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THE

ELEMENTS

OF

MATERIA MEDICA;

COMPREHENDING

THE NATURAL HISTORY, PREPARATION, PROPERTIES,

COMPOSITION, EFFECTS, AND USES

OF

MEDICINES.

PART I.

CONTAINING

THE GENERAL ACTION AND CLASSIFICATION OF MEDICINES,
AND THE MINERAL MATERIA MEDICA.

BY

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LONDON:

LONGMAN, ORME, BROWN, GREEN, AND LONGMANS.

1839.

TO

HENRY CLUTTERBUCK, M.D.

FORMERLY PHYSICIAN TO THE GENERAL DISPENSARY, ALDERSGATE STREET,

AND

LECTURER ON THE THEORY AND PRACTICE OF PHYSIC,

This Work is Dedicated,

AS A TESTIMONY OF HIGH RESPECT AND ESTEEM,

BY HIS FAITHFUL FRIEND,

AND GRATEFUL PUPIL,

THE AUTHOR.

PREFACE.

THE object of the Author, in preparing the present work for the press, has been to supply the Medical Student with a class book on Materia Medica, containing a faithful outline of this department of Medicine, which should embrace a concise account of the most important modern discoveries in Natural History, Chemistry, Physiology, and Therapeutics, in so far as they pertain to Pharmacology, and treat the subjects in the order of their natural-historical relations. This order he has followed for many years past in his Lectures, believing it to be the most convenient and, on the whole, the least objectionable mode of classifying the objects of Pharmacology: and he is glad to find that some of the most eminent professors (among whom he may mention his friends Drs. Christison and Royle), follow a similar order in their lectures. Hitherto, however, no systematic work has been published in the English language in which this method has been adopted[a].

It must be admitted, that, as the ultimate object of all our inquiries into the Materia Medica is the attainment of the knowledge of the physiological effects and therapeutical uses of medicines, an arrangement founded on the effects and uses would be much more valuable to the medical student than one based on properties only indirectly related to those for which the agents possessing them are employed. For it would enable him more readily to practise on general indications, and to substitute one remedy for another, belonging to the same class or order.

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[a] The *Therapeutic Arrangement and Syllabus of Materia Medica*, by J. Johnstone, M.D., can hardly be regarded as constituting an exception to this statement.

Under this point of view, the author is fully impressed with the value of a physiological or therapeutical arrangement of medicines, and, could it be effected, would readily acknowledge its vast superiority, considered in a medical point of view, over all other classifications: but he is of opinion that Pharmacologists are too imperfectly acquainted with the operation of Therapeutical agents to enable them to effect a classification of this kind with much success. Scarcely two medicines give rise to precisely the same effects; and, as we are unable to determine the nature of the modification produced by each, "it is impossible to bring the substances used in medicine under a general good arrangement[b]." Every writer, who has attempted it, has found the facts hitherto ascertained insufficient for his purpose, and has, therefore, been necessarily obliged to call in the aid of theory: hence the so-called physiological classifications of medicines are in reality founded on the prevailing medical doctrines of the day, or on the peculiar notions of the writer.

Opium and mercury may be referred to in illustration of the author's meaning. They are substances in ordinary use, and their effects are well known. Yet writers are neither agreed as to the nature of the primary influence which these agents exercise over the animal economy, nor as to their proper position in a physiological classification.

Thus several physicians (as Dr. John Murray[c] and Dr. A. T. Thomson[d]) consider opium to be primarily stimulant; some (as Dr. Cullen[e] and Barbier[f]) regard it as sedative; one (Mayer[g]) as both—viz., a stimulant to the nerves and circulatory system, but a sedative to the muscles and digestive organs; another (Orfila[h]) as neither; while others (as Müller[i]) call it alterative.

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[b] *Elements of Physiology.* By J. Müller, M.D.; translated by W. Baly, i. 57.
[c] *A System of Materia Medica and Pharmacy.* 5th ed. 1828. Edinburgh.
[d] *Elements of Materia Medica and Therapeutics.* 2 vols. London. 1832.
[e] *Treatise of the Materia Medica.* 2 vols. Edinburgh. 1787.
[f] *Traité Elémentaire de Matière Médicale.* 2de éd. Paris. 1824.
[g] Quoted by Orfila (*Toxicologie Générale*).
[h] *Toxicologie Générale.* 3me éd. 1827. 2 tom. Paris.
[i] *Op. cit.*

Again, mercury is by several writers (as Drs. Cullen [k], Chapman [l], Young [m], and Eberle [n]) placed in the class of sialogogues; by many (as Dr. A. T. Thomson [o], MM. Edwards and Vavasseur [p], and MM. Trousseau and Pidoux [q]) among excitants; by some (as Conradi, Bertele, and Horn [r]) it is considered to be sedative; by one (Dr. Wilson Philip [s]) to be stimulant in small doses, and sedative in large ones; by some (as Dr. John Murray [t]) it is placed among tonics; by another (Vogt [u]) among the *resolventia alterantia;* by one (Sundelin [x]) among the liquefacients (*verflüssigende Mittel*); by the followers of Broussais (as Begin [y]) among revulsives; by the Italians (as Giacomini [z]) among contra-stimulants or hyposthenics; by others (as Barbier [aa]) among the *incertæ sedis!!*

The author is fully aware of the objections which some will be disposed to raise to the natural-historical and chemical details contained in this work. But, with due deference to the opinions of others, he thinks the absence of these subjects would render the present volume incomplete. A knowledge of them, it is true, is not essential to the successful practice of our profession; but surely a physician will not make a worse practitioner because he is acquainted with the natural history and chemistry of the agents he is employing in the treatment of disease. The author is not ambitious to raise into unnecessary importance these topics; yet he cannot help expressing his belief, that they, who are the loudest in decrying the value and utility of natural history and chemistry

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[k] *Op. cit.*

[l] *Elements of Materia Medica and Therapeutics.* 2 vols. 4th ed. Philadelphia. 1825.

[m] *An Introduction to Medical Literature;* art. *Pharmacology.* 2d ed. London. 1823.

[n] *Treatise on Materia Medica and Therapeutics.* 2 vols. 2d ed. Philadelphia. 1825.

[o] *Op. cit.*

[p] *Manuel de Matière Médicale,* Paris. 1831.

[q] *Traité de Thérapeutique,* tom. i. Paris. 1836.

[r] Quoted by Richter (*Ausführliche Arzneimittellehre,* Bd. v. 307. 1830).

[s] *On the Influence of Minute Doses of Mercury.* London. 1834.

[t] *Op. cit.*

[u] *Lehrbuch der Pharmakodynamik.* 2 Bd. 2te Aufl. Giessen. 1828.

[x] *Handbuch der Speciellen Heilmittellehre.* 3te Aufl. Berlin. 1833.

[y] *Traité de Thérapeutique.* Paris. 1825.

[z] *Trattato filosofico-sperimentale dei Soccorsi Terapeutici.* Padova. 1833.

[aa] *Op. cit.*

to the medical practitioner, are those, for the most part, whose information on these points is most limited.

The Second and concluding part of this work will contain the Vegetable and Animal Materia Medica, and a concise tabular view of the History and Literature of Pharmacology: that portion of the table which pertains to Oriental Medicine has been kindly undertaken by Professor Royle, the learned author of *An Essay on the Antiquity of Hindoo Medicine*, and of the *Illustrations of the Botany of the Himalayan Mountains.*

Artillery Place, London,
Nov. 1838.

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ORDER XIX.—Silver and its Compounds.

ORDER XX.—Mercury and its Compounds.

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CORRIGENDA ET ADDENDA.

Page.	*Line.*	
62 ...	6	from bottom, *after* "Materia," *insert* "Medica."
84 ...	26	*for* "lactus," *read* "lactis."
124 ...	14	*for* "insoluble," *read* "insoluble, or nearly so."
144 ...	15	from bottom, *for* "non-pyrites," *read* "iron pyrites."
144 ...	6	from bottom, *for* "Bertholett," *read* "Berthollet."
157 ...		last line of diagram, *for* "Hydrated Sulphate of Potash," *read* "Hydrated Bisulphate of Potash."
174 ...	1	col. 2 of diagram, *for* "Mur. Amm." *read* "Mur. Acid."
216 ...	18	from bottom, *after* "nitrogen," *insert* "or an acid of nitrogen."
234 ...	32	*for* "*Acidum Succinum*," *read* "*Acidum Succinicum*."
280 ...	16	from bottom, *after* "of," *insert* "by."
301 ...	16	from bottom, *insert* "a," before the word "chloride."
333 ...	19	*for* "Galls," *read* "Gauls."
434 ...	12	from bottom, *for* "Argentum," *read* "Argenti."
462 ...	26	*for* "Hydrargyri-Nitrico-Oxydum," *read* "Hydrargyri Nitrico-Oxydum."
481 ...	12	*for* "Binoxide," *read* "Binamide."

ELEMENTS

OF

MATERIA MEDICA.

PROLEGOMENA.

1. *Definitions.*

THERAPEUTICS (*Therapeia*, *Therapeutice*, *Therapeutica*, from θεραπεύω, *I cure*) is that branch of medicine which has for its object the treatment of diseases.

ACOLOGY (*Acologia*, from Ἄκος, *a remedy*, and Λόγος, *a discourse*) is that department of therapeutics devoted to the consideration of remedies.

REMEDIES (*Remedia*, from *re* and *medeor*, I heal; *Auxilia medica*) are agents used in palliating or curing diseases. They are of two kinds—those acting directly, and those indirectly, on the body.

1. The remedies which act on the body *directly* are—
   - *a.* Physical but imponderable agents, as light, heat, and electricity.
   - *b.* Mechanical and surgical remedies.
   - *c.* Hygienic means, as diet and exercise.
   - *d.* Pharmacological agents or medicines.

2. The remedies which act on the body *indirectly* are those which operate primarily, by the agency of the mind. Certain affections of the mental faculties produce alterations in the condition of the body, and are, therefore, occasionally employed in the treatment of disease. These affections are of two kinds, agreeable or disagreeable.
   - *a.* The *agreeable* mental affections are pleasure, joy, and ecstacy.
   - *b.* The *disagreeable* mental affections are pain, grief, and misery.

PHARMACOLOGY (*Pharmacology*, from Φάρμακον, *a medicine*, and Λόγος, *a discourse*), or *Materia Medica*, is a branch of acology devoted to the consideration of medicines. It is subdivided into *Pharmacognosia*, which treats of simples, or unprepared medicines; *Pharmacy*, which teaches the modes of collecting, preparing, and preserving medicines; and lastly, *Pharmaco-dynamics*, which is devoted to the consideration of the effects and uses of medicines.

2. *Means of ascertaining the Operation of Medicines.*

In order to ascertain the kind of influence which a medicine exerts over the system, we may—

a. Examine its physical and chemical properties.

b. Observe the phenomena caused by its contact with the animal body.

a. Examination of the physical and chemical properties of a medicine.—The *sensible qualities* (odour, taste, and colour) give very little insight into the action of medicines; since some substances (as strychnia and quinia), which agree in these properties, disagree in the effects which they produce on the organism.

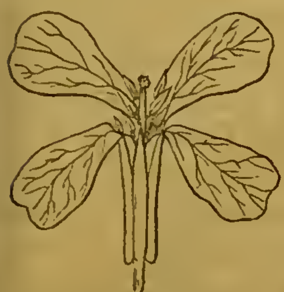
The *natural-historical properties* (external form and structure) are of little value in ascertaining the operation of either mineral or animal substances. It is well known that two dissimilar bodies may assume the same crystalline shape, and they are said, therefore, to be *isomorphous*. Identity of form in the mineral kingdom depends not on the quality, but on the number, of the constituent molecules.

No attempts have been made to trace any relation between the toxicological or edible properties and the anatomical structure of animals. This has probably arisen from the comparatively small number of these beings which possess medicinal or poisonous properties; for we are enabled to employ, as food, animals of every class, from the highest to the lowest. Among quadrupeds and birds no species is poisonous, unless, indeed, the Arctic bear be an exception, whose liver is stated by Captain Scoresby to be deleterious.—(*Fleming's Philosophy of Zoology*, vol. ii. p. 110.) Among fishes, molluscous animals, and insects, however, several species are hurtful; and it is frequently found that where one is deleterious, kindred species are likewise more or less so. Thus all the coleopterous insects belonging to the tribe *Cantharidiæ* (*Latreille*) possess blistering properties.

The relations existing between natural-historical qualities and medicinal effects have been attentively examined with respect to vegetables. It has long been supposed that those plants which resemble each other in their external appearances are endowed with analogous medicinal properties. Cæsalpinus was, according to Dierbach, the founder of this doctrine; though Decandolle regards Camerarius as the first who clearly announced it. Linnæus says, "Plantæ quæ *genere* conveniunt, etiam virtute conveniunt; quæ *ordine* naturali continentur, etiam virtute propius accedunt; quæque *classe* naturali congruunt, etiam viribus quodammodo congruunt."—(*Philosophia Botanica*, ed. 4ta. p. 278.) I may also refer to Isenflamm, Wilcke, Gmelin, Jussieu, and Barton, as other supporters of this opinion. But the most important writer in favour of it is Decandolle, who, in 1804, published his *Essai sur les Propriétés Médicales des Plantes;* a second edition of which appeared in 1816. In the year 1831, we had another interesting treatise on the same subject by Dierbach. (*Abhandlung über die Arzneikräfte des Planzen, vergleichen mit ihrer Structur und ihren chemischen Bestandtheilen.)* There are other writers, however, who deny altogether the possibility of judging of the virtues of plants by their exterior forms and botanical characters. Of these I shall refer to one only, namely, Gleditsch *(De Methodo botanicâ dubio et fallaci virtutum in plantis indice*, 1742.)

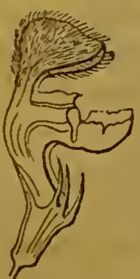
It must be admitted that vegetable substances owe their peculiar qualities to the structure and consequent action of the organs producing them; and, therefore, that alterations in the structure of an organ, are attended with corresponding alterations in the qualities of its products. It consequently follows that the medicinal qualities of plants should accord with their classification in natural families. That they do so to a certain extent is fully ascertained by numerous facts. If one vegetable species serve as nutriment for either animal or plant, we frequently observe that other species of the same genus, or even of a different genus but of the same family, are also adapted for a like use; while, on the other hand, if any particular species be injurious, neighbouring species are likewise more or less so. Experience has fully proved that in a very large number of instances there exists an analogy between the exterior forms and the medicinal properties of plants, so that we can sometimes predict the active principle and mode of operation of a vegetable, merely by knowing to what part of a natural arrangement it properly belongs. *Cruciferæ* (fig. 1), for example, present the greatest uniformity in their botanical, chemical, and medicinal characters. They contain a volatile acrid principle, which renders them stimulant; and having been employed successfully in scurvy, are frequently termed anti-scorbutics. The *Labiatæ* (fig. 2), which constitute, perhaps, the most natural family of the whole vegetable kingdom, contain a bitter resinous, or extractive matter, and an etherial, aromatic, or volatile oil; which two principles, mixed in different proportions, are found in all the species, to which they communicate tonic and carminative properties. Neither *Cruciferæ* nor *Labiatæ* contain a single unwholesome or even suspicious species. In *Coniferæ* (fig. 3) we find the different species pervaded with an oleo-resinous juice, in consequence of which they possess stimulant properties.—Many other families might be quoted to the same effect, and, therefore, we admit as a general rule, that plants of similar structure possess similar medicinal qualities.

FIG. 1.



Raphanus sativus.

FIG. 2.



Glechoma hederacea.

FIG. 3.

Picea vulgaris (Nees ab Esenbeck.)

We are obliged, nevertheless, to admit the existence of numerous exceptions. There are many families, the plants of which appear to possess the greatest botanical affinity for each other, but which are endowed with very dissimilar remedial properties. *Umbelliferæ* (fig. 4) is an example of this. The root and leaves of *Daucus Carota* are wholesome and nutritive, but the analogous parts of *Conium maculatum* are highly poisonous. In some cases we even find plants of the same genus differing considerably in their medicinal properties. I need only mention in proof, *Cucumis Melo* and *Cucumis Colocynthis.* If we are to believe the statements of credible writers, even *Gramineæ*, which Decandolle declares to be "la famille la plus naturelle," contains more than one exception to the general statement in question. For the most part the plants of this family are farinaceous and nutritive. "None," says Dr. Lindley (*Natural System*), "are unwholesome in their natural state, with the single exception of *Lolium temulentum* (fig. 5), a common weed in many parts of England, the effects of which are undoubtedly deleterious, although perhaps much exaggerated." I may remark, however, that several other grasses have been asserted to be unwholesome. Loudon (*Encyclopædia of Plants*, p. 64) tells us that the seeds of *Bromus mollis* bring on giddiness in the human species and quadrupeds, and are fatal to poultry. The root of *Bromus purgans* is said to be used in Canada as an emetic, in doses of forty grains. *Bromus catharticus*, a Chilian plant, has a thick root, which is said to act as a purgative.—(*Dictionn. de Matière Médic. par F. V. Merat et A. J. De Lens*, tom. i. p. 672.) Humboldt (*Voyage*, t. i.) tells us that *Festuca quadridentata* (fig. 6) is very poisonous, and even fatal to animals. Perhaps this may be the grass described by some under the name of *Carapoucha*, and which by others has been called *Carapullo*. Frezier, in his *Voyage to the South Sea and along the Coasts of Chili and Peru*, in the years 1712, 1713, and 1714, says, in speaking of Lima, "There is an herb called *Carapullo*, which grows like a tuft of grass, and yields an ear, the decoction of which makes such as drink it delirious for some days. The Indians make use of it to discover the natural disposition of their children. All the time when it has its operation, they place by them the tools of all such trades as they may follow,—as by a maiden, a spindle, wool, scissars, cloth, kitchen furniture, &c.; and by a youth, accoutrements for a horse, awls, hammers, &c.: and that tool they take most fancy to in their delirium, is a certain indication of the trade they are fittest for,—as I was assured by a French surgeon, who was an eye-witness of this verity."

Fig. 4.

Fœniculum vulgare.

In the family *Solaneæ* we meet with other exceptions. Compare the fruit of *Capsicum annuum* with that of *Atropa Belladona*. I might select many other instances (as from the family *Leguminosæ*), to the same effect, but shall content myself with the examples already adduced, as sufficiently warranting the assertion that, in the present state of science, botanical affinities cannot be confidently relied on by the medical practitioner for determining the effects of remedial agents. I do not, therefore, agree with Dr. Lindley (*Natural System*, 2nd edit. p. viii.), that "a knowledge of one plant is a guide to the practitioner, which enables him to substitute *with confidence* some other plant that is naturally allied to it." As a *general rule* we may admit, that plants of the same family agree in the *nature* of their medicinal operation, but to this there are many remarkable exceptions, which diminish, though they do not absolutely destroy, its utility in practice. Furthermore, it deserves especial notice that certain vegetable families whose structure is most dissimilar, possess analogous properties: as *Melanthaceæ* and *Ranunculaceæ*.

In some instances the exceptions are perhaps only apparent, and arise from our imperfect acquaintance with the affinities or structure of plants. We can readily imagine, that a slight and almost imperceptible difference in the structure of the nutritive organs of two plants, may be the cause of a trivial difference in the chemical composition of their products. But organic analysis has shown us that a very inconsiderable difference in the combining proportions of the elements of organic substances is sometimes attended with important differences of medicinal activity.

The *chemical properties* of medicines may occasionally assist us in

Fig. 5.

Lolium temulentum, or *Bearded Darnel.*

determining the influence which these bodies have over the organism. For we sometimes find that substances possessed of similar chemical qualities operate in an analogous manner on the system. Thus sulphuric, nitric, and hydrochloric acids, act very much alike; so also do potash and soda. But these analogies are not common, and we frequently meet with substances whose chemical properties are similar, but whose medicinal qualities are most incongruous, as in the case of baryta and strontia; and of quinia and morphia: while, on the other hand, bodies whose chemical properties are exceedingly unlike, sometimes act in a very analogous manner; for example, manna and bitartrate of potash.

The properties of bodies are so completely altered by chemical combination, that it is in most cases difficult to form a correct opinion as to the action of a compound medicine, merely by knowing the nature and proportion of its constituent parts. Many metals, however, offer exceptions to this statement: thus all compounds into which arsenicum enters as a constituent are poisonous, and act alike on the organism.

b. Observation of the effects caused by the application of medicines to the animal body. On animals generally.—Some have examined the action of medicines on *dead* animal tissues, and drawn inferences therefrom as to the operation on the living organism. This mode of proceeding was adopted by Dr. Adair Crawford—(*An Experimental Inquiry into the effects of Tonics and other Medicinal Substances*, 1816.) But it is admissible only for those remedies whose action is either mechanical or chemical; and, therefore, with respect to the greater number of our remedial means, it is useless.

The examination of the effects of medicines on *living* animals is a much more valuable and important mode of investigation; for it may be asserted, as a general rule, that a substance which is poisonous to one species is more or less so to all classes of animals; and, in a considerable number of instances, its action is of the same nature or quality, though usually very different in degree, and modified by the variations in the developement of the several organs and functions. It has indeed been stated that many substances which are poisonous to man are innocuous to animals, and *vice versâ*. That this statement is wholly untrue, I will not venture to affirm, but I feel convinced it is an exaggerated one; and I

Fig. 6.

Festuca quadridentata (Kunth).

believe, with Dr. Christison (*Treatise on Poisons*, 3rd ed. p. 65,) that "if the subject be studied more deeply, the greater number of the alleged diversities will prove rather apparent than real."

The animals employed for the purpose of ascertaining the operation of medicines are, ordinarily, the dog and the rabbit, and, occasionally, the cat and the horse. The dog and cat are supposed to be "affected by almost all poisons exactly in the same way as ourselves," (*Christison*, p. 64;) yet they offer some peculiarities deserving of notice, especially in the case of narcotics. Their brains being much less developed than the cerebral organ in man, we naturally look for some diversity in the action of substances whose influence is principally directed to this viscus. Charvet, in describing the effects of opium (*De l'action comparée de l'Opium*,

p. 164,) observes, that from this inferior developement, the brain of the dog "is not so liable to sanguineous congestion, and when this condition is observed, it is not very intense—stupor is the only symptom of it; never coma, loss of consciousness, nor profound sleep." I have observed that the root of monkshood does not act precisely alike on rabbits and dogs. In the latter, one of the most remarkable symptoms of its operation is diminution of feeling; in the former, the function of feeling is much less obviously affected, but we observe more evident paralysis of the hind extremities. Differences of this kind are to be expected, since they are connected with unequal developement of the nervous system. As rabbits and horses cannot vomit, irritant poisons when administered to them cannot act as emetics. The skin of horses is more susceptible than the human integument of the action of turpentine. On the other hand, certain agents, whose operation on the human body is most energetic, have, comparatively, very little effect on the horse—as colocynth, briony, and jalap.—(*Moiroud, Pharmacologie Vétérinaire*, pp. 269 and 274.)

