARATION. DOSE.
B.P.	
Caffeinæ Citras	2–10 grains.

B.P. Caffeinæ Citras. CITRATE OF CAFFEINE.—$C_8H_{10}N_4O_2$, $H_3C_6H_5O_7$. A weak compound of caffeine and citric acid.

CHARACTERS.—A white inodorous powder with an acid and faintly bitter taste and an acid reaction on litmus.

PREPARATION.—Dissolve citric acid (1) in hot water (2), add caffeine (1), evaporate to dryness, and reduce to a fine powder.

U.S.P. Quinina. QUININE. $C_{20}H_{24}N_2O_2.3H_2O$ (crystallised); 378.—An alkaloid prepared from different species of cinchona.

PREPARATION.—By adding to the solution of the sulphate a quantity of water of ammonia or solution of soda, just sufficient to precipitate the alkaloid.

Although it is not separately mentioned in the B.P., it is used in the preparation of citrate of iron and quinine.

PREPARATIONS.

U.S.P.	DOSE.
Ferri et Quininæ Citras	3–5 gr.
Liquor Ferri et Quininæ Citratis	8–45 min.
Syrupus Ferri Quininæ et Strychninæ Phosphatum	1–2 fl. dr.

Quininæ Sulphas, B. and U.S.P. SULPHATE OF QUININE. $(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$; 872.—The sulphate of an alkaloid, prepared from the powder of various kinds of Cinchona and Remijia bark.

PREPARATION.—By extraction with spirit after the addition of lime, or by the action of alkali on an acidulated aqueous infusion with subsequent neutralisation of the alkaloid by sulphuric acid and purification of the resulting salt.

CHARACTERS.—Filiform, silky, snow-white crystals, of a pure intensely bitter taste.

SOLUBILITY.—It is sparingly soluble in water, that is 1 part in 700 or 800 parts, at common temperatures, yet imparting to the water a bluish tint or fluorescent appearance. Entirely soluble in water acidulated by sulphuric acid.

REACTIONS.—Its solutions give with chloride of barium a white precipitate insoluble in nitric acid. When treated first with solution of chlorine and afterwards with ammonia they become of a splendid **emerald-green colour**, and solution of ammonia gives with them a white precipitate of quinine soluble in ether, and in excess of the solution of ammonia. It dissolves in pure sulphuric acid with a feeble yellowish tint, and undergoes no further change of colour when gently warmed. For the mode of testing the purity of the salt, *vide* B.P.

PREPARATIONS.

B.P.	DOSE.
Ferri et Quininæ Citras	5–10 gr.
Tinctura Quininæ Ammoniata	½–2 fl. dr.
Vinum Quininæ	½–1 fl. oz.

U.S.P. Quininæ Bisulphas. BISULPHATE OF QUININE. $C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$; 548.

CHARACTERS.—Colourless, clear, orthorhombic crystals or small needles, efflorescing and becoming opaque on exposure to air, no smell, very bitter taste, strongly acid reaction.

SOLUBILITY AND REACTIONS.—It resembles the sulphate in its reactions, but is much more readily soluble. It dissolves with vivid blue fluorescence in 10 parts, while the sulphate requires 740 parts, of water at 59° F.

U.S.P. Quininæ Hydrobromas. HYDROBROMATE OF QUININE. $C_{20}H_{24}N_2O_2HBr.2H_2O$; 440·8.

CHARACTERS.—Colourless, lustrous needles, no smell, very bitter taste, and a neutral or slightly alkaline reaction.

SOLUBILITY.—It is soluble in about 16 parts of water at 59° F.

REACTIONS.—The solution gives the reactions of quinine, and with test solution of nitrate of silver yields a white precipitate insoluble in diluted nitric acid, and in solution of carbonate of ammonium.

CHARACTERS.—A short, yellowish-white rhizome, with numerous fibrous roots about two or three inches long; of a bitter taste and penetrating odour, agreeable in the recent root, becoming fetid by keeping; yielding volatile oil and valerianic acid when distilled with water.

COMPOSITION.—Contains a **volatile oil** and **valerianic acid.**

PREPARATIONS.

B.P.	DOSE.
Infusum Valerianæ (2 dr. in ½ pint)	1–2 fl. oz.
Tinctura „ (2½ oz. in 1 pint spirit)	1–2 fl. dr.
„ „ **Ammoniata** (2½ oz. in 1 pint aromatic spirit of ammonia)	½–1½ fl. dr.

U.S.P.	
Abstractum Valerianæ	15–45 gr.
Extractum „ Fluidum	15–30 min.
Tinctura „ (20 per cent.)	1–2 fl. dr.
„ „ Ammoniata (20, in aromatic spirit of ammonia up to 100)	1–2 fl. dr.
Oleum Valerianæ	One or more drops
Quininæ Valerianas	1–2 gr.

U.S.P. Oleum Valerianæ. OIL OF VALERIAN.—A volatile oil distilled from Valerian.