On man.—The action of medicines on the *dead* human body, or on parts separated from it, as the blood recently drawn from the veins, has been examined, with the view of learning the operation of these agents on the living body. It may be of assistance to us in ascertaining either the mechanical or chemical action of substances; but as the greater number of medicines act only on the living body, and quite independently of any known mechanical or chemical influences, this mode of investigation is of very limited value.

In ascertaining the action of remedial agents on the *living* body, it is necessary that we examine their influence both in healthy and diseased conditions. For, by the first we learn the positive or actual power of a medicine over the body; while by the second, we see how that power is modified by the presence of disease. Moreover, in the latter condition we sometimes discover remedial influences which our knowledge of the effects of medicines on the healthy body could not have led us to anticipate. The beneficial operation of arsenious acid in agues, or in lepra, could never have been inferred from any experiments made with this substance in health merely; nor could we have formed a correct estimate of the effects and proper dose of opium by employing it in tetanus, nor by using mercurials in fever. The homœopathists assert, and with truth, that the study of the effects of medicines in the healthy state is the only way of ascertaining the *pure* or *pathogenetic* effects of medicines—since when we administer our remedies to invalids "the symptoms of the natural disease, then existing, mingling with those which the medicinal agents are capable of producing, the latter can rarely be distinguished with any clearness or precision."—(*Hahnemann's Organon*, translated by *C. H. Devrient*, p. 190.)

3. *Mode of Action of Medicines.*

The production of effects by the application of medicines to the living body, depends on the existence of two classes of powers or forces; the one in the medicine, the other in the organism.

1. *Active forces of Medicines.*—Bodies act on each other in one or more of three ways, viz.: *mechanically*, by their weight, cohesion, external form, and motion; *chemically*, by their mutual affinities; and *dynami-*

cally, by agencies which are neither mechanical, nor chemical merely. Hence we may examine the actions of medicines under the three heads of mechanical, chemical, and dynamical.

a. Mechanical.—The alterations of cohesion, of form, of relative position, &c. caused by medicines, are denominated their mechanical effects. They are frequently attended or followed by organic changes; consequently, a medicine, whose action is simply mechanical, may produce two classes of effects—the one mechanical, the other vital; and the whole of its operation may be denominated *mechanico-vital.*

Müller *(Elements of Physiology,* translated by Baly, p. 59) considers that mechanical agents may give rise to chemical changes in the tissues. "Mechanical influence in frictions," he observes, "acts under certain circumstances as a vivifying stimulus; it has this effect, probably, by inducing in the composition of the tissues, slight chemical changes, as a consequence of which the affinity of the tissues for the general vital stimuli already in the organism is increased."

Formerly most of the articles of the Materia Medica were supposed to act on the organism mechanically merely. "I doubt not," says Locke, "but if we could discover the figure, size, texture, and motion of the minute constituent parts of any two bodies, we should know, without trial, several of their operations one upon another, as we do now the properties of the square or a triangle. Did we know the mechanical affections of the particles of rhubarb, hemlock, opium, and a man, as a watchmaker does those of a watch, whereby it performs its operations, and of a file, which, by rubbing on them, will alter the figure of any of the wheels, we should be able to tell before-hand that rhubarb will purge, hemlock kill, and opium make a man sleep."—(*Essay concerning Human Understanding*, book iv. chap. 3.) These mechanical notions of Locke harmonized well with those of the *iatromechanical* or *iatromathematical* sect of the age in which he lived; a sect which ranked amongst its supporters Borelli (its founder,) Bellini, and others, in Italy; Sauvages, in France; and Pitcairn, Keill, Mead, and Freind, in England. The functions of the body, the production of diseases, and the operation of medicines, were explained on mechanical principles. The action of stimulants, for example, was supposed to depend on the pointed and needle-like form of their particles, and the operation of emollients on their globular form.—(*Sprengel, Hist. Médec. by Jourdan*, t. 5, p. 131, *et seq.*) I need hardly say, the existence of particles with the peculiar shapes assumed, is quite imaginary; and, indeed, if, for the sake of argument, we assume their existence, the action of medicines is, notwithstanding, quite inexplicable. We can, indeed, easily believe that a ball of glass may be swallowed with impunity, and that the same substance, reduced to the form of a coarse powder, might cause irritation by the mechanical action of the angular particles on the tender alimentary tube; but we could not, on this hypothesis, explain why one medicine acts on one part of the body, and a second on another part.

There are very few medicinal agents now in use whose remedial efficacy can be solely referred to their mechanical influence. Indeed, several of the processes to which medicines are subjected before they are administered, have for their principal object the prevention or diminution of this influence. Among the medicines still employed, on account of their mechanical action, are the hairs of the pods of *Mucuna pruriens*, quicksilver, and, perhaps, powdered tin; the first and the last are used as anthelmintics—the second, to overcome intus-susception, or intestinal invagination.

b. Chemical.—If substances, having powerful affinities for organic matter, be applied to the living tissues, they first destroy the life of the part, and then enter into combination with one or more constituents of the tissues: such substances are termed caustics. But the destruction of life in one part is attended with alterations in the vital actions, and the production of inflammation in surrounding parts; so that the chemical action of caustics is attended by both chemical and vital effects, and the whole of their operation may be denominated a *chemico-vital process.*

If the energy of the affinity of caustics for organic matter be diminished, as by diluting them, the vital powers are sometimes enabled to resist the production of any immediate chemical change, and the life of the part is consequently preserved. The caustic, then, operates at first as a mere irritant, and causes alterations of vital action only. In this case the active force is still supposed to be affinity; that is, the particles of the caustic are presumed to have a tendency to unite with those of the organised tissues; but the union being resisted by the vital powers, a new action is set up which constitutes the changes or effects before referred to. The long-continued application, however, of these weak chemical agents, will gradually effect slight changes in the composition of the tissues without producing the death of the altered parts. These organic alterations of a living part are of course attended by the production of morbid actions.

Chemical changes are sometimes produced in the secretions of distant parts by the internal use of certain agents. Thus the qualities of the urine are modified by the administration of acids or alkalis. Do these modifications or changes depend on the chemical influence of the substances swallowed? or on some other kind of influence which these agents exert, either directly or indirectly, over the secreting organs? Neither explanation is without difficulties; but I conceive the first to present the fewest. It cannot be denied that when either alkalis or acids are swallowed, they pass out of the system, in part at least, by the kidneys; and that in the urine they possess their usual chemical properties, modified by the presence of any substances with which they may have united. Moreover, the qualities which they impress on the urine are similar to those which they produce when added to this secretion after its evacuation from the bladder. Thus, by the internal use of alkalis, it has been found that the natural acidity of the urine may be destroyed, and an alkaline quality substituted for it: the same condition of urine is produced by the addition of alkalis to this fluid out of the body. Again, the internal use of soda or magnesia may give rise to the appearance of white sand (phosphates) in the urine: now the same kind of deposit may be produced in healthy urine by the addition of a few drops of an alkaline solution to it. Furthermore, by the administration of acids (sulphuric or hydrochloric), phosphatic deposits are diminished or entirely prevented, while the employment of alkalis promotes them. Now this influence of acids is probably, in part at least, chemical, since we find that a few drops added to urine which contains these deposits, dissolves them. In other words, as the modifications which acids and alkalis produce in the condition of the urine are precisely those which we might expect from the known chemical properties of these bodies, it is more rational to refer these modifications to influences the nature of which we can understand, than to those which are incomprehensible.

Do substances (such as acids, alkalis, and metallic salts) which are known to possess affinities for the constituents of the blood and of the tissues, exercise those affinities in their passage through the system? and are the constitutional effects of those substances referrible to chemical influences? It is impossible to give satisfactory answers to either of these questions. We cannot deny the chemical influence of these agents; but we are hardly authorised to ascribe the whole of their effects to it. The truth is, that the facts on which we are required to form our opinion are too few to enable us to draw any accurate or precise conclusions. By the internal use of madder, the bones and some other parts become coloured; and the long continued employment of the nitrate of silver gives rise occasionally to a deposit of silver under the skin. But with two or three exceptions of this kind, no chemical changes in the living tissues or organs are obvious, and we have no right, therefore, to assume that any exist. For when external agents are taken into the system, they become subject to a superior power, and are no longer at full liberty to obey the ordinary laws of affinity. It must be some power superior to that recognized in chemical operations which prevents the action of the gastric juice on the stomach during life.

Müller, (*Elem. Phys.* p. 58, *et seq.*) however, ascribes the operation of most external agents to their chemical influence. Vital stimuli, (a certain degree of external heat, atmospheric air, water, and nutriment,) he observes, "do not merely produce a change in the composition of the organic structures, and stimulate by disturbing the balance in the system, but renovate the tissues by entering, in a manner indispensable to life, into their composition." On the other hand, all agents of this kind, as well medicinal substances as caloric, electricity, and mechanical influences, "may, when their action is excessive, have the very opposite of a vivifying effect, by producing such a violent change in the organic matter, that the combinations necessary to life cannot be maintained." "A great number of substances are important as medicaments, from producing a chemical change in the organic matter, of which the result is, not an immediate renovation of material and increase of vital force, but the removal of that state of combination of the elements which prevented healthy action, or excited diseased action; or the chemical change produced is such as to render the organ no longer sensible to a morbid stimulus; or it is such that certain apprehended destructive changes in its composition are no longer possible, as in the antiphlogistic plan of treatment; or, lastly, these substances produce a change in the nutritive fluids. Such substances are alteratives. By these remedies an organ morbidly changed in composition cannot be rendered sound by, as it were, a chemical process, but such a slight chemical change can be produced as shall render it possible for nature to restore the healthy constitution of the part by the process of nutrition. These remedies, again may be divided into two principal kinds, according as they act chiefly on the nervous system, or on the other organs dependent on that system. Among those of the first kind, the most important are the so-called narcotics; those of the latter kind comprehend the numerous medicines which exercise their action on diseases in other organs. These remedies also, by removing the obstacles to cure, become indirectly vivifying or renovating stimuli; and they may themselves, by disturbing the balance in a part, produce symptoms of irritation. If used in excess, they either give rise to the injurious effects of the heterogeneous stimulants, or, by inducing a sudden change of composition, annihilate the vital force, as is the case with the narcotics. Since, however, such alterative medicines affect the composition of an organ each in its own way, one alterative may, after a time, lose its influence, as it were, by saturation, while the organ may still be susceptible of the influence of another. A great number of the instances of habituation are referrible to this cause."

Such are the statements, as to the operation of medicines, made by one of the first physiologists of the age. They deserve careful and attentive examination. But however plausible they may appear, the student is not to be unmindful that, for the most part, they are opinions merely, and that the chemical changes in the tissues, so frequently referred to, have not been as yet demonstrated by chemical analysis. Furthermore, I would refer those who are desirous of becoming acquainted with the arguments which have been adduced against the chemical action of medicines on the system, to Vogt's *Pharmakodynamik*, bd. i. p. 9, *et seq.* The only chemical change which this author will admit medicines to be capable of producing, is that which takes place in the parts to which they are applied.

c. Dynamical.—The above-mentioned mechanical and chemical influences are considered by many writers insufficient to explain the effects caused by the greater number of the articles composing our Materia Medica; principally on the ground that substances which exercise a most potent influence over the organism, frequently do so without producing any obviously mechanical or chemical changes in the condition of the body. A third mode of operation has, therefore, been admitted, which is unattended with any recognizable changes of form or of composition.

In the inorganic kingdom we have also evidence of an influence which cannot be denominated either mechanical or chemical. The communication of magnetical and electrical properties to iron by mere contact with another body, without the production of any change of form or of composition, either of the iron itself or of the imparting body, is an example of this. Now to influences of this kind the term *dynamical* has been applied; and in several pharmacological works, (among which are Burdach's *System der Arzneymittellehre*, C. H. E. Bischoff's *Handbuch der Arzneimittellehre*, and Vogt's *Lehrbuch der Pharmakodynamik*), it is employed to indicate those influences of medicines over the organism which are ascribable to neither mechanical nor chemical causes.

Some have attempted to account for the action of medicines on electrical principles. All bodies, says Bischoff, (*op. cit.* bd. i. p. 158,) by contact with each other, act as electrics, without, however, necessarily undergoing any chemical changes. Therefore, when a medicine is applied to the organism, its action is electrical (p. 162.) But though, says this writer, a medicine may produce electrical without chemical changes, yet the reverse of this does not hold good, for no chemical changes can occur without the production of alterations in the electrical condition of bodies (p. 163); and, consequently, the operation of caustics is an electro-chemical process.

In some few instances the effects of medicines are analogous to those of electricity. Thus the instantaneous death caused by hydrocyanic acid is something like an electrical phenomenon. "A drop of acid, mixed with a few drops of alcohol," says Magendie, "when injected into the jugular vein, kills the animal instantly, as if he had been struck by lightning."—(*Formulaire*, 8^{me} ed. p. 174.) The same physiologist has compared the convulsive shock, caused by the Upas Tieuté, "to that which takes place when a current of galvanic fluid is directed along the spinal marrow of an animal recently killed."—(See *Orfila's Toxicologie Générale.*) Again, "If an animal be touched whilst under the action of this substance [extract of nux vomica,] it experiences a commotion similar to that of a strong electrical shock; and this takes place every time the contact is renewed."—(*Formul.* p. 5.) These phenomena deserve especial notice in relation to the suggestion of Dr. Faraday, (*British Annals of Medicine*, for Feb. 24, 1837,) that the agent or source of the animal portion of the nervous system may be electricity.

2. *Vital force of the Organism.*—The peculiar properties possessed by living beings are two in number; namely, a capability of receiving impressions, and a capability of contracting—that is, of executing certain motions when the requisite impression has been made. The first has been denominated *latent* or *organic sensibility;* while the second has been termed *insensible* or *organic contractility.* These two properties, observes Adelon (*Physiologie de l'Homme*, 2^{e} ed. t. iv. p. 565,) are reducible to one (*sensibility;*) for to feel is to change the mode of existence, in consequence of an impression—that is, it is to move in a way that is neither physical nor chemical. But as Mr. Grainger (*Observations on the Structure and Functions of the Spinal Cord*, p. 105,) has justly observed, "Organic sensibility is not sensibility of any kind; but a capability possessed by certain nerves (the incident) of receiving and transmitting the impressions of physical agents to the true spinal cord; which organ, by its peculiar power, excites muscular contraction through the medium of the reflex nerves." He proposes, therefore, to call it *excitability* (p. 127;) and suggests "that the contraction required for the nourishment and support of plants is the result of an excited action, effected by a structure analogous in its office, though differing in its physical character, to the true spinal (and, I believe, sympathetic) system of the animal kingdom."—(P. 131.)

Vital properties have by some been ascribed to organic structure, by others to a distinct internal principle called *Life* or the *Vital Force*. For an account of the opinions of writers on this subject I must refer to *Barclay's "Inquiry concerning Life and Organization*,"—as the subject hardly falls within the scope of a work on Pharmacology.

4. *Physiological Effects of Medicines.*

The *primary* or *physiological effects* of medicines may for convenience be divided into such as are *local*, or those that occur in the part to which the agent is applied;—and into those that take place in distant organs, and which by way of distinction we denominate *remote effects.*

1. Topical or Local Effects.—These are of three kinds:—

a. Mechanical or Mechanico-vital effects, as those caused by the hairs of the pods of Mucuna pruriens,—by demulcents,—by adhesive plaster, &c.

b. Chemical or Chemico-vital effects, as those produced by the agents denominated caustics. The constituents of the tissues on which the caustics expend the energy of their affinities are principally water, albumen, fibrin, and gelatine. Water constitutes four-fifths of the weight of the animal tissues and without it, they are wholly insusceptible of vitality, except in the case of some of the lower animals.—(*Müller's Elem. of Physiol.* p. 7.) Hence, therefore, agents like sulphuric acid, which powerfully attract water, act as caustics. Substances which either coagulate liquid albumen, as the mineral acids and alcohol, or which dissolve solid albumen, fibrin, and gelatine, as the alkalis, are also powerful caustics. Many salts, as bichloruret of mercury, sulphate of copper, acetate of lead, and chloruret of zinc, form new compounds when placed in contact with the organic principles just referred to: they also are caustics. As a preliminary to the production of the chemical changes here mentioned, the caustic must destroy the life of the part. Lastly, around the cauterized parts inflammation is set up.

c. Vital Effects.—The effects placed under this head are those which are unaccompanied by any obvious mechanical or chemical changes. As examples we may select two kinds—the vascular and nervous.

The *vascular effects* are those caused by the agents termed *irritants* or *acrids*, as cantharides, savine, gamboge, croton oil, &c. They are, pain, heat, redness, and the other phenomena of inflammation.

The *nervous effects* are numbness, tingling, pricking, and sometimes paralysis, without necessarily any redness or other obvious change in the vascular conditions of the part. When a few drops of the tincture of the root of aconite are applied to a delicate part of the skin, as the inner surface of the lips, numbness and tingling are speedily experienced. The most powerful effects are produced by the *Aconitum ferox*, a native of Nepal, and used as a poison under the name of *Bish* or *Bikh*. Some years ago, at the request of Dr. Wallich, I undertook a series of experiments to determine its effects, (see his *Plantæ Asiaticæ rariores*). I found that one drop of the alcoholic tincture of the root applied to the tongue, caused, within ten minutes, intense numbness in the tip of that organ, and also in the lips, with a sensation as though the soft palate and uvula were relaxed and rested on the tongue. The latter symptom continued for about 15 minutes only, but the numbness and tingling endured for 18 hours.

2. Remote Effects.—These are of two kinds, chemical and vital.

a. Chemical effects.—Vogt (*Pharmakodynamik*, bd. i. p. 15) denies that any remote chemical effects can be produced. But for the reasons before detailed, I regard the alteration in the qualities of the urine, by the internal use of acids or alkalis, as the effect of chemical influence. Moreover, the deposition of silver under the skin by the exhibition of the nitrate, and the colour communicated to bones by the use of madder, seem to show that even solids may undergo chemical changes by the internal employment of medicines.

b. Vital effects.—The functions of remote parts are affected by medicines, as when narcotics or diuretics are exhibited:—The former act on the brain, the latter on the kidneys. Inflammation even may be set up in a distant organ,—as of the bladder, by the use of cantharides.

5. *Absorption of Medicines.*

PROOFS.—The particles of most medicinal substances, when applied to the living body, become absorbed and pass into the circulation. Two facts prove this, viz., the disappearance of certain substances from a shut cavity into which they had been introduced,—and the detection of medicinal particles in the blood, secretions, or solids of the body.

a. Disappearance from a shut cavity.—Drs. Christison and Coindet found that four ounces of a solution of oxalic acid injected into the peritoneal sac of a cat, killed the animal in fourteen minutes. On a post-mortem examination, although none of the fluid had escaped by the wound, they found scarcely a drachm remaining.—(*Edin. Med. and Surg. Journ.* xix. 335).

b. Detection in other parts of the body.—Tiedemann and Gmelin (*Versuche über d. Wege auf welchen Substanzen aus dem Magen u. Darmkanal ins Blut gelangen.* 1820) have detected the following substances in the *blood* of animals to whom those agents had been administered: camphor, Dippel's oil, musk, indigo, rhubarb, lead, cyanuret of potassium, sulphocyanuret of potassium, iron, mercury, baryta, and alcohol. By other experimenters, asafœtida, sal ammoniac, iodine, hydrocyanic, and sulphocyanic acids, &c. have been found. (For authorities consult Magendie's *Elementary Compendium of Physiology*, and Christison's *Treatise on Poisons*).

In the *solids* of the body several substances have been recognized: for example, madder in the bones, silver in the skin, copper in the liver, lead in the liver, spinal cord, and muscles, mercury in various parts, &c.

In the *secretions* various medicinal agents have been recognized.—Thus, *in the cutaneous secretions*, mercury, iodine, sulphur, the odorous matter of musk, of garlic, and of onions, and other substances, have been detected;—*in the breath*, several substances have been recognized by their odour; for example, camphor, alcohol, ether, phosphorus, asafœtida, sulphur, the odorous matter of garlic, and of onions, &c. The *milk* sometimes acquires purgative properties, in consequence of the employment of purgatives (senna, for example) by the nurse. Bitters, indigo, iodine, and madder, have also been distinctly recognized in it. *In the urine* so many substances have been discovered, that it will be most convenient to exhibit them in a tabular form. The following is taken principally from the experiments of Drs. Wöhler and Stehberger, as mentioned by the late Dr. Duncan (*Supplement to Edinburgh Dispensatory*, 1829.)

SUBSTANCES WHICH PASS OFF BY THE URINE.

(A) UNCHANGED, OR NEARLY SO.

Salts.

Carbonate of potash.	Sulphuret of potassium.	Tartrate of nickel and potash.
Nitrate of potash.	Ferro-cyanuret of potassium (in 66 minutes.)	Borax.
Chlorate of potash.	Silicate of potash.	Chloruret of barium.
Sulpho-cyanuret of potassium.		

Colouring Principles.

Indigo, Madder } (in 15 minutes.)	Red radishes.
Rhubarb (in 20 minutes.)	Mulberry.
Gamboge.	Black cherry (in 45 minutes.)
Logwood (in 25 minutes)	Cassia Fistula (in 55 minutes.)
	Elder rob (in 75 minutes.)

Odorous Principles somewhat altered.

Oil of turpentine.	Asafœtida.	Narcotic principle of Amanita muscaria
—— juniper.	Garlic.	Asparagus (*Cullen.*)
Valerian.	Castoreum.	
Saffron.	Opium.	

Other Matters.

Astringency of Uva ursi (in 45 minutes.) Oil of almonds (*Bachetoni.*)

(B) In a state of combination.

Sulphur, as sulphuric acid and sulphuretted hydrogen.
Iodine, as hydriodic acid or ioduret.
Oxalic, Tartaric, Gallic (in 20 minutes), Succinic, Benzoic — Acids, appear in combination

(C) In a Decomposed state.

Tartrate, Citrate, Malate, Acetate — of potash, or soda, are changed into the carbonate of the same alkali.
Sulphuret of potassium changed, in a great measure, into the sulphate of potash.

Fig. 7.

Amanita muscaria.

If the accounts published respecting the *Amanita muscaria* (fig. 7) be correct, its effects are most extraordinary. A variety of this fungus has a powerful narcotic or rather inebriating effect; and that the active molecules get into the blood is proved by the fact of the urinary secretion being impregnated with them, and thus possessing an intoxicating property; and we are told that the inhabitants of the north-eastern parts of Asia use it for this property. A man, for example, may have intoxicated himself to-day by eating some of the fungus; by the next morning he will have slept himself sober; but by drinking a tea-cupful of his urine he will become as powerfully intoxicated as on the preceding day. "Thus," says Dr. Greville, on the authority of Dr. Langsdorf, "with a very few *Amanitæ*, a party of drunkards may keep up their debauch for a week;" and "by means of a second person taking the urine of the first, a third of the second, and so on, the intoxication may be propagated through five individuals."

Vessels effecting absorption.—The particles of medicinal and poisonous substances are absorbed by the veins principally, but also by the lymphatics and lacteals.