CHARACTERS.—A greenish or yellowish, thin liquid, becoming darker and thicker by age and exposure to air, having the characteristic odour of valerian, an aromatic, somewhat camphoraceous taste, and a slightly acid reaction; sp. gr. about 0·950. It is readily soluble in alcohol.

ACTION AND USES.—The activity of valerian is chiefly due to the volatile oil it contains, and not to the valerianic acid. The **oil** in large doses **paralyses** both the **brain** and **spinal cord,** and lessens the convulsions due to strychnine-poisoning, lowers the **blood-pressure** and slows the **pulse.** It is employed as an **antispasmodic** and stimulant in cases of hysteria, and is most useful in those occurring in delicate and young women.

Valerianate of zinc has been supposed to combine the nervine tonic action of zinc with the antispasmodic effect of valerian, but it is much better to use valerian itself or its oil along with a salt of zinc, as the acid has no important physiological action. It is used in chorea, especially when occurring in hysterical persons, and should not be discontinued until symptoms of nausea begin to make their appearance. It is also employed in epilepsy and neuralgia.

Valerianate of iron and valerianate of ammonium have also been used in medicine, and may be given in the same doses as the corresponding salt of zinc. For the action of valerianate of quinine, *vide* p. 943.

COMPOSITÆ.

Pyrethri Radix, B.P.; Pyrethrum, U.S.P. PELLITORY ROOT, B.P.; PYRETHRUM, U.S.P.—The dried root of *Anacyclus Pyrethrum.* The Levant.

Glycerin acts as a laxative, and when used along with castor oil increases its power. It is largely destroyed in the system, has an influence on nutrition, and has been proposed as a substitute for cod-liver oil, but without much benefit. Very large doses cause a red coloration in the urine, due to the colouring matter of the blood, without any free corpuscles.

It is used as a **laxative** in hæmorrhoids; as a **solvent** of other drugs, as borax, tannic acid; as an **emollient** to soften the hands, and applied to sore nipples, fissure of the tongue, in advanced phthisis, croup, laryngitis, &c. It has been painted on in eczema, psoriasis, pruritus; also as a preventive of bed-sores. It must be diluted with water, or it will irritate the part. It has been proposed as a substitute for sugar in diabetes.

Manna, B. and U.S.P. MANNA.—A concrete saccharine exudation obtained by making transverse incisions in the stems of the trees of *Fraxinus Ornus*, cultivated in Calabria and Sicily.

CHARACTERS.—In stalactiform pieces from one to six inches in length, and one or two inches in width, uneven, porous, and friable, curved on one side, of a yellowish-white colour. Odour faint, resembling honey; taste sweet and honey-like, combined with a slight acridity and bitterness.

DOSE.—60 grains to 1 ounce.

PREPARATION.

U.S.P.	DOSE.	B.P.
Infusum Sennæ Compositum	2½ fl. oz.	None.

COMPOSITION.—It consists principally of **mannite** or mannitol, a hexahydric alcohol, $C_6H_8(OH)_6$, together with common **sugar** and extractive matter. The mannite, which forms from 60 to 80 per cent. of the manna, may be extracted by means of boiling rectified spirit, from which it will afterwards separate on cooling in colourless, shining crystals. It requires five parts of cold water for its solution, and this does not undergo vinous fermentation in contact with yeast, being thus distinguished from grape-sugar.

USE.—Manna is used as a simple **laxative.**

APOCYNACEÆ.

U.S.P. Apocynum. APOCYNUM. CANADIAN HEMP.—The root of *Apocynum cannabinum.*

CHARACTERS.—Long, cylindrical, somewhat branched, one-fourth to one-third of an inch (6 to 8 millimetres) thick, pale brown, longitudinally wrinkled and transversely fissured; brittle; fracture short, white; the bark rather thick; the wood porous, spongy, with delicate, medullary rays and a thin pith; inodorous; taste bitter, disagreeable.

COMPOSITION.—It contains an amorphous substance—**apocynin**—easily soluble in alcohol, but insoluble in water, and a glucoside—**apocyneïn**—easily soluble in water.

certain point the pulse-rate suddenly rises just as it would do if both vagi were cut. This is shown in Fig. 214. When the pulse-rate has been thus quickened by heat, section of the vagi does not render it any quicker (Figs. 215 and 216).