1. *Absorption by the Veins.*—The circumstances which seem to prove venous absorption are the following:—

a. Detection of substances in the venous blood.—Tiedemann and Gmelin (*op. cit.*) administered a variety of colouring, odorous, and saline substances to animals, mixed with their food, and afterwards examined the state of the chyle, and of the blood of the (splenic, mesenteric, and portal) veins. The *colouring* substances employed were—indigo, madder, rhubarb, cochineal, litmus, alkanet, gamboge, and sap-green; none of them could be detected in the chyle, but some were found in the blood and urine. The *odorous* substances used were—camphor, musk, spirits of wine, oil of turpentine, Dippel's oil, asafœtida, and garlic: they were for the most part detected in the blood and urine, but none were found in the chyle. The *saline* substances tried were—acetate of lead, acetate and cyanuret of mercury, chloruret and sulphate of iron, chloruret of barium, and ferro-cyanuret and sulpho-cyanuret of potassium. A few of these were detected in the chyle, and most of them in the venous blood and urine. From these experiments we may conclude, that although saline substances occasionally pass into the chyle, odorous and colouring matters do not; all the three classes of substances, however, are found in the venous blood. These results, observe Tiedemann and Gmelin, are opposed to those of Lister, Musgrave, J. Hunter, Haller, Viridet, and Mattei, but agree with those of Hallé, Dumas, Magendie, and Flandrin.

b. Magendie's experiment.—Magendie and Delille *(Elem. Comp. Physiol.)* performed a striking experiment, with the view of settling, if possible, the question of venous or lymphatic absorption of medicines and poisons. They divided all the parts of one of the posterior extremities of a dog, except the artery and vein, the former being left entire, for the purpose of preserving the life of the limb. A portion of the *Upas Tieuté* was then applied to a wound in the foot: in the short space of four minutes the effects of the poison were evident, and in ten minutes death took place. To the inferences drawn from this experiment, however, several objections have been stated: first, the exhibition of opium, to diminish the pain of the operation, has been said to vitiate the whole of the experiment; secondly, the coats of the arteries and veins contain lymphatics, by which absorption might be carried on; and thirdly, as the poison was introduced into a wound, the poison might have combined with the blood, and have rendered it deleterious, without the process of absorption taking place. The first two of these objections have been obviated. In a second experiment, Magendie severed the artery and the vein, and reconnected them by quills, so as to preclude the possibility of absorption taking place by the lymphatics of these vessels: the effects were the same. Some years since I assisted my friend Mr. Lloyd, assistant-surgeon of St. Bartholomew's Hospital, in performing an analogous experiment, using *Strychnia* instead of *Upas Tieuté*, and without administering opium: death took place in twelve minutes.

c. Lacteals tied: effects of poisons still produced.—Magendie says that symptoms of poisoning were observed in six minutes, when nux vomica was applied to the intestine, though the lacteals had been tied.

d. Blood-vessels tied: poisons do not act.—Segalas tied the veins of a portion of intestine, and applied poison, but no effects were produced. Emmert observed, that when the abdominal aorta was tied, hydrocyanic acid was applied to the foot without producing any effect, but when the ligature was removed, symptoms of poisoning came on. *(Müller.)*

e. Rapidity of absorption.—Mayer found that ferrocyanuret of potassium could be detected in the blood, in from two to five minutes after its injection into the lungs. The rapidity with which this salt enters the blood, says Müller, is too great for it to be explained by means of the slow circulation of the lymph.

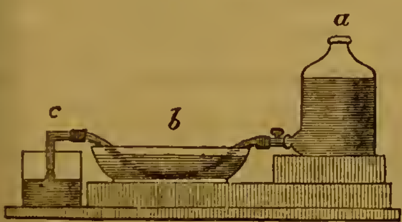
These circumstances appear to me to establish the fact of venous absorption.

2. *Absorption by the lacteals and lymphatics.*—The particles of medicinal and poisonous substances are probably absorbed by the lacteal and lymphatic vessels, as well as by the veins. But the process seems to be slow, and, moreover, is confined to certain agents. Tiedemann and Gmelin, whose experiments I have above referred to, were unable to recognize either colouring or odorous substances in the chyle, but occasionally detected certain salts. The absorption of saline, and non-absorption of colouring matters, have likewise been noticed by others *(Müller's Physiology.)*

MECHANISM OF ABSORPTION.—The facts connected with absorption are best explained by assuming the existence of two powers or agencies by which this process is effected;—the one physical, and the other vital.

1. *Absorption by physical agency (Imbibition*, Magendie; *Exosmose* and *Endosmose*, Dutrochet.)—Two fluids separated by an interposed dead membrane, mutually, though not equally, permeate the membrane, so as to become intermixed with each other. If a current of water, coloured by litmus, be allowed to pass from a bottle (*fig.* 8, *a*), through a vein immersed in diluted sulphuric acid contained in a glass dish (*b*), into a reservoir (*c*), the litmus liquor is soon observed to become reddened by its passage through the vein, in consequence of the acid permeating the venous coats. If the relative position of the fluids be altered,—that is, the litmus put in the dish (*b*) and the acid passed from the bottle (*a*) through the vein, the litmus will still become reddened, shewing that the acid has passed in this case from within outwards.

FIG. 8.



But it may be said this effect is cadaveric only; that is, it occurs in the dead but not in the living vessels:—and in support of this view may be urged, the transudation of blood within the blood-vessels, and of bile within the gall-bladder, both of which phenomena are observed after death. Magendie has endeavoured to meet this difficulty with respect to the imbibition of poisons. He exposed and isolated the jugular vein of a dog, placed it on a card, and dropped some aqueous solution of the extract of nux vomica on its surface, taking care that the poison touched nothing but the vein and the card. In four minutes the effects of the substance became manifest, and the dog died.—*(Magendie's Lectures* in the *Lancet*, Oct. 4, 1834.) It must be admitted, however, that the result of this experiment does not absolutely prove, though it strongly supports, the opinion of the imbibing power of the living vessels; for it might be objected, that the nerves of the venous coats propagated the impression of the poison, and that death took place without absorption; or, that the small veins of the venous coat had taken up the poison. The proof, therefore, should consist in the detection of the poison within the vessel. Now this has been obtained by Magendie: a solution of nux vomica was placed on the carotid artery of a rabbit; but as the tissue of arteries is firmer and less spongy, and their parietes thicker than those of veins, a longer time elapsed before the poison traversed the vessel. In fifteen minutes, however, it had passed, and on dividing the vessel the blood adherent to its inner wall was found to possess the bitter taste of the poison.

With these results before us, we can hardly refuse to admit the imbibition of living tissues, though I think we may fairly question whether this process can be effected so readily in the living as in the dead tissue.

2. *Absorption by a vital agency.*—The physical and chemical agencies with which we are at present acquainted are totally inadequate to explain all the phenomena of absorption. We are constrained, therefore, to admit another agency, which we may denominate vital or organic.

Is THE ABSORPTION OF A MEDICINE, OR POISON, ESSENTIAL TO THE PRODUCTION OF ITS REMOTE EFFECTS?—Magendie and Müller (*Physiol.* p. 246, *et seq.*) seem to consider the passage of poisons into the circulation essential to their operation on the system: while Messrs. Morgan and Addison (*Essay on the Operation of Poisonous Agents*, 1829,) deny that in any case absorption is absolutely necessary for the operation of a poison. "We are not opposed," observe the latter gentlemen, "to the theory of venous absorption, but to that theory which would associate with it the *absolute necessity* for the admission of a poison into a vein." The following facts will be of considerable assistance to us in forming an opinion on this controverted point:—

1. *Activity of substances injected into the blood-vessels.*—Medicinal or poisonous agents injected into the blood-vessels, exert the same kind of specific influence over the functions of certain organs, as when they are administered in the usual way; but that influence is more potent. Thus tartar emetic causes vomiting, castor oil purging, opium stupor, and strychnia convulsions, when thrown into the veins.

2. *Detection of substances in the blood.*—All those medicinal and poisonous agents whose sensible or chemical properties enable them to be readily recognised, have been detected in the blood, or in the secretions which are formed from the blood, after their ordinary modes of administration; as by the stomach.

3. *Activity of medicines promoted by the means which promote absorption, and vice versâ.*—The remote effects of many medicinal and poisonous agents are influenced by the same circumstances that influence absorption; and we are therefore naturally led to presume a mutual relation. Now these circumstances are principally three in number, viz. the nature of the tissue to which the agent is applied—the properties, (physical or chemical) of the medicine itself—and the condition of the system.

a. Nature of the tissue.—Nux vomica acts with the greatest energy when applied to the pulmonary surface,—with less when introduced into the stomach,—and with the least of all, when applied to the skin. The same order of gradation is observed with respect to opium. Now the faculty of absorption, or of imbibition, as Magendie calls it, does not take place with equal intensity in all tissues. Certain physical conditions, (viz., a fine and delicate structure, and great vascularity) enable the pulmonary surface to absorb or imbibe with extreme rapidity: in this respect, indeed, it is not equalled by any tissue of the body. Hence, then, if we assume that nux vomica and opium act by becoming absorbed, we can easily comprehend why they are so energetic when applied to this part. The membrane lining the alimentary canal absorbs with less facility than the pulmonary membrane, which may be accounted for by its less vascularity, and by its being covered, in some parts at least, by an epidermoid layer, and in all its parts by mucus, which, to a certain extent, checks absorption. The cutaneous surface, lastly, being covered by an inorganic membrane (the epidermis,) does not possess the same physical faculties for absorption met with in either of the foregoing tissues; and hence the comparative inertness of medicines when applied to it. In fact, it is only by the long-continued application of these agents to the skin, that we are enabled to affect the general system; and that the obstructing cause is the epidermis, is shewn by the facility with which the system may be influenced when this layer is removed, as has been proposed and practised by Lembert and Lesieur, constituting what has been denominated the *endermic* or *emplastro-endermic* method of treating diseases; of which method I shall have occasion to speak hereafter.

b. The physical and chemical properties of the medicine.—Another circumstance, tending to prove some connexion between the activity of a medicine and its absorption is, that the effect of many medicines is in proportion to their solubility. Arsenic and morphia are both more energetic in solution than in the solid state. Now liquids, (particularly those miscible with the blood,) are much more readily absorbed than solids. In the treatment of many cases of poisoning, we endeavour to take advantage of this principle, and by rendering substances insoluble, diminish their activity, or render them quite inert. Thus the antidote for the salts of lead, or of baryta, is a sulphate, the acid of which forms an insoluble salt with either of the bases (lead or baryta.) Tannic acid (or astringent infusions which contain it,) is for the same reason found useful in cases of poisoning by vegetable substances whose active principle is an alkaloid; and we employ carbonate of lime as an antidote for oxalic acid, to render this substance incapable of being absorbed.

c. Condition of System.—Magendie asserts, as the result of experiments, that plethora uniformly retards, and depletion as constantly promotes, absorption. If, therefore, we wish to promote this function, we have a ready means of doing so, in blood-letting. Now every surgeon knows that one powerful means of promoting the action of mercurials on the mouth, is to abstract blood; and, therefore, we should be cautious about bleeding a patient, while a poisonous dose of some narcotic, as opium, is in the stomach. Nay, in theory, the best means of preventing the operation of poisons which act by becoming absorbed, would be to throw a quantity of warm water into the veins. Magendie tried this on animals, and found it successful.

4. *Magendie's experiment.*—The experiment of Magendie, already related, of applying the *Upas Tieuté* to the leg of a dog, connected to the body only by two quills, is another argument in favour of the operation of medicines by absorption: for in this case the action of the poison could have taken place only after it had passed into the blood.

5. *Division of the spinal cord.*—Some poisons, as hydrocyanic acid, are equally active when applied to the legs of an animal in whom the spinal marrow has been divided. In this case, the effect of the poison could not be the result of its action on the nerves of sensation and voluntary motion. But it may be said the division of the lumbar spine does not prevent the action of poisons by the nervous system, because it does not destroy the action of the excito-motory or sympathetic systems, the nervous branches of which are distributed to the lining membrane of the blood-vessels. I am aware that it is an experiment liable to objection; but, on the whole, it is certainly favourable to the opinion of the operation of poisons by absorption; more particularly when we bear in mind that the motion of the blood is

necessary to the action of the poison; for if the circulation of a part be obstructed, the poison will no longer act. These reasons are, to my mind, conclusive, that in a large number of instances at least, if not in all, the operation of a medicine on remote parts of the system depends on its absorption. Nor can I admit that this opinion is at all invalidated by the arguments and experiments of Messrs. Morgan and Addison.

The principal objections which have been raised to the theory of the operation of medicines by absorption, are the following:—

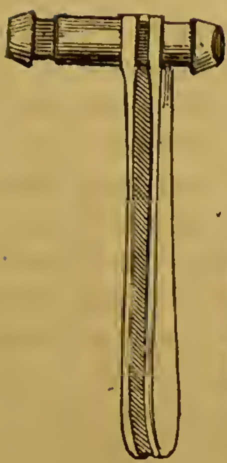
a. The experiments of Magendie and others, it has been observed, only show that a poison may get into the veins, and do not prove that absorption is essential to the effect. "We must strongly protest," say Messrs. Morgan and Addison, "against the assumption that, because a poison has been found to enter and pass through a vein, it is thence to be inferred that such a process is, under all circumstances, absolutely necessary to its operation." But it has been proved that the more absorption is facilitated the more energetic do poisons act, and *vice versâ.*

b. Mr. Travers, in his *Further Inquiry concerning Constitutional Irritation,* points out very forcibly the analogy to be observed between the effects of severe injuries and of poisons which operate rapidly on the system. Thus both strychnia and punctured wounds cause tetanus, and he, therefore, concludes their *modus operandi* must be identical: consequently, as there is nothing to absorb in the one case, so absorption cannot be essential in the other. But although the symptoms caused by the above poison are very analogous to those of traumatic tetanus, yet we are not to conclude that the effects of strychnia and of a puncture are precisely alike. "The fact of two substances producing similar symptoms in one organ," observes Müller (*op. cit.* p. 56) "does not prove that these substances produce exactly the same effects, but merely that they act on the same organ, while the essential actions of the two may be very different." And I confess I see nothing unphilosophical in supposing that the same morbid condition of a part may be induced in more than one way: for as every part of the organism depends for the performance of its proper functions on the receipt of arterial blood and of nervous influence, so alterations in the supply of either of these essentials may modify or even suspend the functions of a part.

c. Messrs. Morgan and Addison tell us that the blood circulating in the carotid artery of a dog poisoned by strychnia is not poisonous to a second dog, and they therefore infer that this poison does not act on the brain by absorption, but by an impression upon the sentient extremities of the nerves.

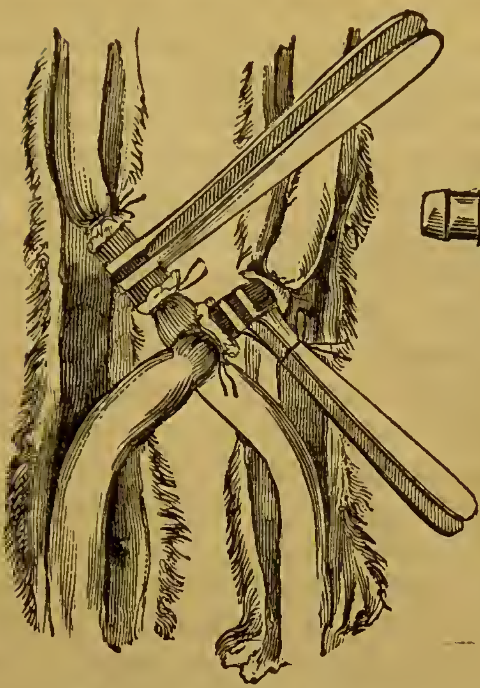
By the aid of a double brass tube, (fig. 9,) consisting of two short brass cylindrical tubes to each of which a long handle is attached (fig. 11), they established a complete circulation between the carotids of a poisoned and of a sound dog, by connecting the lower and upper ends of the divided arteries in both animals, so that each supplied the brain of the other with the portion of blood which had previously passed through the carotid artery to his own, and, consequently, the poisoned dog in this case received from the unpoisoned animal a supply of arterial blood equal to that with which he was parting. (Fig. 10.) One of the dogs was then inoculated with a concentrated preparation of strychnia, which had been found upon other occasions to produce death in these animals in about three minutes and a half. In three minutes and a half the inoculated

Fig. 9.



Double Brass tube.

Fig. 10.



Double circulation between the Carotids of a poisoned and a sound dog.

Fig. 11.

Single cylindrical Brass tubes.

animal exhibited the usual tetanic symptoms which result from the action of this poison, and died in little less than four minutes afterwards, viz. about seven minutes from the time at which the poison was inserted, during the whole of which period a free and mutual interchange of blood between the two was clearly indicated by the strong pulsation of the denuded vessels throughout their whole course. The arteries were next secured by ligature, and the living was separated from the dead animal; but neither during the operation, nor subsequently, did the survivor shew the slightest symptom of the action of the poison upon the system.

The inference which has been drawn from this experiment is, that the arterial blood of an animal under the influence of poison is not poisonous. But it appears to me that this is not a necessary inference, and as it is opposed to the result of other experiments, it requires careful investigation ere we admit it. Vernière has proved that if the extract of nux vomica "be thrust into the paw of an animal after a ligature has been tightened round the leg, so as to stop the venous, but not the arterial circulation of the limb, blood drawn from an orifice in a vein between the wound and ligature, and transfused into the vein of another animal, will excite in the latter the usual effects of the poison, so as even to cause death; while, on the contrary, the animal from which the blood has been taken will not be affected at all, if a sufficient quantity is withdrawn before the removal of the ligature."—(*Christison's Treatise on Poisons*, 3d ed. p. 10.)

Mr. Travers, (*op. cit.*) in noticing the different results obtained by Vernière and Messrs. Morgan and Addison, observes, that "if it be inquired why the poisoned blood concentrated below a ligature, and transferred into the vein of a healthy animal, proves destructive, while the blood of their common circulation affects only the one of the two animals which is the subject of the inoculation, the answer is obvious—that either the mechanical impulse fails, or the activity of the poison is exhausted before, in the latter case, it reaches the second animal."

A remarkable error pervades the whole train of reasoning adopted by Messrs. Morgan and Addison, and vitiates some of their conclusions. They assume that Magendie considers actual contact with the brain as essential for the operation of the Upas poison, (see pp. 42, 43, 47, 49, &c. of the *Essay.)* This assumption, however, is not correct. "In 1809," says Magendie (*Formulaire*, 8^{me} éd. p. i.) "I laid before the first class of the French Institute, a series of experiments which had conducted me to an unexpected result, namely, that an entire family of plants (the bitter Strychnos) have the singular property of powerfully exciting the spinal marrow, without involving, except indirectly, the functions of the brain." Now, this being Magendie's opinion, it is evident that, in the experiment performed by Messrs. Morgan and Addison, the blood sent from the carotid artery of the poisoned animal to the brain of the sound one could only reach the spinal marrow by the usual route of the circulation; that is, it must be returned by the jugular veins to the heart, from thence to the lungs, back again to the heart, from thence into the aorta, and then distributed through the system. Now it is not too much to suppose that, during this transit, some portion of the poison might be decomposed or thrown out of the system before it could arrive at the spinal marrow; and even if this were not the case, this organ could only receive a small quantity of the poison contained in the system, namely, that sent by the vertebral to the spinal arteries. Hence we ought to expect that a poison thrown into the arteries will operate less powerfully than when thrown into the veins, unless it be into the arteries supplying the parts on which the poison acts. Moreover, as an anonymous reviewer has observed (*Lond. Med. and Phys. Jour.* vol. lxiii.) it is to be recollected that as the carotid artery, in its healthy state, is little more than one-fourth of the calibre of the vessels carrying blood directly to the brain, consequently the dog not inoculated was subject to the influence of one-fourth only of the quantity of the poison which was conveyed to the *brain alone* of the inoculated animal. Furthermore I would add, that it is not too much to suppose that the circulation of the blood through the tube would not be so free as through the artery.

HOW DO MEDICINES AND POISONS WHICH HAVE ENTERED THE BLOOD-VESSELS AFFECT DISTANT ORGANS?—Viewing the question theoretically, we see three ways by one or more of which remote parts might be conceived to become affected after medicinal globules have passed into the blood.

1. *By modifying or altering the properties of the blood, and thereby unfitting it for carrying on the functions of the body.*—Although no facts are known which can be regarded as absolutely proving that the action of medicines or poisons is primarily on the blood, yet none I believe are inconsistent with such a notion in all cases, while several strongly favour it: and it has been justly observed by Andral (*Treatise on Pathological Anatomy*, translated by Drs. Townsend and West, vol. i. p. 642), that "as the blood nourishes the solids, and as without its presence they cannot support life, the state of the solids cannot but be influenced by the state of the blood."

In the first place, it must be admitted that in many diseases the properties of the blood are altered, and in some cases these alterations often appear to be primary; that is, they precede alterations of the solids.—Secondly, in some diseases the blood acquires poisonous properties, and is capable of transmitting the affection of the individual from whom it was taken.—Thirdly, by the use of poisons, medicines, and particular kinds of diet, the properties of the blood become altered, while at the same time the condition of the solids is modified. Now as from the food is formed the chyle; from the chyle the blood, and from the blood the solids, a necessary connexion must exist between the quality of the ingesta and the condition of the solids. For facts and arguments relative to these positions, I must refer to Andral's work before quoted.

But if medicines or poisons introduced into the torrent of the circulation act primarily on the blood, what, it may be asked, are the effects produced?

In some cases the action is mechanical, as when air is introduced into a vein. "A very small quantity of air," says Magendie, (*Lancet*, Nov. 15, 1834) "passed slowly into a vein, mixes with the blood, traverses the lungs, and is exhaled with the pulmonary transpiration, without causing any remarkable accident; but when the quantity is increased, especially in a sudden manner, the air mixes with the blood contained in the heart, and forms with it a foamy kind of liquid, which does not pass readily through the capillary system of the pulmonary artery. In consequence of this obstacle to the passage of the blood through the lungs, the respiration and circulation become necessarily troubled, and the animal soon dies in a state of asphyxia,—not from any pernicious action of the air on nervous system." (For further information *On the Influence of Air in the Organs of Circulation*, see Dr. J. R. Cormack's *Prize Thesis* on this subject; Edin. 1837.) Water, when introduced into the circulation, probably acts merely as a diluent. For though when mixed with blood out of the body it dissolves the envelope of the red particles, we can hardly suspect that it produces a similar effect within the blood-vessels, from the circumstance that large quantities of water may be thrown into the veins without causing any remakable disorder of system; whereas if the globules were deprived of their envelope, or changed in their form, great disorder of the system might be expected. Solutions of various substances (as sal ammoniac, chloruret of sodium, carbonate of potash, sugar, &c.) produce no change in the globules out of the body; they therefore probably act mechanically on the blood.

Some substances exercise a chemical action on the blood; as the mineral acids, the alkalis, various metallic salts, alcohol, &c. The affinity of these agents is principally directed to the fibrin and albumen of the liquor sanguinis, and to the constituents of the globules. Hydrocyanic acid even would appear to be a chemical agent, since it makes the blood oily, fluid, and bluish in colour. Such substances, therefore, as exercise a chemical influence, cause speedy death when they are thrown into the veins, unless, indeed, the quantity introduced be very small. It is possible that organic substances may, as Dr. Christison supposes, be decomposed in the blood, without that fluid undergoing any apparent change. "A very striking proof of this is furnished by oxalic acid. Dr. Coindet and I, in one of our experiments, injected into the femoral vein of a dog, eight grains and a half of oxalic acid, which caused death in thirty seconds. Here it was impossible that the poison could have passed off by any of the excretions; yet we could not detect even that large proportion in the blood of the iliac vein, and vena cava, collected immediately after death. As the blood possessed all its usual properties, we must suppose that the poison underwent decomposition in consequence of a vital process carried on within the vessels."—(*Treatise on Poisons*, 3d ed. p. 16.)

It must not, however, be assumed, that agents which effect chemical changes in the blood out of the body, or when injected into the veins, necessarily produce the same phenomena when absorbed from the intestinal or other surfaces; for the quantity taken up at any one time by this process is small in proportion to the volume of the circulating fluid, and the affinities between these agents and the constituents of the blood seem to be kept in check by the vital properties.

As the blood is a vital fluid, medicines may effect changes in it which are neither mechanical nor chemical. Strychnia and morphia produce no obvious effect on the blood, yet it is not impossible that they may cause some changes in its vital condition; and that to these, part of the symptoms caused by their use are to be referred. Here, however, all our remarks are but conjectural.

2. *By pervading the structure of the organ acted on.*—The usual mode of explaining the action of medicines after their absorption, is, that when they have got into the blood, they are carried in the ordinary course of circulation to the heart, and from thence to the lungs. Here the blood undergoes certain chemical changes, and is probably deprived of part of the medicinal particles: at least this appears to be the case with respect to certain odorous substances. The blood still impregnated with medicinal particles being returned to the heart, is transmitted from thence to all parts of the system. In their passage through the tissues of the different organs, it is presumed that these particles act on one or more parts which are endowed with a peculiar susceptibility to their influence.

Thus the opiate particles are supposed to exert a specific influence on the cerebral tissue; strychnia is thought to act on the grey matter of the spinal marrow; mercury, on the salivary glands; diuretics, on the kidneys; and so on. Müller supposes that a change is effected on the composition of the organic matter of the part acted on. The molecules are ultimately got rid of by the excretory organs. On this supposition, then, the blood is merely the "vehicle of introduction."

It must be admitted, that this theory, plausible as it may appear, cannot be satisfactorily proved. We may adduce several arguments in favour of it, but absolute proof or demonstration cannot be offered: our facts merely show the passage of medicinal particles into the blood, and the affection of the remote organs; but the link which connects the two phenomena cannot be, or at least has not yet been, demonstrated. The strongest argument in favour of this mode of explanation is, that the molecules of certain medicines may be detected in some one or more of the excreted fluids; while, at the same time, the functions of the organs secreting or excreting these fluids, have become influenced by the medicine. Now the simplest, and therefore the most plausible explanation, is, that the molecules, in passing through the organ, acted on its tissue, and thus gave rise to a functional change. The diuretic effects of nitre, alkalis, turpentine, &c., are readily explained on this theory: but when the affected part is not a secreting organ, and especially when the medicinal agent is not readily detected by its physical or chemical properties, we have not the same evidence to offer in support of this view, which, notwithstanding, may be not the less true. Several objections present themselves to this explanation. Many medicinal substances may be detected in the secretion of an organ, though no evident influence has been exercised over the organ itself. Thus the colouring particles of rhubarb may be recognised in the urine, although the action of the kidneys does not appear to be altered; and therefore it may be said, that in those cases where the quality of the secretion is affected, we have no right to infer that it depends on the passage of medicinal particles through the secreting vessels. This objection, however, deserves but little attention, inasmuch as we know that the susceptibility of the same part is not the same to all medicines; for it is not every medicine which produces vomiting when applied to the stomach.

It has also been said that this theory of medicines "being conveyed by the circulation to particular parts, is utterly gratuitous, and no less improbable." "What intelligence," says an American writer, (Chapman's *Elements of Therapeutics*, 4th ed. vol. i. p. 73,) "directs them in this voyage of circumnavigation to the port of destination; and how, on their arrival (admitting it to happen,) are they separated from the great mass of fluids in which they are enveloped?" It is not supposed, on this theory, that medicines are *conveyed to particular parts*, but *to every part* of the body in which the blood circulates. How then, it may be replied, is it that particular parts only are affected, since medicinal molecules are in contact with every part? We do not pretend to account for this circumstance. Every one is familiar with the fact that carbonic acid may be applied to the stomach in large quantity with impunity; whereas, if taken into the lungs, it acts as a narcotic poison. The urine has very little effect on the bladder, but if introduced into the cellular tissue, gives rise to violent inflammation.

I have already alluded to another objection to this theory—namely, that injuries sometimes produce the same symptoms as poisons. But it must be recollected that in a large number of instances injuries do not produce the same symptoms; and in those cases where the effects of the two are analogous, I see no difficulty in assuming that there are two modes of affecting the nervous system.

The most important objections that have been advanced against the operation of medicines through the circulation, by local contact with the tissues, are those founded on the experiments of Messrs. Morgan and Addison. Of all their experiments, the following are, I conceive, the strongest against the theory under examination:—

The jugular vein of a full-grown dog was secured by two temporary ligatures; one of which was tied round the upper, and the other round the lower part of the exposed vein. The vessel was then divided between these two ligatures, and the truncated extremities re-connected by means of a short brass cylinder or tube (fig. 13,) within which was placed a portion of woorara, of the size of a grain of canary-seed (fig. 12.) Both the temporary ligatures were then removed (fig. 14), the accustomed circulation through the vessels was re-established, and in forty-five minutes the animal dropped on the ground, completely deprived of all power over the muscles of voluntary motion: in two minutes, convulsions and respiration had entirely ceased. This result was to be expected, whatever theory be adopted.

Fig. 12.

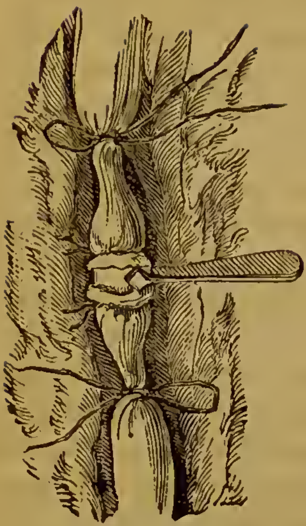
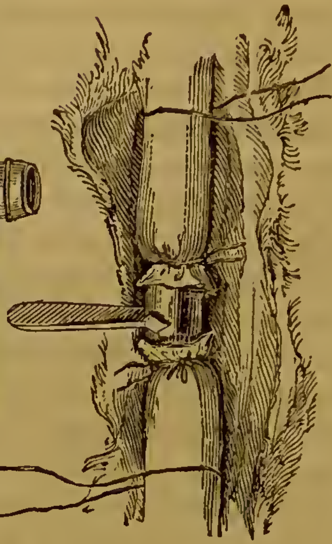


Fig. 13.

Fig. 14.



In another experiment two temporary ligatures were applied to the jugular vein, as in the former case. A cylinder of quill, containing a little woorara, was then introduced into the vein between the two ligatures; another ligature was then applied (fig. 15), and the upper temporary ligature removed (fig. 16). In the space of 108 seconds after the removal of the ligature, the animal dropped in convulsions, as in the former case, and expired in 3¼ minutes. Now, in this experiment, the direct entrance of the poisoned blood into the heart, &c. was prevented by the lower ligature: hence, if this poison operated by contact with the brain, a greater length of time was necessary for its effects to be produced; inasmuch as the circulation was no longer going on through the trunk of the jugular itself, and therefore, if the poison acted by actual contact, it must have got into the system by the vessels of the vein.

Fig. 15.

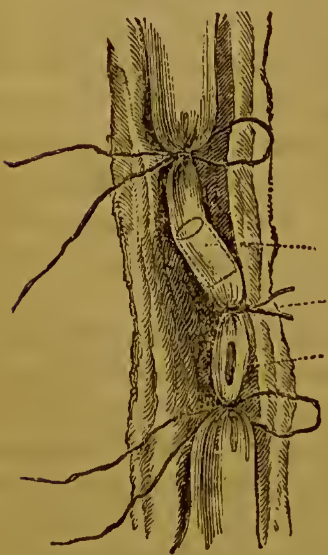
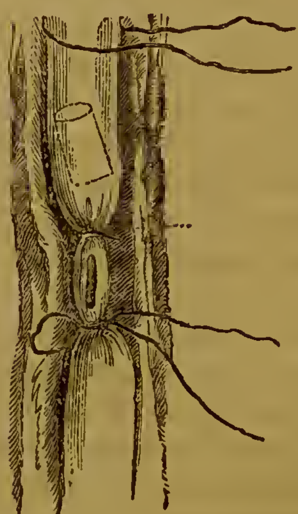


Fig. 16.



"This experiment, however, cannot be regarded as conclusive. For although the "result is certainly different from what might have been anticipated, on the supposition of the circulation of the poison in the blood being essential to its action, yet we cannot regard it as a conclusion against that supposition, unless it were shown that the poison, when the ligature above it is removed, and when it mingles itself with the stream of blood in the vein, does not taint this blood as far back as the next anastomosing branches, and so make its way forward to the heart. That this is not the effect of removing the farther ligature, is not shown by these authors; and their other experiments in favour of their peculiar doctrine of the mode of action of poisons, we have no difficulty in pronouncing to be inconclusive."—(See a criticism in *The British and Foreign Medical Review*, vol. v. for Jan. 1837.)

3. *By acting on the lining membrane of the blood-vessels.*—Messrs. Morgan and Addison contend, that when poisons are "introduced into the current of the circulation in any way, their effects result from th

impression made upon the sensible structure of the blood-vessels, and not from their direct application to the brain itself."—(*Essay*, p. 60.) The proofs adduced in support of this theory are, first, "the extreme susceptibility of the inner coat of a vein, when exposed to the action of a poison," as shown by the experiment related at page 26: secondly, that woorara acts on the brain as quickly when injected into the femoral, as when thrown into the carotid artery: thirdly, that woorara, applied to the cut surface of the cerebrum, caused no symptoms of poisoning: fourthly, that by establishing a complete double circulation between the carotids of a poisoned and of a sound dog, the latter does not become affected.

Of all these "proofs," however, the only important, though not unobjectionable one, is the first. The second and third are merely negative; their object being to show that poisons do not act by pervading the structure of the part, and to the fourth I have before offered some objections.

In conclusion, then, I would observe, that while Messrs. Morgan and Addison have thrown some doubt over our previously received notions on the operation of medicines, they cannot be admitted to have established their own hypothesis; and further experiments are still required to settle this doubtful question.

6. *Operation of Medicines by Nervous Agency.*

Messrs. Morgan and Addison contend, "that all poisons, and perhaps, indeed, all agents, influence the brain and general system, through an impression made upon the sentient extremities of the nerves, and not by absorption and direct application to the brain." Müller, on the other hand, asserts, "that before narcotic poisons can exert their general effects on the nervous system, they must enter the circulation."

Difficulties are met with by exclusively adopting either of these opinions. The operation of some medicines seems to be best explained by supposing the previous absorption of these agents, while that of other substances appears to be most satisfactorily accounted for by presuming they affect the nerves independently of absorption.

PROOFS THAT SOME SUBSTANCES ACT INDEPENDENTLY OF ABSORPTION.—Several circumstances lead us to infer that, in some instances, substances act on the general system without necessarily undergoing absorption.

a. The instantaneous operation of some Poisons.—One drop of pure hydrocyanic acid, says Magendie, placed in the throat of the most vigorous dog, causes it to fall dead after two or three hurried inspirations. If the nose of a rabbit be introduced into a receiver filled with hydrocyanic acid vapour, the animal drops dead instantly. Sir Benjamin Brodie once happened to touch his tongue with the end of a glass rod which had been dipped in the essential oil of bitter almonds; scarcely had he done so, before he felt an uneasy, indescribable sensation at the pit of the stomach, great feebleness of limbs, and loss of power to direct the muscles, so that he could hardly keep himself from falling. These sensations were quite momentary. In the cases now quoted the rapid action of the poisons seems almost incompatible with the idea of their absorption. Müller, however, thinks otherwise, and asserts they are explicable on the theory of absorption by imbibition. "The rapid effects of prussic acid," he observes, "can only be explained by its possessing great volatility and power of expansion, by which it is enabled to diffuse itself through the blood more rapidly than that fluid circulates, to permeate the animal tissues very quickly, and in a manner independent of its distribution by means of the blood, and thus to produce the peculiar material changes in the central organ of the nervous system more quickly in proportion as it is applied nearer to it."—(*Op. cit.* p. 247.)

b. The effects being disproportionate to the facility for absorption.—Orfila (*Toxicologie Générale*) says, that alcohol acts with much less energy when injected into the cellular texture, than when taken into the stomach; and as the power of absorption is greater in the former than in the latter part, he concludes that the remote action of alcohol must be produced by the agency of the nerves. Opium, on the contrary, is supposed to operate by absorption, because it is more active when injected into the cellular texture of the thigh than when taken into the stomach.

c. Dilution diminishing the remote effects.—The effect of dilution on the action of medicinal and poisonous agents oftentimes assists us in determining the mode by which the remote effects take place. Thus if we apply a strong mineral acid to the stomach, great disorder of the general system is produced; but if we dilute the acid previous to its exhibition, little disturbance in the system is observed. Now as dilution facilitates absorption, it is improbable that the constitutional disorder caused by swallowing strong mineral acids depends on their absorption. On the other hand, Dr. Christison (*op. cit.*) has shown that oxalic acid, considerably diluted, quickly enters the blood, and causes speedy death: hence it is presumed to kill in consequence of absorption.

d. Effect of Mechanical Injury.—Mechanical injuries sometimes give rise to effects on remote parts similar to those caused by the action of certain medicines or poisons. Laceration of the stomach produces similar constitutional disorder to that occasioned by the strong acids.

Agency of the Nervous System.—Between the individual parts of the organism there exist certain relations or connexions, which Adelon (*Physiologie de l'Homme*, t. 4me, p. 200,) has arranged in three classes,—the mechanical, the functional, and the sympathetic. It frequently happens that one organ in the performance of its functions exercises a mechanical influence over another. Thus the motions of the respiratory muscles have an important influence over the circulation of blood within the chest. By the contraction of the muscles of the fore-arm, pressure is made on the deep-seated veins, and the passage of blood through them thereby obstructed. These, then, are evident and clear cases of a *mechanical relation* between certain organs. We have also numerous instances of what have been called *functional relations;* but one example will suffice: the liver cannot secrete bile if the supply of arterial blood, or of nervous energy, be cut off: hence it is evident that the function of the liver depends for its performance on the proper execution of the functions of the arterial and nervous systems. But there is a class of relations which cannot be referred to either of the preceding heads, and which have been called the *true sympathies*, or the *sympathetic relations.* Thus if we titilate the mucous membrane of the nose, sneezing is produced; if the soft palate, vomiting.

The phenomena hitherto called sympathetic have been denominated by Dr. Marshall Hall (*Memoirs on the Nervous System*, 1837,) *excito-motory.* They must not be confounded with those of sensation and olition, from which they are quite distinct. They are effected by nervous fibres and a nervous centre. The fibres are of two kinds, one termed *incident excitor*, the other *reflex motor*. The centre is the grey matter of the true medulla oblongata and medulla spinalis, from which the nervous fibres arise.—(See *Grainger's Observations* on the *Structure* and *Functions* of the *Spinal Cord*, 1837.) The mode of action of these parts is this: when a physical agent is applied to any of the external or internal surfaces of the body, an impression is made on, and carried by, the incident excitor nerve to the grey matter, constituting the nervous centre of the system; and this part, by its peculiar power, excites contraction through the medium of its reflex motor nerves. Electricity has been suspected to be the secret agent effecting these communications.

When the nostrils are stimulated, the fauces irritated, or cold water dashed upon the face, filaments of the fifth pair of nerves are the incident excitors; when carbonic acid, or a drop of water, comes in contact with the larynx, and when the dust of ipecacuanha is inhaled into the bronchia, with the effect of inducing asthma, filaments of the pneumogastric nerve are the incident excitors. In all these instances filaments of the pneumogastric are the reflex motors, by means of which the actions of sneezing, vomiting, sobbing, closure of the larynx, and asthma, are produced. "It is singular," observes Dr. Hall, (*Lectures on the Nervous System*, p. 156, note,) "that ipecacuanha, taken into the stomach, should excite vomiting, and, inhaled into the bronchia, should excite spasmodic asthma, equally, as it would appear, through the pneumogastric nerve." Belladonna applied to the eyebrow causes dilatation of the pupil: the incident excitors concerned in this process are the fibres of the portio major of the fifth,—while the reflex motors are derived from the third or oculo-motor nerve. In cases of poisoning by this substance, difficulty or impossibility of deglutition has been observed,—another effect of its action on the excito-motory system.

Mr. Grainger is of opinion, that the ganglions of the sympathetic form a part, though to a certain degree an isolated one, of the excito-motory system; and that their action is excited like that of the spinal cord.—(*Op. cit.* p. 136, *et seq.*) He has also suggested (*op. cit.* pp. 131-2, 155-6-7,) that the motions displayed by plants and the lower animals are excited, and not voluntary; and that even in plants it may be effected by a structure analogous in its office, though differing in its physical characters, to the true spinal system of animals. Hitherto, however, no one has been able to demonstrate a nervous system in vegetables. Dutrochet (*Recherches anatomiques et physiologiques sur la structure intime des Animaux et des Végétaux*, 1824,) indeed asserts, that the small points, or spots, observed on the cells and vessels of plants (figs. 17 and 18,) are analogous to the nervous globules of animals; he calls them *nervous corpuscles*, and regards them as the scattered elements of a diffused nervous system. That globules are found in vegetables in the situation described by Dutrochet no one can deny; but the grounds on which he asserts them to be nervous are very slender. The researches of Leeuwenhoek, Prochaska, Fontana, Sir Everard Home, Bauer, the brothers Wenzel, and Dr. Milne

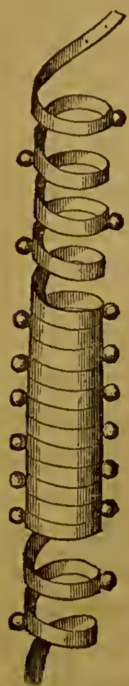
Fig. 17.

Section of the medulla of the *Mimosa pudica*, shewing the globular bodies adhering to the sides of the cells.

Edwards, he observes, have shewn that the nervous system of animals is composed essentially of agglomerated globular corpuscles.

If we examine, by the aid of a simple microscope, the pulpy matter of which the œsophageal ganglia of the great or vineyard snail *(Helix*

Fig. 18.



A spiral vessel, as found in the stems of *Solanum tuberosum*, and *Cucurbita Pepo*, with the adhering globules.

Fig. 19.

Globular cells of the œsophageal ganglia of *Helix pomatia* and *Limax rufus.*

Fig. 20.

Magnified view of the arm of a *Hydra*, (fresh-water polype) shewing the nervous corpuscles.

Fig. 21.

Vorticella Convallaria.

pomatia,) or of the red slug *(Limax rufus,)* is made up, it is seen to be composed of agglomerated globular cells, on the sides of which are numerous globular or ovoid corpuscles (fig. 19.) In form and chemical properties, says Dutrochet, these corpuscles agree with those found in plants. Moreover, in the lower tribes of animals (the *Acrita*) we observe no nervous filaments; the nervous system consisting merely of the diffused or scattered corpuscles (as in the *Hydra* or fresh-water polype, fig. 20, and in *Vorticella Convallaria*, fig. 21; thus presenting another analogy between the nervous corpuscles of animals and the globular bodies of plants.

On these grounds, then, Dutrochet assumes that the little globules sticking to the cells and vessels of plants, and which are nothing but particles of amylaceous, ligneous, or resinous matter, are to be regarded as the scattered elements of a diffused nervous system.

7. *Parts affected by the remote action of Medicines.*

The remote effects of medicines consist of alterations in the functions of one or more organs more or less distant from the parts to which these agents were applied. Although an alteration of function presupposes an organic change, yet the latter is not always obvious.

A medicine may affect a distant organ directly or indirectly. The stupor caused by opium is presumed to arise from the direct influence exercised by this drug over the cerebrum, since it cannot be otherwise accounted for. The convulsions produced by strychnia are best explained, not by ascribing them to any direct influence of this agent over the muscles, but to an influence exercised over the excito-motory system, which is functionally related to the muscles.

Some medicinal agents confine their remote influence principally to one organ, and affect the general system only through the relations existing between the affected organ and the other parts of the body. This is remarkably the case with the substance just referred to,—strychnia. Other agents affect several organs, as arsenic and mercury. We can readily believe that some may affect the whole system, by altering the qualities of the blood. "In fact, when all the tissues thus receive a vitiated blood, is it not consistent with sound physiology to admit that their regular modes of vitality, nutrition, and secretion, must be more or less deeply modified? We must either admit this conclusion, or deny the influence which, according to every physiologist, the blood exerts over each solid. It may, then, happen that one or more organs are affected in a more decided manner than the rest, and there may thus be produced in them various lesions that are only accidental and secondary; but it is not in these lesions the origin of the affection lay; it is not on them all the symptoms depend; nor, lastly, is it to them alone we are to have recourse, to throw a light upon the true nature of the disease, as well as upon the treatment proper to be pursued."—(*Andral's Pathol. Anat.* by Drs. Townshend and West, vol. i. p. 663.)

The intimate relations existing between the different organs and functions, make it exceedingly difficult, and, in many cases, even impossible, to distinguish between the direct and indirect influence of a medicine. In the following examples of organs and functions affected by medicines, this distinction has not been attempted:—

1. *Nervous System.*—Opium causes sleep and stupor,—alcohol inebriates and disturbs volition,—aconite diminishes feeling,—conia paralyses,—strychnia and brucia convulse.

2. *Circulating System.*—The frequency and force of the circulation is increased by the agents termed excitants, calefacients, or stimulants, but diminished by sedatives. Preternatural heat is reduced by refrigerants. (On the influence of asafœtida, digitalis, and senega, on the functions of the heart, see *Continental* and *British Medical Review*, Vol. I. p. 27.)

3. *Respiratory System.*—The frequency of respiration is diminished by narcotics. Emetic tartar and corrosive sublimate, used as poisons, inflame the lungs. Expectoration is promoted by the agents termed expectorants.