Although the vagus centre is so much weakened by the action of the heat that it ceases to exercise any inhibitory action upon the heart, yet its functional activity is not completely de-

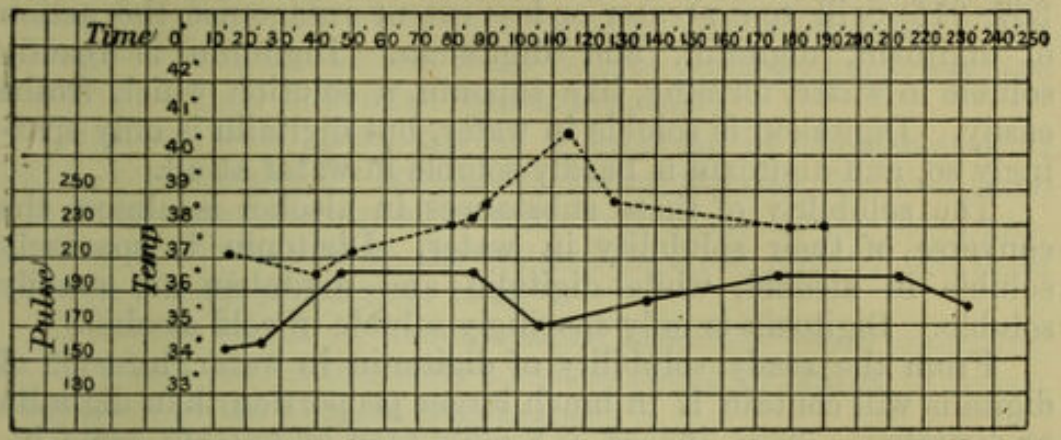


FIG. 216.—Shows the action of digitalis when given after the temperature has already risen. At the 30th minute the warming was begun; at the 100th minute ·75 c.c. of tincture of digitalis was injected.

stroyed even by very high temperatures, and irritation of an afferent nerve will still cause reflex slowing (p. 290) of the pulse, until immediately before the death of the animal from hyperpyrexia.

These experiments render it probable that the rapid rise in the pulse-rate, which a high temperature occasions, is chiefly of central origin, and is due to partial paralysis of the vagus centre, although diminished action of the peripheral ends of the vagus and increased action of the cardiac ganglia also aid in quickening the pulse.

Although neither the vagus centre nor the vagus ends in the heart are completely paralysed by very high temperatures they are yet weakened so much that digitalis, and probably all drugs which act like it, such as adonidin (p. 331), no longer slow the pulse as they do at normal temperatures. This is shown in Fig. 216, where the pulse remained slow until the temperature rose to nearly 41° C. and then suddenly became very quick. Moderately high temperatures do not prevent digitalis from slowing the heart (Fig. 214).

Action of Different Preparations of Digitalis.—The two most marked effects of digitalis in disease are a reduction in the rate of the pulse, and an increase in the amount of urine. These effects are not coincident, and, according to Christison, the diuretic action is less when the heart is much affected. The preparation generally employed to act on the heart is the tincture, while the infusion is regarded as the best diuretic.[1] The

[1] *The National Dispensatory.*

into the eye will often allay the irritation produced by a particle of sand, &c. As a local application, castor oil or poultices of the leaves of the castor-oil plant, are used to the breasts in order to promote the secretion of milk. The oil is useful rubbed into the skin in seborrhœa.

ADMINISTRATION.—If the oil be given the first thing in the morning an hour before breakfast, ten or twenty drops are generally sufficient to open the bowels. This dose may be given in a teaspoonful of peppermint-water or brandy. The brandy should be added in such proportion that the oil neither sinks nor swims in the mixture. The same mixture of peppermint-water and brandy answers well as a vehicle for the administration of larger doses also. In all cases the glass, cup, or spoon should be thoroughly wetted first with water or peppermint-water to prevent the oil adhering to the side. A little brandy is then to be mixed with the peppermint-water, the oil carefully poured over the middle of it, and then more brandy added. If the whole be drunk at one draught the taste of the oil is not perceived. Lemon-juice, coffee, and the froth of porter are also used as vehicles for the administration of castor oil. It may also be given in capsules, which are perfectly tasteless.

Kamala, B. and U.S.P. KAMALA. WURRUS.—A powder which consists of the minute glands and hairs obtained from the surface of the fruits of *Mallotus philippinensis* (*Rottlera tinctoria*). India.

CHARACTERS.—A fine granular mobile powder, of a brick-red colour; it is with difficulty mixed with water.

COMPOSITION.—A **resin** soluble in alcohol and ether, yielding a crystalline substance, **rottlerin**.

IMPURITIES.—Sand and earthy matters.

TEST.—When boiled with alcohol the greater part is dissolved, forming a red solution. Ether dissolves most of it; the residue consisting principally of tufted hairs.

DOSE.—30 grains to ¼ ounce.

ACTION AND USES.—It is used as an **anthelmintic** against tapeworm. It is very efficacious, killing the worm and producing free purgation. It is best given with honey or thick gruel.

URTICACEÆ.

SUB-ORDER I.—ULMEÆ.

U.S.P. Ulmus. ELM. SLIPPERY ELM.—The inner bark of *Ulmus fulva*.

CHARACTERS.—In flat pieces, varying in length and width, about one-eighth of an inch (3 millimetres) thick; tough, pale brownish-white, the inner surface finely ridged; fracture fibrous and mealy; the transverse section delicately checkered; odour slight, peculiar; taste mucilaginous, insipid.

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