4. *Digestive System.*—Salivation is produced by mercury. The power of deglutition is diminished or destroyed by belladonna, when employed in poisonous quantities. Vomiting is caused by emetics. Digestion is promoted by condiments and the bitter tonics, but checked by opium. Purging is effected by cathartics,—constipation by opium and vegetable astringents. Mercury and aloes are believed to stimulate the liver.

5. *Secreting and exhaling organs.*—Mercurials and the alkalis increase the activity of all the secreting and exhaling organs. The oleo-resins and balsams stimulate the mucous surfaces. Opium diminishes the mucous secretions. Diuretics promote the secretion of urine,—diaphoretics the cutaneous exhalation,—sialogogues the flow of saliva,—emmenagogues the catamenial secretion,—expectorants the bronchial secretions, &c.

6. *Lymphatic System.*—Iodine, bromine, mercury, and the alkalis, are presumed to increase the activity of the lymphatic system.

7. *Muscular System.*—The tone of this system is promoted by cinchona. Strychnia convulses, conia paralyses the muscles.

8. *Sexual System.*—The sexual feelings are supposed to be excited by phosphorus. The catamenial discharge is promoted by emmenagogues. Parturition is assisted by ergot of rye.

9. *The Urinary organs.*—Diuretics increase the secretion of urine. Alkalis and acids alter the qualities of this fluid. Opium diminishes the contractility of the ureters and bladder. Cantharides irritate the bladder. The oleo-resins affect the urethra, and cure blennorrhagia.

8. *Of the nature or quality of the actions induced by Medicines.*

Medicinal agents may increase, diminish, or alter the vital actions, and, consequently, may be arranged in the three classes of stimulants, contra-stimulants or sedatives, and alteratives.

a. Stimulants.—In a therapeutic sense, says Müller, (*op. cit.* p. 62,) a stimulant is an agent which vivifies the organs, and renovates their composition. "Besides the vital stimuli before alluded to, there are other agents which, under certain conditions, exert a local, vivifying, and strengthening influence: they produce this effect by restoring the composition of the organ by their ponderable or imponderable influence, or by so changing its composition that the renovation by the general vital stimuli is facilitated. All this, however, depends on the state of the diseased organ; and the cases in which the so-called stimulant and tonic remedies have really their supposed effect, are very rare."

Many other agents are called stimulants, although they have no renovating influence, and do not vivify except by exciting re-action, and which, by long-continued operation, destroy, instead of restoring, the powers of the system.

b. Contra-stimulants, or sedatives.—These are agents whose action is the reverse of that of stimulants.

c. Alteratives.—These are neither stimulants nor contra-stimulants merely. They produce some unnatural or morbid change in the organic textures, and consequently occasion alteration of function. This class includes nearly the whole of the articles comprising our materia medica.

Brunonian theory.—The theory of Dr. John Brown supposes that all living beings possess a peculiar principle, termed *excitability*, and which distinguishes them from inanimate bodies. The agents which support life are termed *exciting powers;* and these acting upon the *excitability*, maintain life; in the language of Brown, produce *excitement.* Whatever can modify the excitability, and produce a greater or less degree of excitement, are termed *stimulant powers:* these are either universal or local. When the exciting powers act moderately, *health* is produced: when they act with too great energy, they cause *indirect debility:* when with too little, they produce *direct debility.* According to this doctrine, all medicines are stimulants, and differ from each other in little more than the degree in which they exert their stimulant power: moreover, they cannot cause exhaustion (of the excitability) except by an excessive action; in other words, by producing previous over-excitement.—(*The Works of Dr. John Brown,* by Dr. W. C. Brown, 1804.)

Considered in a therapeutical point of view merely, the following objections present themselves to this theory:—1. Many agents produce exhaustion without previously occasioning any obvious over-excitement (as the respiration of sulphuretted hydrogen or hydrocyanic acid gases):—2. Medicines differ from each other in something more than the degree of their power; compare together foxglove, ammonia, hydrocyanic acid, cinchona, mercury, alcohol, elaterium, and opium:—3. The great majority of our medicines act neither as stimulants nor sedatives merely; they alter the quality of the vital actions: and this alterative effect has been quite overlooked by the Brunonians.

THEORY OF CONTRA-STIMULUS—NEW ITALIAN DOCTRINE.—This theory may be considered as a modification of the preceding. It was founded about the commencement of the present century, principally by Rasori and Borda, and was subsequently adopted by Tommasini and other Italians.

It admits two classes of medicines, *stimulants* and *contra-stimulants*, thus obviating one of the objections to the doctrine of Brown. An agent that counteracts the effects of some well-known and well-characterized stimulant is denominated a contra-stimulant. The following is a list of remedies classified according to these principles:—

Stimulants.		*Contra-stimulants.*	
Caloric.	Carbonic acid.	Cold.	Nux vomica.
Opium.	The electric fluid.	Blood-letting.	Valerian.
Musk.	Aromatics.	Metallic medicines.	Coffee.
Camphor.	Cinchona (by some this is regarded as contra-stimulant.)	Emollients.	Mustard and pepper.
Phosphorus.		Tonics.	Cantharides.
Ether.		Ipecacuanha.	Turpentine.
Ammonia.	Red particles of the blood.	Purgatives.	Squills.
Wine.		Hydrocyanic acid.	Nitrate of potash.
Alcohol.	Animal food.	Digitalis, belladonna, stramonium, *Lactuca virosa*, &c.	Acids and oxygen.

It will be perceived that the founders of this doctrine have assembled, under the same head, agents causing the most opposite effects: for example, animal food and opium, aromatics and alcohol, cold and turpentine, hydrocyanic acid and cantharides. Moreover, they have separated others whose general operation is very analogous;—as musk and valerian; opium and *Lactuca virosa;* aromatics and pepper. In their anxiety to find stimulants and contra-stimulants, they have quite overlooked the large and important class of alteratives. They have taken no notice of the physiological effects of medicines, but have directed their whole attention to curative influences, which are accidental and uncertain: for the agents which they have collected under the head of contra-stimulants do not always, or even frequently, relieve excitement; on the contrary, they often have the reverse effect.

There is one part of the theory that deserves especial notice. It is asserted that the dose of a contra-stimulant should be proportioned to the degree of excitement; for when the inflammatory action runs high, the patient will bear enormous doses without any obvious evacuation from the skin, stomach, or bowels, and the disease will be subdued wholly by the contra-stimulant effect upon the fibres and other solids of the body. This capability of bearing large doses has been termed *tolerance* of medicines;—and, of course, if the theory be true, ought to decrease as the disease declines; but this certainly does not generally hold good with respect to emetic tartar, as will be mentioned hereafter. Dr. Marshall Hall (*Researches relative to the Morbid and Curative Effects of Loss of Blood*, 1830, also, *Introductory Lecture*, 1834,) maintains, that while a man in health can lose a given quantity of blood (say ℥xv.) without fainting, the same individual, affected with congestion of the brain or inflammation, can bear a much larger quantity (as from ℥xxx. to ℥l.) before incipient syncope,—while in fever, intestinal irritation, dyspepsia, or cholera, a smaller quantity (as from ℥vi. to ℥xii.) will occasion fainting:—so that congestion and inflammation augment, while fever, cholera, &c. diminish the tolerance of blood-letting; he therefore makes use of this circumstance as a diagnostic to enable him to distinguish irritation from inflammation.

9. *Circumstances which modify the effects of Medicines.*

The circumstances which modify the effects of medicines may be arranged under two heads; those relating to the medicine, and those relating to the organism.

1. Relating to the Medicine.—Under this head are included,—

a. State of Aggregation.—The state of aggregation of a medicine modifies the effect. Thus morphia is more active in solution than in the solid state.

b. Chemical combination.—The soluble salts of the vegetable alkalis are more active than the uncombined alkalis, and *vice versâ*, the insoluble salts are less active. Lead and baryta are rendered inert by combination with sulphuric acid.

c. Pharmaceutical mixture.—The modifications produced by medicinal combinations have been very ably described by Dr. Paris.—(*Pharmacologia*, 6th ed. vol. i. p. 267.) The objects to be obtained, he observes, by mixing and combining medicinal substances, are the following:—

I. *To promote the action of the basis or principal medicine:*—

A. By combining together several forms or preparations of the same substance: as when we conjoin the tincture, decoction, and extract of cinchona in one formula.

B. By combining the basis with substances which are of the same nature, that is, which are individually capable of producing the same effect, but with less energy than when in combination with each other: as when we prescribe a compound of cassia pulp and manna.

C. By combining the basis with substances of a different value, and which do not exert any chemical influence upon it, but are found, by experience, to be capable of rendering the stomach, or system, or any particular organ, more susceptible of its action: as when we combine mercury with antimony and opium, to increase the activity of the former.

II. *To correct the operation of the basis, by obviating any unpleasant effects it might be likely to occasion, and which would pervert its intended action, and defeat the objects of its exhibition.*

A. By mechanically separating, or chemically neutralizing, the offending ingredient; as by digesting *Cetraria Islandica* in an alkaline solution, in order to remove the bitter principle, and to enable us to obtain a tasteless, but highly nutritious fecula.

B. By adding some substance capable of guarding the stomach or system against its deleterious effects; as when we combine aromatics with drastic purgatives, to correct the griping qualities of the latter;—or opium with mercurials, to prevent the latter affecting the bowels.

III. *To obtain the joint operation of two or more medicines.*

A. By uniting those substances which are calculated to produce the same ultimate results, although by totally different modes of operation: as when we combine digitalis and potash to produce diuresis,—the first acting on the absorbents, the second on the secreting vessels of the kidneys.

B. By combining medicines which have entirely different powers, and which are required to obviate different symptoms, or to answer different indications: as when we combine opium and purgatives in painter's colic,—the first to relieve the spasm, the second to evacuate the contents of the intestinal canal.

IV. *To obtain a new and active remedy not afforded by any single substance.*

A. By combining medicines which excite different actions in the stomach and system, in consequence of which new or modified results are produced: as when we combine opium (a narcotic) with ipecacuanha (an emetic) to obtain a sudorific compound.

B. By combining substances which have the property of acting chemically upon each other; the result of which is, the formation of new compounds, or the decomposition of the original ingredients, and the developement of their more active elements: as when solutions of acetate of lead and sulphate of zinc are mixed to procure a solution of the acetate of zinc; and when the compound iron mixture of the Pharmacopœia is prepared.

C. By combining substances, between which no other chemical change is induced, than a diminution, or an increase, in the solubilities of the principles, which are the repositories of their medicinal virtues: as when we combine aloes with soap, or an alkaline salt, to quicken their operation, and remove their tendency to irritate the rectum.

V. *To afford an eligible form.*

A. By which the efficacy of the remedy is enhanced; as in the preparation of decoctions, infusions, tinctures, &c.

B. By which its aspect or flavour is rendered more agreeable; as when we exhibit medicines in a pilular form, or when we exhibit them in a state of effervescence.

C. By which it is preserved from the spontaneous decomposition to which it is liable; as when we add some spirituous tincture to an infusion.

d. Organic peculiarities.—Vegetables have their medicinal properties considerably modified by the nature of the soil in which they grow, by climate, by cultivation, by age, and by the season of the year when gathered.

e. Dose.—The modifications produced in the effects of medicines by differences of dose, are well seen in the case of opium, mercurials, and turpentine.

2. Relating to the Organism.—Under this head are included several circumstances, of which the most important are the following:—

a. Age.—One of the most distinctive characters of organised beings is that of undergoing perpetual mutation during the whole period of their existence; thus constituting the phenomena of age. In order the better to appreciate these changes, the life of man has been portioned out into certain periods or ages, as they have been termed, though as these pass imperceptibly into each other, there is no absolute or fixed distinction; and, consequently, the number of these periods has not been generally agreed on; some admitting only three, others four, five, six, seven, or even eight; the most popular number being seven.

Each period of life is characterised by certain conditions of the solids, by particular states of the functions, by a tendency to certain diseases, and by a different susceptibility to the influence of medicines.

The effects of medicines are modified both quantitatively and qualitatively, by the influence of age. Hufeland (*Lehrbuch der allgemeinen Heilkunde*, 2te Aufl. 1830, p. 84) has drawn up the following scale for different ages:—

Years. 25	20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Doses. 40	35	30	29	28	27	26	25	24	23	22	21	20	18	16	13	10

Months.	11	10	9	8	7	6	5	4	3	2	1	½
Doses.	9		8		7		6		5	4	2	1

Suppose the dose at the end of the first year to be 1, then at the fifth it will be 2, at the fifteenth 3, and at the twenty-fifth 4. In the above table the dose for an adult is supposed to be 40 grains. Dr. Young (*Introduction to Medical Literature*, 2nd ed. p. 453) gives the following rule for determining the doses for children under twelve years of age:—"The doses of most medicines must be diminished in the proportion of the age to the age increased by 12. For example, at two years old, to $\frac{1}{7} = \frac{2}{2+12}$. At twenty-one, the full dose may be given." But no rule is of much value, as the degree of developement is very unequal in different children of the same age. Moreover, the rule that applies to one medicine will not hold good with respect to others. This is particularly obvious in the cases of opium and calomel: the first must be given to children with the greatest caution, and in excessively small doses, whereas the second may be given to them almost as freely as to adults. Acetate of lead, nitrate of silver, arsenious acid, and some other metallic compounds, ought, perhaps, never to be prescribed for infants.

b. Sex.—The sex has an influence in the operation of medicines. Females differ from males in greater susceptibility of the nervous system, more excitability of the vascular system, and less energy or power in all parts. In these respects, indeed, they approach children. Women, therefore, require, for the most part, smaller doses of medicinal agents than men.

The periods of menstruation, pregnancy, and lactation, are attended with peculiarities in relation to the action of medicines. Drastic purgatives should be avoided during these states, especially the two first. Agents which become absorbed, and thereby communicate injurious qualities to the blood, are of course to be avoided during pregnancy, on account of the probable ill effects on the fœtus.

c. Mode of life: Occupation.—These circumstances affect the susceptibility of the whole organism, or of individual parts, to the influence of external agents.

d. Habit.—The habitual use of certain medicinal or poisonous agents, especially narcotics, diminishes the influence which they ordinarily possess over the body. Of the truth of this statement we have almost daily proofs in those who are confirmed drunkards, chewers and smokers of tobacco, and opium-eaters. Instances of the use of enormous doses of opium, with comparatively slight effects, will be found in every work on pharmacology. One of the most remarkable I have met with, is that related by G. V. Zeviani (*Sopra un vomito Urinoso*, in the "*Memorie di Matematica e Fisica della Societa italiana.*" Verona, t. vi. 1792-4, p. 93). A woman of the name of Galvani, during a period of thirty-four years, took more than *two cwt.* of solid opium!! When nineteen years old she fell down stairs, and divided her urethra by a knife. Although the wound healed, she was unable to pass her urine in the usual way, but vomited it up daily with excruciating pain, to relieve which, she resorted to the use of opium, the doses of which were gradually increased to 200 grains daily.

The influence of acrid or irritating substances is but little diminished by repetition,—a remark which applies especially to bodies derived from the mineral kingdom. There are, indeed, a few instances illustrative of the effect of habit in lessening the sensible influence of inorganic agents, but their number is small. The most common is the tolerance obtained by the repeated use of tartar emetic in peripneumonia.

Several attempts have been made to account for the effect of habit. Some ascribe it to an increased power acquired by the stomach of decomposing the medicinal agent,—an explanation adopted, in the case of poisons, by Dr. Christison, and which he illustrates by reference to the increased facility acquired by the stomach of digesting substances which had at first resisted its assimilative powers. If this explanation were correct, we ought to observe the effect of habit principally when substances are swallowed, and little, or not at all, when they are applied to a wound, to the cutis vera, or other parts unendowed with digestive powers, and opium ought to have its usual effects in ordinary doses, on application to any part of the body of an opium-eater, except to his stomach. Müller (*op. cit.* p. 60), as I have before noticed (p. 11), ascribes a great number of the instances of habituation to the substance affecting the composition of an organ, and losing its influence by saturation, while the part may still be susceptible of the action of another agent. But a strong objection to this hypothesis is, that the effect of habit is observed principally in the case of narcotic vegetables, and is scarcely perceived in inorganic substances which evince the most powerful affinities for organic principles. The same physiologist ascribes part of the phenomena observed in the effects of habit to the excitability of the organ being deadened by the stimulus being too often repeated.

e. Diseased conditions of the body.—Diseases of various kinds sometimes have a remarkable influence in modifying the effects of medicines; a fact of considerable importance in practice. One of the most striking instances is that of opium in tetanus. A scruple of this substance has been given at one dose, and repeated every two or three hours for several days, without any remarkable effects being produced. The late Mr. Abernethy mentions in his lectures (*Lancet*, vol. v. 1824, p. 71) a patient who had tetanus from a wound which he received at the time of the riots in the year 1780, to whom a scruple of opium was given every day, besides a dose of a drachm at night: when his body was opened, thirty drachms of opium were found undissolved in his stomach. It might perhaps be inferred, that the diminished effect arose from the want of solution of the medicine; and that this was Mr. Abernethy's opinion seems presumable from his advice as to the mode of using it in this disease. "Give it," says he, "repeatedly in small doses, so that it may liquefy." However, that the want of liquefaction or solution is not the sole cause of this diminished influence, is proved from the fact that the tincture is also less effective in tetanus than in health.

Begin (*Traité de Thérapeutique*, t. ii. p. 701) tells us, that M. Blaise, in a case of tetanus, administered in ten days, four pounds, seven ounces, and six drachms of laudanum, and six ounces, four drachms, and forty-five grains of solid opium! Begin (*op. cit.* t. i. p. 113) endeavours to explain these facts by assuming that the stomach acquires an increase of assimilative power, so that it is capable of digesting these enormous quantities of opium, in consequence of which their usual narcotic effects do not take place. He supports this hypothesis by stating, that if, during tetanus, opium be injected into the veins in much smaller quantities, it produces its usual effects. But if this latter assertion be correct, it does not at all warrant Begin's assumption; and bearing in mind that opium administered by clysters during tetanus is less powerful than usual, and also taking into consideration the case related by Mr. Abernethy, I think we have evidence sufficient to warrant our non-admission of this hypothesis. All, therefore, that can be said in the way of explanation, is, that in tetanus the nervous system has undergone some change by which its susceptibility to the influence of opium is considerably diminished.

Another example of the influence of disease in modifying the effects of medicines is seen in the difficulty of causing salivation in fever by the use of mercury. I have repeatedly seen large quantities of mercurials exhibited internally during this disease, and in some cases accompanied with mercurial frictions, without affecting the mouth, and in general such cases terminated fatally. I never saw a fatal case of fever in which salivation was established; but whether the recovery was the consequence of the mercurial action, or the salivation of the recovery, I will not pretend to decide, though the first is the more plausible view.

e. Climate.—The well-known influence of climate in modifying the structure and functions of the animal economy, and in promoting or alleviating certain morbid conditions, necessarily induce us to ascribe to it a power of modifying the effects of medicines. But it is difficult to obtain pure and unequivocal examples of it, in consequence of the simultaneous presence and influence of other powerful agents.

f. Mind.—The effects of medicines are very much modified by the influence of the mind. Hufeland (*op. cit.* p. 80,) knew a lady who, having conceived a violent aversion to clysters, was thrown into convulsions by the injection of a mixture of oil and milk. I have heard the most violent effects attributed to bread pills, which pills the patients had been previously informed exercised a powerful influence over the system. Much of the success obtained by empirical practitioners depends on the confidence which patients have in the medicines administered.

g. Race or *species.*—The effects of some medicines are not uniform on the different races or species of man.

The genus *Homo* is considered by most naturalists (among which may be mentioned the names of Blumenbach, Cuvier, Lawrence, and Pritchard,) to be made up of but one species: the differences which are observed between the inhabitants of certain regions of the world being regarded as sufficient to constitute varieties or races only, and not distinct species. Bory de St. Vincent, (*Essai Zoologique sur le Genre Humain*, 2nd edit. 1827,) however, admits no less than fifteen species.

The *races*, according to Cuvier, (*Le Règne Animal*, nouv. ed. 1824,) are three: the white, or *Caucasian;* the yellow, or *Mongolian;* the negro, or *Æthiopian.*

Fig. 22.

Head and skulls of the Caucasian Race.—(Homo Japeticus, Bory.)

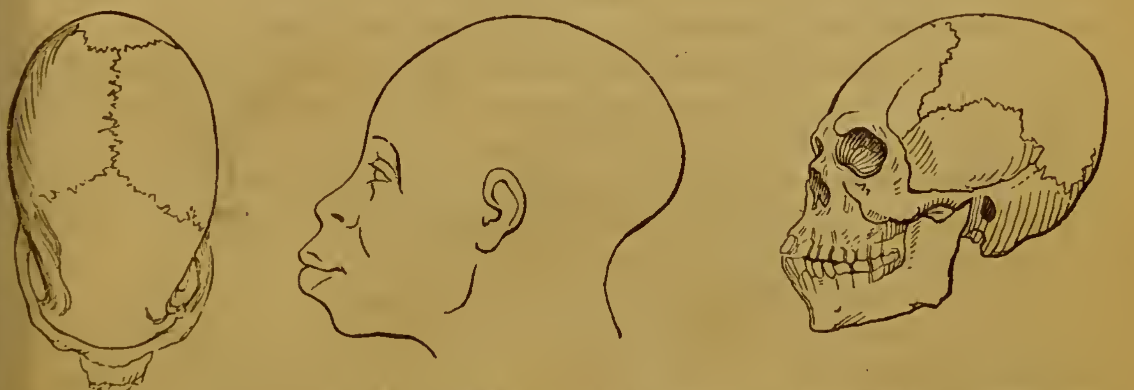
The *Caucasian race* is characterised "by a white skin; red cheeks; copious, soft, flowing hair, generally curled or waving; ample beard; small, oval, and straight face, with the features very distinct; expanded forehead; large and elevated cranium; narrow nose; and small mouth." It includes all the Europeans, the Laplanders excepted, the western Asiatics, and northern Africans.

Fig. 23.

Head and skulls of the Mongolian race.

The *Mongolian* race is characterised by "an olive yellow-coloured skin; hair thin, coarse, and straight; little or no beard; broad flattened face, with the features running together; small and low forehead; square-shaped cranium; wide and small nose; very oblique eyes; and thick lips. Stature inferior to the Caucasian." This race includes the eastern Asiatics, the Laplanders in Europe, and the Esquimaux in North America.

Fig. 24.



Head and skulls of the Æthiopian or Negro Race.—(Homo Æthiopicus, Bory.)

The *Æthiopian race* is characterised by "a black skin; hair short, black, woolly; skull compressed on the sides, and elongated towards the point; forehead low, narrow, and slanting; cheekbones very prominent; jaws projecting, so as to render the upper front teeth oblique; eyes prominent; nose broad and flat; lips (especially the upper one) particularly thick." It comprehends the Africans to the south of the Atlas chain.

Differences of race have been supposed to give rise, in some cases, to differences in the action of medicines on the body. Thus Charvet (*De l'Action comparée de l'Opium*, p. 59,) ascribes to this circumstance the different effects of opium on the Javanese and Malays (both belonging to the Mongolian race) as compared with those produced on Europeans, Turks, and Persians (the Caucasian race.) "The Javanese," says Lord Macartney, (*Embassy to China*, vol. i. p. 263-4,) "under the influence of an extraordinary dose of opium, becoming frantic as well as desperate, not only stab the objects of their hate, but sally forth to attack, in like manner, every person they meet, till self-preservation renders it necessary to destroy them." A very similar account is given by Raynal (*Histoire Philosophique et Politique des Deux Indes*, t. 1er, p. 359,) of the effects of opium on the Malays.

h. Temperaments. — Under the denomination of temperaments are included peculiarities affecting certain individuals, independent of race, and which consist in disproportions in the developement or activity of certain organs, by which the whole animal economy is influenced. The term temperament is derived from the Latin verb *tempero, to mix together*, or *to temper*, and is applied to certain conditions of the body formerly supposed to arise from variations in the proportions of the fluids of the body. Thus, when the fluids were thought to be in proper relative proportions, they were said to temper each other, and by so doing, to produce a perfect temperament. When the yellow bile was supposed to be in excess it produced the choleric or bilious temperament; when black bile, the atrabilious or melancholic; when blood, the sanguineous; and lastly, when pituita or phlegm, the pituitous or phlegmatic. Although in modern times physiologists do not admit these notions, yet we cannot but acknowledge that individuals do present certain physical and functional peculiarities: and thus the existence of temperaments has been generally admitted, while the theory or explanation of them has varied with the prevailing medical doctrines of the day.

The number of temperaments has not been agreed on; Hippocrates admitted four, Boerhaave eight, others five. Under five heads, I think, we may include the leading varieties, which will then stand as follows:—

1st. The *nervous* temperament, characterised by great susceptibility of the nervous system, and comparatively little muscular power.

2d. The *sanguine* temperament, known by great developement of the vascular system. The functions are performed with considerable activity, but the strength is soon exhausted.

3d. The *muscular* temperament is characterised by great developement of the locomotive organs (bones and muscles;) but is accompanied by diminished nervous energy.

4th. The *relaxed* temperament, marked by deficiency of power and imperfect performance of all the functions, with a soft and flabby condition of the solids.

5th. The most *perfect* temperament is that in which all the organs and functions are properly balanced, and in which we have the greatest strength.

Each of these temperaments varies in regard to its susceptibility to the influence of medicinal agents. In the sanguine temperament stimulants are to be employed very cautiously: in the nervous and relaxed temperaments, evacuants are to be used with great care.

i. Idiosyncrasy.—Under this denomination are included these peculiarities which affect the functions of organs, without having any obvious relation to developement, and which are not common to a number of individuals. Its effect in modifying the effects of medicines and poisons is, in general, to increase their activity. Thus, some individuals are peculiarly susceptible of the action of opium, some of mercury, and others of alcohol. The odour of ipecacuanha will, in certain persons, produce short and difficult respiration, approaching almost to a paroxysm of asthma. The late Mr. Haden (*Dr. Dunglison's translation of Magendie's Formulary, with notes* *by C. T. Haden, Esq.* 1825,) has related a case in which two drachms and a half of tincture of colchicum produced death: the mother of the patient was also exceedingly susceptible of the action of colchicum even in very small doses. In some instances the effect of idiosyncrasy is to diminish the activity of medicines. Thus some persons are exceedingly insusceptible of the action of mercury.

k. Tissue or *organ.*—The nature of the part to which a medicine is applied, has an important influence over the effect produced. The stomach, for example, is much more susceptible of medicinal impressions than the skin. Opium acts more powerfully on the system when applied to the serous than to the mucous tissues. Carbonic acid acts as a positive poison when taken into the lungs, but as a grateful stimulant when applied to the stomach. The modifications effected by the nature of the tissue will be more fully noticed hereafter.

8. *Therapeutical Effects of Medicines.*

The effects produced on diseases by the influence of medicines are denominated *therapeutical.* They are sometimes termed *secondary,* because, in a great majority of instances they are subordinate to those already described under the name of physiological.

Mode of production.—Therapeutical effects are produced in two ways:—

1. *By the influence of a medicine over the causes of diseases.*—This may be *direct* or *indirect.* Medicines which act directly are termed by Hufeland (*Lehrbuch,* p. 194) *specifica qualitativa.* As examples, the chemical antidotes may be referred to. Those anthelmintics (as oil of turpentine), which poison intestinal worms, also belong to this division. If the efficacy of sulphur in the cure of itch depend on its destroying the *Acarus Scabiei,* this will be another instance of the direct operation of an agent on the cause of a disease. As an example of a medicine acting *indirectly,* I may mention the dislodgement of a biliary calculus, contained in the ductus choledochus, by the administration of ipecacuanha as an emetic: or the removal, by a purgative, of a morbid condition of system, kept up by the presence of some depraved secretion in the bowels, the result of a previous disease.

2. *By modifying the actions of one or more parts of the system.*—In a large majority of instances the causes of disease are either not known, or they are not of a material nature. In all such cases we administer medicines with the view of producing certain changes in the actions of one or more parts of the system, and thereby of so altering the diseased action as to dispose it to terminate in health. Thus inflammation of the lungs frequently subsides under the employment of nauseating doses of tartarized antimony; and emetics will sometimes put a stop to the progress of hernia humoralis.

The medicines belonging to this division may be arranged in two classes; those which are applied to the diseased part, and, secondly, those which are applied to other parts.

a. Topical agents.—Under this head we include unguents or lotions used in cutaneous diseases, ulcers, &c.; gargles in affections of the mouth and throat; collyria in ophthalmic diseases; and injections into the vagina and uterus in affections of the urino-genital organs. In all such cases we can explain the therapeutic effect in no other way than by assuming that the medicine sets up a new kind of action in the part affected, by which the previous morbid action is superseded; and that the new action subsides when the use of the medicine is suspended or desisted from. Sometimes it may be suspected that the influence which certain medicines exercise in diseases of remote organs, arises from their particles being absorbed, and, through the medium of the circulation, carried to the parts affected. Thus the beneficial influence which the turpentines occasionally exert in affections of the mucous membranes (as in gleet and leucorrhœa) may perhaps be owing to a topical influence of this kind; as also strychnia in affections of the spinal marrow.

b. Medicines which indirectly influence diseased action.—Under this head I include all those agents operating on some one or more parts of the body, which have a relation with the diseased part. Thus emetics may influence a disease by the mechanical effects of the vomiting which they induce. Alterations in the quality of the food relieve diseases depending on morbid changes of the blood,—as when we substitute fresh meat and vegetables, and the use of vegetables acids, for salt provisions in scurvy. Opium relieves spasm and pain, as in colic, or in the passage of calculi. Purgatives relieve cutaneous and cerebral affections; diuretics, dropsies; blisters, internal diseases, &c.

FUNDAMENTAL METHODS OF CURE.—According to the homœopathists there are only three possible relations between the symptoms of diseases and the specific effects of medicines—namely, *opposition, resemblance*, and *heterogeneity*. It follows, therefore, that there are only three imaginable methods of employing medicines against disease; and these are denominated *antipathic*, *homœopathic*, and *allopathic*.

1. *Antipathia* (from Ἀντὶ, *opposite*, and Πάθος, *disease*).—The antipathic (called also by Hahnemann, *enantiopathic* or *palliative*) method consists in employing medicines which produce effects of an opposite nature to the symptoms of the disease, and the axiom adopted is "*contraria contrariis opponenda*." Hippocrates may be regarded as the founder of this doctrine; for in his twenty-second Aphorism (*Aphorismi, Sectio* 2nda,) he observes—"All diseases which proceed from repletion are cured by evacuation; and those which proceed from evacuation are cured by repletion. And so in the rest; contraries are the remedies of contraries."

We adopt this practice when we employ purgatives to relieve constipation; depletives to counteract plethora; cold to alleviate the effects of scalds; narcotics to diminish preternatural sensibility or pain; and opium to check diarrhœa.

But purgatives are not to be invariably employed in constipation, nor opium in pain. Reference must be constantly had to the cause of these symptoms. If confinement of bowels depend on a torpid condition of the large intestines, powerful purgatives may be administered with great benefit; but if it arise from acute enteritis or strangulated hernia, they will probably increase both the danger and sufferings of the patient. Again, opium may be beneficially given to relieve the pain of colic, but it would be highly improper in all cases of acute pain, as in pleurisy.

The homœopathists object to antipathic remedies, on the ground that though the primary effects of these agents may be opposite to the phenomena of a disease, the secondary effects are similar to them. "Constipation excited by opium (primitive effect) is followed by diarrhœa (secondary effect); and evacuations produced by purgatives (primitive ffect) are succeeded by costiveness, which lasts several days (secondary ffect)." (*Hahnemann, Organon*, § lxi). The only mode of meeting statements of this kind is to appeal to experience. Is opium ever beneficial 1 diarrhœa? Are purgatives useful in any instances of constipation? 'he homœopathists reply to both of these questions—No. We answer—'es. Here, then, we are at issue with them on a matter of fact.

2. *Homœopathia* (from Ὅμοιος, *like* or *similar*, and Πάθος, *a disease*).—'he homœopathic method of treating diseases consists in administering a iedicine capable of producing an affection similar to the one to be emoved, and the axiom adopted is "*similia similibus curantur.*"

Hahnemann's first dissertation on homœopathy was published in 1796, 1 Hufeland's Journal (*Preface* to the English Translation of the *Organon.*") In 1805 appeared his "*Fragmenta de viribus medicamen-orum positivis.*" But the first systematic account of this doctrine appeared 1 1810, in a work entitled "*Organon der rationellen Heilkunde.*"

The following, says Hahnemann, are examples of homœopathic cures erformed unintentionally by physicians of the old school of medicine:

The author of the fifth book, Ἐπιδημιῶν, attributed to Hippocrates, peaks of a patient attacked by the most violent cholera, and who was ured solely by white hellebore; which, according to the observations of 'orestus, Ledelius, Reimann, and many others, produces of itself a kind f cholera. The English sweating sickness of 1485, which was so fatal hat it killed 99 out of 100 affected with it, could only be cured by the se of sudorifics. Dysentery is sometimes cured by purgatives. Tobacco, which causes giddiness, nausea, &c. has been found to relieve these ffections. Colchicum cures dropsy, because it diminishes the secretion f urine, and causes asthma in consequence of exciting dyspnœa. Jalap reates gripes; therefore it allays the gripes which are so frequent in oung children. Senna occasions colic; therefore it cures this disease. pecacuanha is effectual in dysentery and asthma, because it possesses he power of exciting hæmorrhage and asthma. Belladonna produces ifficult respiration, burning thirst, a sense of choking, together with a orror of liquids when brought near the patient; a flushed countenance, yes fixed and sparkling, and an eager desire to snap at the by-standers; n short, a perfect image of that sort of hydrophobia which Sir Theodore le Mayerne, Münch, Buchholz, and Neimicke, assert they have completely ured by the use of this plant. When, indeed, belladonna fails to cure anine madness, it is attributable, according to Hahnemann, either to the emedy having been given in too large doses, or to some variation in the ymptoms of the particular case, which required a different specific—erhaps hyoscyamus, or stramonium. Drs. Hartlaub and Trinks have ubsequently added another homœopathic remedy for hydrophobia—amely, cantharides. Opium cures lethargy and stupor, by converting it nto a natural and healthy sleep. The same substance is a cure for con-tipation. Vaccination is a protection from small-pox, on homœopathic rinciples. The best application to frost-bitten parts is cold, either by he use of some freezing mixture or by rubbing the part with snow. In urns or scalds the best means of relief are the exposure of the part to eat, or the application of heated spirit of wine or oil of turpentine.

Hahnemann thinks that it is of little importance to endeavour to lucidate, in a scientific manner, how the homœopathic remedy effects a ure; but he offers the following as a probable explanation. The medicine sets up, in the suffering part of the organism, an artificial but somewhat stronger disease, which, on account of its great similarity and preponderating influence, takes the place of the former; and the organism from that time forth is affected only by the artificial complaint. This from the minute dose of the medicine used, soon subsides, and leaves the patient altogether free from disease; that is to say, permanently cured. As the secondary effects of medicines are always injurious, it is very necessary to use no larger doses than are absolutely requisite, more especially as the effects do not decrease in proportion to the diminution of the dose. Thus eight drops of a medicinal tincture do not produce four times the effect of two drops, but only twice: hence he uses exceedingly small doses of medicines. Proceeding gradually in his reductions, he has brought his doses down to an exiguity before unheard of, and seemingly incredible. The millionth part of a grain of many substances is an ordinary dose; but the reduction proceeds to a billionth, a trillionth, nay, to the decillionth of a grain, and the whole materia medica may be carried in the waistcoat pocket.

The following is the method of obtaining these small doses:—Suppose the substance to be a solid; reduce it to powder, and mix one grain of it with ninety-nine grains of sugar of milk: this constitutes the *first attenuation.* To obtain the *second attenuation,* mix one grain of the first attenuation with a hundred grains of sugar of milk. The *third attenuation* is procured by mixing one grain of the second attenuation with ninety-nine grains of sugar of milk. In this way he proceeds until he arrives at the *thirtieth attenuation.* The following table will shew the strength of the different attenuations, with the signs he employs to distinguish them:—

Signs.	Strength of one grain.	Signs.	Strength of one grain.
1. First attenuation	One hundredth part of a grain.	V. Fifteenth	One quintillionth.
2. Second	One thousandth.	VI. Eighteenth	One sextillionth.
I. Third	One millionth.	VII. Twenty-first....	One septillionth.
II. Sixth	One billionth.	VIII. Twenty-fourth..	One octillionth.
III. Ninth..........	One trillionth.	IX. Twenty-seventh	One nonillionth.
IV. Twelfth	One quadrillionth.	X. Thirtieth	One decillionth.

Here is a tabular view of the doses of some substances employed by the homœopaths:—

Charcoal, one or two decillionths of a grain.
Chamomile, two quadrillionths of a grain.
Nutmeg, two millionths of a grain.
Tartar emetic, two billionths of a grain.
Opium, two decillionths of a drop of a spirituous solution.
Arsenious acid, one or two decillionths of a grain.
Ipecacuanha, two or three millionths of a grain.

These doses are given in pills (*globuli*), each about the size of a poppy-seed.

Hahnemann gravely asserts, that the length of time a powder is rubbed or the number of shakes we give to a mixture, influences the effect on the body. Rubbing or shaking is so energetic in developing the inherent virtues of medicines, that latterly, says Hahnemann, "I have been forced, by experience, to reduce the number of shakes to two, of which I formerly prescribed ten to each dilution" (*Organon*). In mixing a powder with sugar, the exact period we are to rub is, therefore, laid down: in dissolving a solid in water, we are told to move the phial "*circa axim* *iam*," and at each attenuation to shake it *twice*—" *bis, brachio quidem* *s moto, concute*." (See Dr. Quin's " *Pharmacopœia Homœopathica*.")

The principal facts to be urged against this doctrine may be reduced to ur heads:—

1st. Some of our best and most certain medicines cannot be regarded homœopathic: thus sulphur is incapable of producing scabies, though ahnemann asserts it produces an eruption analogous to it. Andral took uinia in the requisite quantity, but without acquiring intermittent fever; t no person can doubt the fact of the great benefit frequently derived from e employment of this agent in ague; the paroxysms cease, and the atient seems cured. " But," says Hahnemann, " are the poor patients ally cured in these cases?" All that can be said is, that they seem to e so; but it would appear, according to this homœopath, that our paents do not know when they are well. We are also told, that whenever intermittent resembles the effects of cinchona, then, and not till then, an we expect a cure. I am afraid if this were true, very few agues ould be cured. Acids and vegetable diet cure scurvy, but I never heard f these means causing a disease analogous to it.

2dly. In many cases homœopathic remedies would only increase the riginal disease. Only contemplate the evils likely to arise from the xhibition of acrid substances in gastritis, or of cantharides in inflamation of the bladder, or of mercury in spontaneous salivation.

3dly. The doses in which these agents are exhibited are so exceedngly small, that it is difficult to believe they can produce any effect on e system, and, therefore, we may infer that the supposed homœopathic ures are referrible to a natural and spontaneous cure. What effect can e expected from one or two decillionth parts of a drop of laudanum? Hahnemann says it is foolish to doubt the possibility of that which really ccurs; and adds, that the sceptics do not consider the rubbing and aking bestowed upon the homœopathic preparation, by which it acuires a wonderful developement of power!

4thly. Homœopathia has been fairly put to the test of experiment by ome of the members of the *Académie de Médecine*, and the result was a ilure. Andral tried the system on 130 or 140 patients, in the presence f the homœopaths themselves, adopting every requisite care and precauon, yet in not one instance was he successful. (See *Medical Gazette*, ol. xv. p. 922.)

3. *Allopathia* (from Ἄλλος, *another*, and Πάθος, *a disease*). The allopaic (called also by Hahnemann *heteropathic*) method consists in the mploying medicines which give rise to phenomena altogether different r foreign (neither similar nor exactly opposite) to those of the disease.

Under this head is included that mode of cure effected by what is alled *Counter-irritation*; that is, the production of an artificial or seconary disease, in order to relieve another or primary one. It is a method f treatment derived from observation of the influence which maladies utually exert over each other. For example, it has been frequently oticed, if a diarrhœa come on during the progress of some internal disases, the latter are often ameliorated, or perhaps they rapidly disappear, pparently in consequence of the secondary affection. The result of bservations of this kind would naturally be the employment of alvine vacuants in other analogous cases where diarrhœa did not spontaneously ake place: and this practice is frequently attended with beneficial results. The appearance of a cutaneous eruption is sometimes a signal for the disappearance of an internal affection; and *vice versâ*, the disappearance of a cutaneous disease is sometimes followed by disorder of internal organs. Here, again, we have another remedy suggested, namely, the production of an artificial disease of the skin, as by blisters, by an ointment containing tartar emetic, or by other irritating applications —a suggestion the advantage of which experience has frequently verified. I might bring forward numerous other examples to prove the fact (which, however, is so well known as to require little proof,) that action in one part will often cease in consequence of action taking place in another. Diseases, then, appear to have what Dr. Pring (*Principles of Pathology*, 1823, p. 352, *et seq.*) calls a *curative relation* with respect to each other and we shall find that the greater part of our most valuable and certain remedies operate on the principle of counter-irritation; that is, they produce a secondary disease which is related to the primary one. Dr. Parry (*Elements of Pathology and Therapeutics*, 2nd edit. 1825,) calls this the "*cure of diseases by conversion.*" Let us offer a few examples:—vomiting is a powerful means of relief in bubo, and also in swelled testicle. John Hunter says, he has seen bubo cured by a vomit. I have frequently seen the progress of swelled testicle in gonorrhœa stopped by the exhibition of full doses of tartar emetic. Now it is very improbable that the benefit arises from the mere evacuation of the contents of the stomach. The only plausible explanation to be offered is, that the emetic sets up a new action in the system, which is incompatible with that going on in the groin or in the testicle. If this notion be correct, emetics act in these cases as counter-irritants. The efficacy of purgatives, in affections of the head, is best accounted for by supposing that they operate on the principle of counter-irritation. Blisters, cauteries, issues, moxa, and other remedies of this kind, are universally admitted to have a similar mode of operation.

Even the efficacy of blood-letting, in inflammatory affections, is better explained by assuming that this agent induces some new action incompatible with the morbid action, than that it is merely a debilitant. The immediate effect sometimes produced on disease, by this remedy, is so remarkable as hardly to admit of the supposition of its acting as a mere weakening agent. One full blood-letting will sometimes put an immediate stop to ophthalmia; and I have sometimes seen, even while the blood was flowing, the vascularity of the eye diminish, and from that time the disease progressively declined. When to this fact we add that the same disease is often successfully treated by other different, and even opposite remedies, such as mercury, and stimulant applications, we find a difficulty in explaining their beneficial agency, except by supposing that they influence disease by some relation common to all of them. This view of the counter-irritant operation of blood-letting is supported by Dr. Clutterbuck, (*Lectures on the Theory and Practice of Physic*, published in the *Lancet*, vol. x. 1826,) Dr. Pring, (*op. cit.* pp. 465-8,) and others. The term *counter-irritant* is, however, objectionable, since literally it expresses that the secondary disease should be a state of irritation,—a term hardly applicable to the condition caused by blood-letting. But this, as well as other remedial agents (mental impressions, for example,) agrees with the counter-irritants, commonly so called (blisters, &c.) in influencing diseases only by an indirect relation; it would better, therefore, either to extend the meaning of the term counter-irri-nt, or to employ some other, such as *counter-morbific.*

The older writers employed two terms, *Revulsion* and *Derivation;* the st was applied to those cases in which the secondary disease occurred a part remote from the seat of the primary affection; the second was, the contrary, confined to those instances in which the secondary was oduced in the neighbourhood of the primary disease. For example, eches or blisters applied to the feet in apoplexy were called revulsives, it the same applications to the head, in the same disease, would be rivatives. There is, however, no real distinction between them, their eration being similar; for revulsion was, even in their own sense of the ord, only derivation at a distant part.

Topical applications are frequently counter-irritants. Thus we see imulant washes, applied to the eye, cure ophthalmia; and they operate, pparently, by altering the morbid action, and substituting a milder and ore easily cured disease for the one previously existing.

Using the term, therefore, in its most extended sense, we see our list of unter-irritants is a most extensive one. It comprehends emetics, pur-tives, diffusible stimulants, mercury, blisters, cauteries, issues, setons, oxa, blood-letting, (including arteriotomy, venesection, cupping, and eches,) irritating lavements, frictions, sinapisms, rubefacients, the hot d cold baths, and even mental impressions. That is, all these agents cite some action in the system which has a relation (oftentimes bene-ial) with the morbid action: to use Dr. Parry's words, these agents cure sease by *conversion.*

The most unsatisfactory part of our subject is, the theory or hypothesis the manner in which the mutual relations of diseased actions are ected. Dr. Parry presumes most diseases consist in local determina-ns of blood, and that it is a law of the human constitution that exces-e morbid determination to two different parts shall not exist in the me person at the same time. Neither of these assumptions, however, is ite correct; but if both were true, they still leave untouched the ques-n how determination of blood to one organ is cured by producing a termination to another. To account for it, some assume that the sys-m can produce only a certain quantity of nervous energy, and that, as every disease, there is an undue or preternatural distribution of ner-us energy, so the production of an artificial disease in one part must, consuming the nervous energy, diminish the disease in another. But e whole hypothesis is grounded on assumptions perfectly gratuitous and capable of proof. As Dr. Pring justly observes, were this hypothesis ie, it would lead us to employ not bleeding, purgatives, blisters, and all direct remedies in hepatitis or consumption, but the exercise of the eadmill for a few hours; so that a patient labouring under phrenitis or eumonia should be made to walk fifteen or twenty miles a day, by hich it would be presumed so much nervous energy would be consumed the arms and legs, that there could not possibly be any preponderance excess in any other seat.

Let us, then, discard absurd hypotheses of this kind; and for the pre-nt be content with the knowledge of the fact that one disease, whether tificially or spontaneously generated, will often, but not invariably, persede another.

9. *Parts to which medicines are applied.*

Medicines are applied to the skin, to mucous or serous membranes, to wounds, ulcers, or abscesses, or they are injected into the veins.

I. Applications to the skin.—Medicinal applications are frequently made to the skin in order to produce local effects, as in the case of blisters, cataplasms, fomentations, lotions, embrocations, &c.; and occasionally to affect remote parts of the system, as when we use mercury. Most, if not all medicines, which influence distant organs by application to the skin, do so in consequence of their absorption; and as the cuticle offers a mechanical impediment to this process, we generally either remove it or make use of friction.

There are three methods of applying medicines to the skin; namely the *enepidermic*, the *iatraleptic*, and the *endermic*.

1. The *Enepidermic method* consists in the application of medicines to the skin, unassisted by friction; as when we employ plasters, blisters, poultices, lotions, fomentations, baths, &c.

Baths are made of liquids (as simple water), soft substances (as hot dung, and saline mud), dry bodies (as sand), gases (as hot air), or vapours (as aqueous vapour). Gases or vapours are sometimes applied to the skin, either as local agents, or as means of affecting the constitution. Thus, baths of sulphurous acid gas are employed in itch; chlorine gas is recommended as an application to the skin in liver complaints; vapours of various mercurial preparations have been employed to excite salivation. The vapour of hot water, holding in solution the volatile matters of vegetables, has been employed in the treatment of many diseases, under the name of *medicated vapour baths;* though the greater part of their efficacy is to be ascribed to the influence of the vapour.

2. The *Iatraleptic method* (which has been so called from Ἰατρεύω, *to cure* or *heal*, and Ἀλείφω, *to anoint*), consists in the application of medicines to the skin, aided by friction. It has been termed the *epidermic method*—sometimes *anatripsologia* (from Ἀνατρίβω, *to rub in*, and Λόγος, *a discourse*), and also *espnoïc medicine*. It was employed by Hippocrates and other old writers, but fell into disuse until attention was again drawn to it by Brera, Chiarenti, Chrestien, and others. Among the substances which have been employed in this way, are camphor, digitalis, squills, cantharides, sulphate of quinia, veratria, colocynth, rhubarb, opium, belladonna, mercury, chloruret of gold, &c.

The mode of employing medicinal agents according to the iatraleptic method, is the following:—The substance to be applied being reduced to the finest possible state of division, is to be dissolved or suspended in some appropriate liquid, and in this state rubbed into the skin. The dose is always considerably larger than for the stomach—generally two or three, often as much as ten, and in some cases even twenty times the ordinary dose: but no absolute rule can be laid down on this head. The liquids employed to dissolve or suspend the medicine may be water, spirit, or oily or fatty matter. Iatraleptic writers, however, prefer the gastric juice, or saliva, or even bile; but I am not acquainted with any just grounds for this preference. Collard de Martigny (*Dict. de Méd. et de Chirurg. pratiq.* art. *Iatraleptie*) concludes from his experiments that the palms of the hands, soles of the feet, neighbourhood of the oints, the chest, the back, and the inner parts of the limbs, are to be preferred for the application of medicines.

The objections to this mode of employing medicines are the uncertainty of results, the time required to affect the system, the frequently unpleasant nature of the process (as when mercurial inunctions are employed), and the local irritation sometimes produced by the friction. Notwithstanding these, however, it may be resorted to occasionally with advantage, as where the patient cannot or will not swallow, or where the alimentary canal is very irritable, or insensible to the action of the medicine.

3. *The Endermic, or Emplastro-endermic method*, consists in the application of medicinal agents to the denuded dermis. For its introduction into practice we are indebted to M.M. Lembert and Lesieur.—(*Essai sur la Méthode Endermique*, par *A. Lembert*, 1828.)

The denudation of the dermis is usually effected by a blistering plaster. When the cuticle is elevated, an opening is to be made into it, in order to allow the serum to escape. The medicine is then to be applied to the dermis either with or without removing the cuticle. At the first dressing, the transparent pellicle formed by the dermis is to be carefully removed, as it very much impedes absorption. The medicine is applied to the denuded surface, either in its pure state, in the form of an impalpable powder,—or, if too irritating, it is to be incorporated with gelatine, lard, or cerate. Should any circumstances arise to lead us to fear that the quantity of the medicine applied has been too large, the mode of proceeding is the following:—Cleanse the surface immediately; make compression (as by a cupping-glass) around the denuded part, in order to prevent absorption, and apply any substance that will neutralize the effect of the medicine. Thus Lembert has found that two grains of the acetate of morphia will destroy the tetanic symptoms caused by the application of two grains of strychnia.

Instead of a blistering plaster, Trousseau recommends a vesicating ointment, composed of equal parts of a strong solution of ammonia and lard. Two applications, of five minutes each, are sufficient to raise the cuticle. Boiling water, which has been employed by some persons, is uncertain, painful, and dangerous: it may cause mortification of the dermis, and thus stop absorption.

The advantages of the endermic method are, that substances are not submitted to the influence of the digestive process, and their pure effects can be better ascertained;—their operation is in general very quick, and in some cases more rapid than when they are applied to the stomach. If the gastric membrane be inflamed, or if the patient cannot (or will not) swallow, more especially if the case be urgent, this is an admirable method of putting the system under the influence of a medicine.

The disadvantages of the endermic method are, the pain sometimes experienced by the application of medicinal agents to a denuded surface —some even may occasion mortification of the part; the possibility of the skin being permanently marked; lastly, some substances have no effect when used endermically.

The substances which have been used by this method are morphia and its acetate, muriate and sulphate, in doses of from a quarter of a grain to two grains; strychnia, from a quarter of a grain to a grain; aconitina, one-sixteenth to one-eighth of a grain; extract of belladonna, three four grains; sulphate of quinia, two to six grains; musk, six or eight grains; tincture of asafœtida, ten minims. Many other agents have also been employed endermically; as digitalis, extract of squills, aloes, saffron, bichloruret of mercury, tartar emetic, &c. For further information on the endermic method, consult, besides Lembert's Essay before quoted, the article "*Endermique Méthode*," by Bouillaud, in the *Dict. de Médec. et Chirurg. pratiques*; also some articles by Dr. Bureaud Riofrey, in the *Continental and British Medical Review*, vol. i. pp. 66, 321, and 385.

Method by inoculation.—In connexion with the endermic method may be mentioned another mode of employing medicines; namely, the method by inoculation proposed by M. Lasargue de St. Emilion. (See the *Continental and British Review*, vol. i. pp. 41 & 388.)

II. APPLICATIONS TO THE MUCOUS MEMBRANES. — We have two mucous membranes, to the different parts of each of which we apply medicines: the first is the gastro-pulmonary membrane, the second the urino-genital.

1. *Gastro-pulmonary membrane.*

a. Ocular mucous membrane (conjunctiva).
b. Nasal or pituitary membrane.
c. Bucco-guttural membrane.
d. Eustachian membrane.
e. Aërian or tracheo-bronchial membrane.
f. Gastro-intestinal membrane.
g. Recto-colic membrane.

2. *Urino-genital membrane.*

a. Urethro-vesical membrane.
b. Vagino-uterine membrane.

1. *Gastro-pulmonary membrane: a. Ocular mucous membrane* or *conjunctiva.*—Medicines are applied to the conjunctiva, to excite local effects only, though we might employ this part for other purposes, since remote organs may be affected by it. Thus a drop of hydrocyanic acid applied to the conjunctiva of a dog produces immediate death. The term *Collyrium* (Κολλύριον) was formerly employed to indicate solid substances applied to the eyes. It now usually means liquid washes for the eyes, and is equivalent to *eye-water*. Cottereau (*Traité Elémentaire de Pharmacologie*, 1835,) calls all medicines (solids, soft substances, liquids, and vapours or gases,) which are applied to the eyes, collyria.

b. Nasal or *pituitary membrane.*—We seldom apply medicines to the *pituitary* membrane except in affections of the nose or of parts adjacent. Sometimes they are employed to irritate and excite a discharge; they are then called *errhines;* but when used to produce sneezing, as when foreign bodies are in the nasal cavities, they are termed *sternutatories* or *ptarmics*.

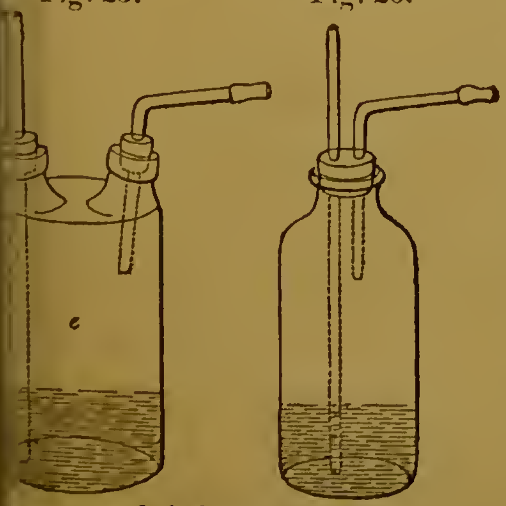
c. Bucco-guttural mucous membrane.—Medicines are very rarely applied to the *mouth* and *throat*, except for local purposes. However, it has been proposed to excite salivation by rubbing calomel into the gums. Solids used in the mouth are termed *lozenges* (*trochisci*) or *masticatories*, according as they are allowed to dissolve slowly or are masticated; liquids are called *collutoria* or *gargarismata*.

d. Eustachian membrane.—Aurists now and then apply washes to the *Eustachian tubes* in local affections; but the occasions for this practice are rare, and the operation difficult, except in practised hands.

e. Aërian or *tracheo-bronchial membrane.*—Accidental observation, as well as experiment, has shewn that medicines produce very powerful effects on the membrane lining the *trachea* and *bronchial tubes*. For the nost part, applications here are made use of for local purposes, as in sthma, chronic bronchitis, phthisis, &c. though occasionally to affect he brain, the blood, the heart, &c. Dr. Myddleton (*A Preliminary Dissertation illustrative of a new System of Pulmonary Pathology*, 1825,) as advocated, in pulmonary diseases, the inhalation of substances (as inchona, sulphate of iron, myrrh, &c.) reduced to an impalpable powder. The fumes (*suffitus*) of tar, balsam, resins, and other burning odies, have also been employed in these cases. Sir Alexander Crichton as strongly recommended tar vapour; the method of using which is he following:—The tar employed should be that used in the cordage f ships; to every pound of which half an ounce of carbonate of potash must be added, in order to neutralize the pyroligneous acid generally ound mixed with the tar, the presence of which will necessarily excite oughing. The tar thus prepared is to be placed in a suitable vessel ver a lamp, and to be kept slowly boiling in the chamber during the ight as well as the day. The vessel, however, ought to be cleansed nd replenished every twenty-four hours, otherwise the residuum may be urned and decomposed,—a circumstance which will occasion increased ough and oppression on the chest.

The inhalation of aqueous vapour (*halitus*,) either alone or with other ubstances, is oftentimes useful in various affections of the lungs and of e throat, &c. The apparatus for this purpose may be that proposed by r. Gairdner (*Edinburgh Medical and Surgical Journal*, vol. xix.;) or Dr. udge's inhaler, or in the absence of these, a teapot, or basin with an verted funnel. In many asthmatic cases the difficulty of breathing is great, that the patient cannot close the mouth around the tube, especally if the latter be small, without exciting a sense of impending ffocation. In such instances I have found the only easy and practicae method of enabling the patient to inhale is, by holding the mouth er hot water contained in a basin or tea-cup. Various narcotic and nollient herbs are sometimes added to the water, but I suspect without ntributing in any way to its efficacy. The vapour of hot vinegar, of lphuric ether, of iodine, of camphor, and of other volatile bodies, is casionally employed in pulmonary diseases. The vapour of iodine ay be conveniently inhaled by means of a double-necked glass bottle (fig. 25,) into which we introduce about an inch of water, to which a few drops of the tincture of iodine have been added. Through one of the necks a straight glass tube passes, and dips under the surface of the water. The other neck has a short curved glass tube passing through it, by which the patient inhales. In the absence of a double-necked bottle we may use a common wide-mouthed bottle (fig. 26,) the cork of which has two perforations, through which pass the glass tubes. Chlorine gas may be inhaled in a similar manner, using solution of the gas, or of chloride of lime, instead of the tincture of line. If oxygen, or nitrous oxide, be inhaled, the most easy and con-

Fig. 25. Fig. 26.



Inhaling bottles.

venient mode of effecting it is from a bladder; but for other and more complete, though more costly methods, I must refer you to the works of the late Dr. Beddoes, and of the celebrated engineer, Mr. James Watt.—(*Considerations on the Medicinal Use, and on the Production of Factitious Airs*, 1796.)

f. Gastro-intestinal membrane.—We employ both extremities of the *alimentary canal* for the exhibition of medicines; the upper, however, more frequently than the lower. This mode of employing medicines is called the *method by ingestion.* Of all parts of the body the gastro-intestinal surface is the most useful for the application of medicines. This arises from the great susceptibility, the active absorbing power, and the numerous relations, which the stomach has with almost every part of the body. In many cases remote effects are more easily produced by this than by any other organ, as in the case of diffusible stimulants. Medicines which act by absorption are more energetic when applied to the serous membranes, the bronchial membrane, the cellular tissue, &c. In some cases it is not only possible, but probable, that the stomach may either partially or wholly digest a medicine.

g. Recto-colic membrane.—Sometimes, though less frequently than the stomach, the *rectum* is employed for the application of medicines. It has been asserted that the general susceptibility of the rectum is only one-fifth of that of the stomach, and that medicines take five times as long to operate by the former as by the latter: hence it has been said that both the dose, and the interval between the doses, should be five times as great as when applied to the stomach. But this assertion is far from being universally correct, though it may be so occasionally. Orfila asserts that those agents which operate by absorption, as opium and tobacco, are more active by the rectum than by the stomach; and he assigns as a reason the greater venous absorption of the rectum, and its less digestive power. But this statement is in direct opposition to the experience of almost every practitioner. Whenever I have had occasion to employ opium by way of enema, I always exhibit twice or three times the ordinary dose, without exciting any remarkable effects. Dr. Christison states that he has given two measured drachms of laudanum by injection, without producing more than usual somnolency, a quantity which, if Orfila's statement were correct, would probably prove fatal.

We apply medicines to the rectum sometimes with the view of alleviating disease of this or of neighbouring organs (as of the uterus, bladder, prostate gland, &c.); at other times in order to irritate the rectum, and, on the principle of counter-irritation, to relieve distant parts (as the head); sometimes to produce alvine evacuations, or to dissolve hardened fæces; occasionally, also, when we are precluded from applying our remedies to the stomach, on account of their unpleasant taste and smell, the inability or indisposition of the patient to swallow, or the irritability of the stomach; and, lastly, in order to destroy the small thread-worm (*Ascaris vermicularis.*)

When the substances applied to the rectum are solid, we name them *suppositories* (*suppositoria*, from *suppono, to put under*;) but when of a fluid nature, they are termed *clysters, lavements*, or *enemata.*

Formerly *suppositories* were conical, or cylindrical, like a candle, and of variable size,—sometimes one or two inches long. They are now usually made globular, and of small size. They are employed to evacuate the bowels; to irritate the rectum, and thereby to relieve affections of distant organs; but more commonly to act as local agents in affections of the rectum, bladder, uterus, prostate gland, urethra, &c. I have frequently employed with great advantage a mixture of opium and soap, to prevent the pain of priapism during the night, in gonorrhœa.

Clysters or *lavements* require to be considered under several points of view: *first*, in reference to the material of which they are made, and which must vary with the object for which these remedies are employed; *secondly*, with respect to the quantity of liquid used, and which will depend on the age of the patient. The average quantity for an adult is about twelve or sixteen ounces; and I believe that it is rarely proper to use more than this. I am quite sure that the practice of introducing several pints of fluid into the large intestines, with the view of exciting alvine evacuations, is bad. In the first place it often provokes the contraction of the gut, by which the injection is immediately returned; and, secondly, repeated distension diminishes the susceptibility of the part, so that the ordinary accumulation of fæcal matter no longer acts as a sufficient stimulus. Mr. Salmon (*Practical Essay on Prolapsus of the Rectum*, 1831, p. 24,) has related a case of this kind, where the patient had nearly lost all power of relieving the bowels, except by enemata or purgatives, and had produced dilatation of the rectum, in consequence of having been in the habit of introducing into the intestine two quarts of gruel twice every day. A newly-born infant requires about one fluid ounce; a child of one to five years, from three to four ounces; and a youth from ten to fifteen, from six to eight fluid ounces. *Thirdly*, the impulse with which the fluid ought to be thrown up deserves attention. If too much force be used, the sudden dilatation of the gut may bring on spasmodic action of its lower part, by which the clyster will be returned. *Fourthly*, the instruments by which the injection is effected require notice. The common pipe and bladder are too well known to require description. I am inclined to think that the most convenient, safe, and useful apparatus, is the elastic bottle and tube. Any quantity of liquid, however small, may be thrown up with the greatest ease, and without any danger of the impulse being too great. Its application is exceedingly convenient; a lusty person, by placing one foot on a stool or chair, may easily apply it without assistance; and its price is very moderate Another form of enema apparatus is a narrow water-proof tube, holding about a pint of liquid, about four feet long, narrower at one end, which is furnished with a common injecting pipe, and about two and a half inches in diameter at the other. The fluid being placed in the tube, the pipe is introduced into the rectum, and the apparatus held in a perpendicular direction, by which the fluid is propelled into the gut by its own gravity. This apparatus, although very simple, appears to me to be less convenient for common use than the elastic bottle, and not to be well adapted for the administration of small quantities of fluids. In the shops are sold syringes of various forms as enema apparatus.

Gaseous matters have been sometimes thrown into the rectum. Thus the injection of common air has been proposed in ileus (*Edinburgh Medical and Surgical Journal*, vol. xvi.) Tobacco smoke has sometimes been employed in hernia: it is injected by a peculiarly constructed pair of bellows. Carbonic acid gas has been used in ulceration of the rectum.

2. *Urino-genital membrane: a. Urethro-vesical membrane.*—Applica-

tions to the *urethra* are made only for local purposes; either in a solid form, as caustic or medicated bougies, or in that of a liquid, as an injection: the latter is easily applied by a common syringe. Syringes of various kinds, for this purpose, are sold by Messrs. Maw, of Aldersgate Street.

Injections are sometimes thrown into the *bladder*, but always for local purposes. The operation is easily performed by attaching a catheter to an elastic bottle.

b. Vagino-uterine membrane.—Medicines are applied to the *vagina* and *uterus* to produce local effects only. Thus injections are made to relieve vaginal discharges, to excite the catamenia, &c. They are usually liquids, but the following case, told me by my friend Dr. Clutterbuck, proves that gases are sometimes employed. A lady, who had suffered a considerable time from some uterine affection, and had derived no relief from the treatment adopted, was advised to consult a physician in Italy. After he had examined the condition of the uterus, he assured her there was no organic disease, but merely a considerable degree of irritation; for which he proposed to apply carbonic acid, as a sedative. This was done by means of a pipe and tube, communicating with a gasometer situated in another room. The patient obtained immediate relief, and although she had been obliged to be carried to the doctor's house, on account of the pain experienced in walking, she left it in perfect ease. On her return to England, she had a relapse of the complaint, and applied to Dr. Clutterbuck to know whether she could have the same remedy applied in London, in order to save her the necessity of returning to Italy.

III. Applications to the serous membranes: *a. Tunica vaginalis.*—Irritating injections, such as wine and water, solutions of metallic salts, &c. are thrown into the cavity of the serous membrane of the testicle in hydrocele, in order to excite inflammation and the subsequent adhesion of the sides of the sac.

b. Peritoneum.—Injections have also been made into the peritoneal sac in ascites, and in some cases with success.—(*Philosophical Transactions* for the year 1744.) The practice, however, is very dangerous. Mr. Cooper (*Dictionary of Practical Surgery*, art. *Paracentesis*,) has seen two fatal cases of it.

IV. Applications to ulcers, wounds, and abscesses.—These are employed principally to excite local effects, and sometimes, though rarely, to produce a constitutional affection. Thus it has been proposed to apply corrosive sublimate to wounds, with the view of causing salivation.

V. Injection of medicines into the veins, (*Chirurgia infusoria; Ars clysmatica nova; Infusion of medicines.*)—This history of this operation is inseparably connected with that of *Transfusion*. The first experiments on infusion are said to have been performed in Germany. (See Paul Scheel's work, entitled "*Die Transfusion des Bluts und Einsprützung der Arzneyen in die Adern*," Kopenhagen, 1802: Zweiter Band, 1803.) But the first scientific examination of the operation was made by Sir Christopher Wren.—(*Philosophical Transactions* for 1665, vol. i. p. 131.) His example was followed by Boyle, Clarke, Henshaw, Lower, and others. (For further information on the history of this operation, consult Scheel's work, before quoted; also Dieffenbach's essay, "*Ueber die Transfusion des Bluts und die Infusion der Arzneien*," 1833; or Marx's, "*Die Lehre von den Giften*," 1827 and 1829.)

The partisans of this method of treatment assert, that when medicines are administered by the stomach, their properties are more or less altered by the digestive powers of this viscus; and that by injecting medicines at once into the veins, we avoid this influence. This statement, however, is not accurate, since Drs. Christison and Coindet have shown that some substances are decomposed even in the blood, or at least that they cannot be recognized in this fluid. Furthermore, it has been proved that the effects are of the same general nature as when medicines are applied to the skin or stomach; thus, tartar emetic vomits, senna purges, opium stupifies, and so on. So that some of the supposed advantages of this operation have no real existence, while several objections to it exist: such as the danger of introducing air into the veins, or of throwing in too large a dose of the remedy (for a slight excess in some cases may prove fatal), or of the occurrence of phlebitis. These, then, are sufficient reasons for not resorting to this practice, except on very urgent occasions; for example, to excite speedy vomiting when the patient is unable to swallow. Köhler (mentioned by Dieffenbach, who notices also several other analogous cases) preserved the life of a soldier, in whose throat a piece of beef tendon was sticking, by throwing a solution of six grains of tartar emetic into a vein of the arm: vomiting was induced, and the meat expelled. Meckel injected two grains of this salt, dissolved in water, into the veins of a woman, to restore suspended animation, from immersion in water.

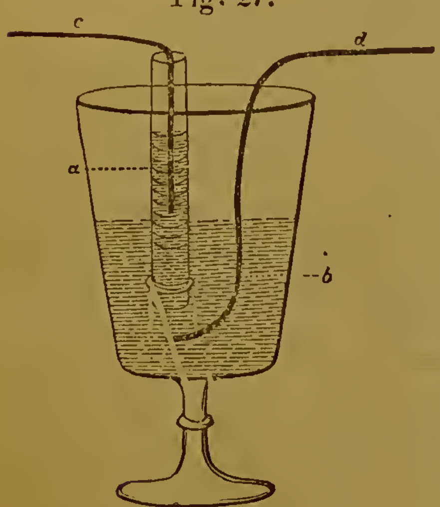
In some obstinate and dangerous diseases this operation is admissible as a last resource; for example, in cases of poisoning, in hydrophobia, in malignant cholera, &c. As plethora appears to diminish absorption, it has been proposed to throw tepid water into the venous system in cases of narcotic poisoning, and thus to cause artificial plethora, in order to prevent the occurrence of the symptoms of poisoning by stopping absorption. Vernière found three grains of nux vomica produced no effect when applied to a wound in a dog into whose veins water had been thrown; and he asserts, that by the early use of aqueous injections we may prevent the developement of contagious diseases. Magendie has tried the effects of injecting tepid water into the veins in hydrophobia. The operation was first performed at the Hôtel-Dieu, at Paris, in October, 1823: the convulsions were stopped, but the patient died in a day or two afterwards. This operation has been several times repeated, and with the same results. In June 1832, I tried it on a patient (afflicted with this terrible disease) under the care of the late Mr. Bennett, of the Commercial Road: the patient was a boy about nine years of age; he was nearly insensible at the time I performed the operation. I threw in about one quart of tepid water without any obvious effect on the pulse: no convulsions were subsequently observed, but the patient died in a few hours. Saline solutions were injected into the veins in malignant cholera, and often with apparent advantage. Purgatives, narcotics, &c. have been thrown into the veins by different physiologists, and in most cases the effects observed were similar to, though more powerful than, those produced when these agents were administered by the stomach. To this statement, however, the oils are an exception; for when injected into the veins in large quantities they interrupt the circulation, and produce a kind of asphyxia.

Agency of Galvanism.—It has been proposed to assist the introduction of certain medicinal particles into the blood by galvanism. This practice was first adopted with iodine in 1823, by Dr. Coster, (*Archives*

Générales de Médecine, t. ii. p. 432,) and in 1833 by M. Fabré-Palaprat, (*Arch. Gén.* 11me série. t. ii.; also, *Becquerel, Traité de Electricité*, t. iv. p. 321.) The principle on which galvanic electricity has been employed is, that the poles (electrodes) of a voltaic battery have attractive and repulsive powers for certain substances: thus the positive pole (anelectrode) attracts oxygen, chlorine, and iodine,—while the negative pole (cathelectrode) attracts hydrogen and the metals. M. Fabré-Palaprat asserts, that by the aid of galvanism he can cause certain chemical agents to traverse the body and appear at some distant part. He bound on one arm a compress, moistened with a solution of ioduret of potassium, and covered by a platinum disk, connected with the negative pole (cathelectrode) of a voltaic battery of thirty pairs of plates. On the other arm was placed a compress, moistened with a solution of starch, and covered by a platinum disk, connected with the positive pole (anelectrode) of the battery. In a few minutes the starch acquired a blue tinge, shewing that the iodine had been transported from one arm to the other.

But the idea entertained by Davy, that the poles (electrodes) possess attractive or repulsive powers, has been shown by Faraday to be incorrect. It is, indeed, true, that if we place a solution of ioduret of potassium in a glass tube (fig. 27, *a.*) closed at the lower extremity by a piece of bladder, and immerse the tube in a glass vessel containing a solution of common salt and starch, we may, by connecting the liquid in the tube with the negative pole (cathelectrode) (*c*,) and the outer or starch liquid with the positive pole (anelectrode) (*d*) obtain the blue iodide of starch in the outer liquid, shewing that the iodine must have transuded the bladder. But the transudation is effected by exosmosis or imbibition, and not by the action of the battery, since the iodine may be recognised in the external liquid by appropriate tests, when no voltaic apparatus has been employed. The positive pole (anelectrode) does not, therefore, attract the iodine through the bladder, but merely sets it free when the ioduret has transuded.

Fig. 27.



I have twice repeated M. Fabré-Palaprat's experiment,—once on my pupil, Mr. John Smith, and a second time on my assistant, Mr. Scoffern, but though I employed fifty pairs of plates during fifteen minutes, I was unable to obtain the least trace of the passage of iodine through the body.

It is not improbable, however, that electricity may promote absorption, either by increasing endosmosis, or by acting as a stimulus to the blood-vessels and lymphatics.

10. *Classification of Medicines.*

In some works on Medical Botany, which contain figures of the plants employed in medicine, the authors have not followed any arrangement; in consequence, I presume, of the impossibility of procuring specimens in regular order. This is the case in the following works:—

W. Woodville, M.D. Medical Botany, 3 vols. 4to. London, 1790. A Supplement to the Medical Botany, 4to. London, 1794.

J. Bigelow, M.D. American Medical Botany, 3 vols. 8vo. Boston, 1817-18-20.

W. P. C. Barton, M.D. Vegetable Materia Medica of the United States, 2 vols. 4to. hiladelphia, 1818.

J. Stephenson, M.D. and *J. M. Churchill*, Medical Botany, 4 vols. 8vo. London, 327-31.

Flora Medica, 2 vols. 8vo. 1827.

The large number of substances employed in the treatment of diseases nders some arrangement of them almost absolutely necessary;—and I onceive any order of treating of them to be better than none.

Arrangements or classifications of medicines, like those of plants, (*Théo-e Elémentaire de la Botanique*, par P. Decandolle, 1819,) may be ivided into *empirical* and *rational* ones.

1. Empirical Arrangements.—These are independent of the nature f, and have no real relation or connexion with, the substances to be ranged. An *alphabetical* order, since it is founded on names which e arbitrary, and have no relation to the bodies they are intended to esignate, is of this kind. Two advantages have been supposed to be ained by its employment;—firstly, a ready reference to any particular ibstance; and, secondly, the avoidance of errors committed by writers ho adopt other methods. But the first is more imaginary than real; for n index gives to any mode of classification every advantage derived from n alphabetical arrangement; and, as each substance is known by a iriety of names, an index becomes as necessary to an alphabetical, as to ny other method. Like other classifications this has its disadvantages, ie most important of which are, that it brings together substances of the ost incongruous natures, and separates those which agree in most of their operties; and from its want of order, it distracts the attention of the udent, and is, therefore, totally unfitted for an elementary work.

The following are some of the more important works in which medi-ines are described in an alphabetical order:—

M. de la Beyrie, and *M. Goulin*, Dictionnaire raisonné-universel de Matière Médicale, 8. Paris, 1773.

J. Rutty, Mat. Medica antiqua et nova, repurgata et illustrata. 4to. Roterodam, 1775.

W. Lewis, an Experimental History of the Materia Medica, 4to. 1761.—4th edit. by r. Aikin, 2 vols. 8vo. 1791.

Andrew Duncan, jun. M.D. The Edinburgh New Dispensatory, 11th ed. Edinburgh, 326. Supplement to the above, 1829.

J. R. Coxe, M.D. The American Dispensatory. Philadelphia, 1806.

J. Thacher, M.D The American New Dispensatory. Boston, 1810. 2d ed. 1813.

A. T. Thomson, M.D. The London Dispensatory. London, 1811. 9th ed. 1837.

J. A. Paris, M.D. Pharmacologia, 3rd ed. 1820. 8th edit. 1833.

W. Ainslie, M.D. Materia Indica. London, 1826.

W. T. Brande, A Manual of Pharmacy. London, 1825. 3rd ed. 1833.

A. Chevallier, *A. Richard*, and *J. A. Guillemin*, Dictionnaire des Drogues simples et mposées; tom. 5, Paris, 1827-9.

F. P. Dulk, Die Preussische Pharmakopöe, übersetzt und erläutert; 2te Aufl. 2 Th. o. Leipsig, 1830.

L. Martinet, Manuel de Thérapeutique et de Matière Médicale. Paris, 1828.

F. S. Ratier, Traité élémentaire de Matière Médicale; tom. 2, Paris, 1829.

F. V. Mérat et *A. J. De Lens*, Dictionnaire universel de Matière Médicale et de Thé-peutique Générale, t. 6, 1829-34.

L. W. Sachs and *F. P. Dulk*, Handwörterbuch der praktischen Arzneimittellehre, onigsberg, 1830-37. 19 Lief. A.—St.

G. B. Wood, M.D. and *F. Bache*, M.D. The Dispensatory of the United States of merica, 1833. 3rd edit. 1836.

Bachmann, W. L. Handwörterbuch der praktischen Apothekerkunst, 2 Bde. Nürn-rg, 1837.

A. Ure, M.D. A Practical Compendium of the Materia Medica, with numerous For-ulæ for the Treatment of Diseases of Infancy and Childhood. London, 1838.

J. Steggall, M.D. A Text Book of Materia Medica and Therapeutics, 12mo. Lo don, 1837.

2. Rational Arrangements.—These have an actual relation with th bodies for which they are used, and are the classifications properly s called. They are founded on the properties of the substances treated o consequently, are as numerous as there are classes of properties. Th medicines may be arranged according to their

a. Sensible properties (colour, taste, and smell.)
b. Natural-historical properties (external form and structure.)
c. Chemical properties.
d. Physiological effects.

a. Classifications founded on the sensible qualities (*colour, taste, an odour.)*—Classifications of this kind are necessarily very imperfect, owin to the impossibility of defining sensations. Moreover, their use is ver limited, in consequence of the colour, taste, and odour of bodies having n necessary relation to their medicinal properties. In the best execute arrangements of this kind, the denominations of many of the classes o orders are objectionable ;—dissimilar bodies are brought together;—an similar ones separated.

MR. GREEVE'S CLASSIFICATION.

Classes.	Families.	Orders.
I. Inodorous and insipid	1. *Liquid*	1.
	2. *Soft*	1. Pulvereseent.
		2. Unctuous.
	3. *Hard*	1. Tough.
		2. Brittle.
II. Inodorous and sapid	1. *Sweets*	1. Saccharine.
		2. Amylaeeous.
		3. Mucous or Unctuous.
		4. Faint.
		5. Frugous.
	2. *Bitters*	1. Mawkish.
		2. Astringent.
		3. Pure bitter.
		4. Austere.
		5. Styptic
		6. Acrid.
		7. Salino-amare.
	3. *Alkalines*	1.
	4. *Acids*	1. Pure aeid.
		2. Saccharo-acid.
	5. *Salines*	1. Pure salt.
III. Odorous and insipid	1. *Fragrant*	1. Sweet.
		2. Aromatic.
IV. Odorous and sapid	1. *Sweets*	1. Saecharine.
		2. Faint.
		3. Sweet-spicy.
	2. *Bitters*	1. Mawkish.
		2. Subastringent.
		3. Bitter-spiey.
		4. Sharp-bitter.
		5. Austere.
		6. Subacrid.
		7. Aerid.
	3. *Acidous*	1.
	4. *Camphreous*	1. Camphreous aromatics.
		2. Savoury.
		3. Terebinthinate.
		4. Camphreous.
	5. *Spirituous*	1. Vinous.
		2.

The following writers have offered the best examples of this mode of lassification:—

Jon. Osborne, M.D. On the Indications afforded by the Sensible Qualities of Plants ›ith respect to their medical Properties. Contained in the Transactions of the Asso- iation of Fellows and Licentiates of the King and Queen's College of Physicians, ol. v. 1828.

A. F. A. Greeves, An Essay on the Varieties and Distinction of Tastes and Smells, nd on the Arrangement of the Materia Medica. [Published by *Dr. Duncan* in his upplement to the Edinburgh New Dispensatory, 1829.]

b. Classifications founded on natural-historical properties.—By natural- istorical properties, I mean those made use of in natural history. They are principally external form and structure. In living beings we ind that peculiar structure denominated *organized.* The structure called *rystalline* is peculiar to mineral and other inorganized bodies.

A. *Classifications of organized beings.*—In the following works the *egetable* substances employed in medicine are arranged according to heir natural-historical properties :—

J. A. Murray, Apparatus Medicaminum tam simplicium quam præparatorum et ompositorum, vol. v. Göttingæ, 1776-89;—post mortem auctor. edid. *L. C. Althof*, ol. vi. Göttingæ, 1792.

A. P. De Candolle, Essai sur les Propriétés Médicales des Plantes, comparées avec urs Formes Extérieurs et leur Classification Naturelle, 1804, 2d. éd. Paris, 1816.

A Richard, Botanique Médicale. Paris, 1823.

P. J. Smyttère, Phytologie-pharmaceutique et Medicale. Paris, 1829.

J. H. Dierbach, Abhandlung über die Arzneikräfte der Pflanzen verglichen mit ihrer ructur und ihren chemischen Bestandtheilen. Lemgo, 1831.

T. F. L. Nees von Esenbeck und *C. N. Ebermaier*, Handbuch der medicinisch-phar- aceutischen Botanik. Düsseldorf, 3 Th. 1830-32.

The *animal* substances used in medicine are arranged in natural-histo- ical order in the following works :—

J. F. Brandt und *J. T. C. Ratzeburg*, Medizinische Zoologie oder, getreue Darstel- ing und Beschreibung der Thiere die in der Arzneimittellehre in Betracht kommen in ystematischer Folge herausgegeben. Berlin, 2 Bde. 1827-33.

P. L. Geiger, Handbuch der Pharmacie, 2ten Bd. 2te Hälfte. Heidelberg, 1829.

Both the *vegetable* and *animal* materia medica are arranged according › the natural system in the following works :—

J. J. Virey, Histoire Naturelle des Médicamens. Paris, 1820.

A. L. A. Fée, Cours d'Histoire Naturelle pharmaceutique. t. ii. Paris, 1828.

A. Richard, Elémens d'Histoire Naturelle Médicale, t. iii. Paris, 1831-35.

J. Johnstone, M.D. A Therapeutic Arrangement and Syllabus of Materia Medica. 2mo. London, 1835.

E. Soubeiran, Nouveau Traité de Pharmacie théorique et pratique, t. ii. Paris, 1836

As in the subsequent part of this work the vegetable and animal sub- tances used in medicines will be arranged in natural-historical order, it ill be unnecessary here to offer any examples illustrative of it. I have referred this mode of arrangement principally on account of the great ifficulties attending any other method, especially that founded on the ffects of medicines.

Artificial method of Linneus.—This appears to me the best place for oticing those pharmacological works in which the Linnean artificial ethod of arranging plants is followed.

Car. A. Linné, Materia Medica, ed. 4a. curante *J. C. D. Schrebero.* Lipsiæ et Er- ngæ, 1782

P. J. Bergius, Materia Medica e Regno vegetabili, 2tom. ed. 2nda. Stockholmiæ, 1782.

P. L. Geiger, Handbuch der Pharmacie, 3tte. Aufl. 2 Bde. Heidelberg, 1830.

Methods founded on the parts of organized beings employed.—In som works the vegetable and animal substances employed in medicine ar classified according to the parts used; as barks, roots, seeds, secretions, &c

R. A. Vogel, Historia Materiæ Medicæ. Ludg. Batav. & Lipsiæ, 1758.
C. Alston, M.D. Lectures on the Materia Medica, 2 vol. London, 1770.
J. C. Ebermaier, M.D. Taschenbuch der Pharmacie. Leipzig, 1809.
N. J. B. G. Guibourt, Histoire abrégée des Drogues simples, 2de. éd. Paris, 182 3me. éd. 1836.

B. *Classification of inorganized substances.*—I am unacquainted wit any natural-historical arrangement of the inorganized substances of th materia medica; that is, of an arrangement founded on the externa forms and structure of these bodies. Most writers who have followe the natural system in their descriptions of vegetable and animal medi cines, have adopted a chemical classification for the inorganized medi cinal substances; a mode of proceeding which I shall follow in thi work. As an example of a natural-historical classification of minerals, may refer to the following work:—

F. Mohs, Treatise on Mineralogy, translated by W. Haidinger, 3 vols. Edin burgh, 1825.

It may perhaps be useful to present the student with a classification o all the crystallized substances employed as medicines; as far, at least, a their primary forms have been determined. And here I must explain that the forms of crystals are *primary* or *secondary*. "A *primary* form is that parent or derivative form from which all the secondary forms o the mineral species to which it belongs may be conceived to be derive according to certain laws." (*Brooke's Familiar Introduction to Crystallo graphy*, 1823.) The *secondary* forms consist of all those varieties be longing to each species of mineral which differ from the primary form.

All the known primary forms may be arranged in six groups, or sys tems, as follows:—

Group 1st. Regular or Cubic System: (*Octahedral System: Tessular System*, Mohs) —The primary forms belonging to this group, are the *Cube* (or *Hexahedron*), the *Tetra hedron*, the *Regular Octahedron*, the *Rhombic Dodocahedron*, and the *Trapezohedron*. O these the Cube is usually regarded as the fundamental form or type. The following pharmacological agents belong to this group:—

Bismuth	Mercury	Ioduret Potassium
Carbon	Phosphorus	Muriate Ammonia
Copper	Silver	Arsenious Acid
Gold	Chloruret Sodium.	Alum
Iron	Bromuret Potassium	Galena (sulphuret lead).

Group 2nd. Right Square Prismatic System: (*Square Prismatic System: Pyrami dal System*, Mohs).—The primary forms included in this group are, the *Right Prism* wit a *square base*) also called *Right Square Prism*, or simply *Square Prism*), and the *Octa hedron* with a *square base*. The first is considered to be the fundamental form. Th following medicinal substances belong to this group:—

Chloruret Mercury (Calomel)	Ferrocyanuret Potassium	Copper Pyrites
Bicyanuret Mercury	Red. Antimony (oxisulphuret).—(*W. Phillips.*)	Peroxide Tin.

Group 3rd. Right Rectangular or Right Rhombic Prismatic System: (*Righ Prismatic System*).—This group includes the following primary forms; the *Right Rec tangular Prism*, the *Octahedron* with a *rectangular base* (*Right Rectangular Octahedron*) the *Right Rhombic Prism*, and the *Octahedron* with a *rhombic base* (*Right Rhombic Octa *dron*). The fundamental form is either the right rectangular or the right rhombic ism. The following are the pharmacological agents belonging to this group:—

Bichloruret Mercury	Sulphate Magnesia	Morphia
Sesquisulphide Antimony	Sulphate Zinc	Sulphur (native)
Sesquisulphide Arsenicum (Orpiment)	Nitrate Silver	Emetic Tartar
Carbonate Lead	Nitrate Potash	White Antimony (protoxide)
Carbonate Baryta	Citric Acid	
Sulphate Potash	Bitartrate Potash	
	Soda-Tartrate Potash	

Group 4th. Oblique Rectangular or Oblique Rhombic Prismatic System.—*Oblique Prismatic System*).—The primary forms included in this system are, the *Oblique ectangular Prism*, the *Oblique Octahedron* with a *rectangular base* (*Oblique Rectangular ctahedron*), the *Oblique Rhombic Prism*, and the *Oblique Octahedron* with a *rhombic base Oblique Rhombic Octahedron*). Mr. Brooke (*Encyclopædia Metropolitana*, art. *Crystallography*) refers the *Right Oblique-angled Prism* to this group. The fundamental form this system is the Oblique Prism (either rectangular or rhombic). The following iarmacological agents belong to this group:—

Sulphur (by slow cooling)	Sulphate Iron	Acetate Copper
SulphideArsenicum (Realgar)	Chlorate Potash	Acetate Zinc
	Phosphate Soda	Tartaric Acid
Carbonate Soda	Borax	Oxalic Acid
Sulphate Soda	Acetate Soda	Sugar.

Group 5th. Doubly Oblique Prismatic System.—This system includes the *Doubly blique Prism* (also called the *Oblique Prism* with an *oblique-angled parallelogram* for its ise.) The following pharmacological agents belong to this system:—

Sulphate Copper	Sulphate Cinchonia	Nitrate Bismuth

Group 6th. Rhombohedric System (Mohs).—The primary forms of this group are, e *Rhombohedron* (also termed *Rhomboid*), the *Bipyramidal Dodecahedron*, and the *egular Hexagonal Prism*. The fundamental form is the Rhombohedron. The following pharmacological agents belong to this group:—

Antimony	Carbonate Zinc	Nitrate Soda
Plumbago	Bisulphuret Mercury	Hydrate Magnesia
Carbonate Lime	Ice	Chloruret Calcium
Carbonate Iron		

c. Classifications founded on the Chemical Constituents.—The difficul- es attending the analysis of organized substances form a great obstacle the formation of a chemical classification. Most of the writers who ave attempted an arrangement of this kind are German.

Donald Munro, A Treatise on Medical and Pharmaceutical Chymistry, and the Ma- ria Medica. London, 1788.

C. H. Pfaff, System der Materia Medica nach chemischen Principien mit Rücksicht uf. d. sinnl. Merkmale und d. Heilverhältnisse der Arzneimittel. Leipzig, 7 Bde, 308-24.

F. A. C. Gren: Handbuch der Pharmacologie, 3te Aufl. herausgegeben von *Bernardi* und *Buchholz*, 2 Bde. Halle u. Berlin, 1813.

F. G. Voigtels, vollständ. System der Arzneymittellehre, herausgeg. von *Kühn*. 4 Bde. eipzig, 1816-17.

C. W. Hufeland, Conspectus Materiæ Medicæ, Berolini, 1816, ed. 2, 1820; ed. 3, 1828.

G. W. Schwartze, Pharmacologische Tabellen, oder system. Arzneimittellehre in abell. Form. Leipzig, 1819-25. 2 Aufl. fol. 1833.

G. A. Richter, ausführliche Arzneimittellehre, Handbuch für prakt. Aerzte. 5 Bde. 1. Suppl. 1826-32.

As an example of a chemical classification I shall select Schwartze's, nd must refer the reader to the late Dr. Duncan's (jun.) *Edinburgh Dispensatory*, 11th ed. p. 172, for Pfaff's chemical classification of the egetable materia medica.

Schwartze's Classification.

Div.	Div.	Div.
1. Aqua Communis	8. Extractiva amara	15. Alcalina
2. Gummosa, mucilaginosa	9. Adstringentia seu Tannica	16. Salina
3. Farinosa, amylacea	10. Ætherea—Oleosa	17. Metallica
4. Gelatinosa	11. Resinosa	18. Corpora simplicia, solida, non metallica
5. Albuminosa	12. Narcotica	19. Kalia sulphurata
6. Saccharina	13. Spirituosa	20. Sapones
7. Pinguia—Oleosa	14. Acida	

It will be observed that the author has not always founded his divisions on the chemical properties of medicines; some of them refer partly or wholly to the effects produced by these agents on the body. The nomenclature is not always perfect: thus, his seventeenth class is called "Metallica," as if it alone contained metallic substances; whereas divisions fifteen and sixteen also contain them. Again, some of the divisions for example "Resinosa," contain substances whose effects are most dissimilar; while substances of analogous operation are placed in separate divisions.

d. Classifications founded on the Physiological Effects of Medicines.—As the ultimate object of all our inquiries into the materia medica is to obtain a knowledge of the mode of operation of medicinal substances, it follows, that the most desirable and useful, because the most practical, classification of these agents, would be that founded on the similarity of their effects. But so many difficulties exist in the way of producing such an arrangement—so much remains yet to be determined with respect to the nature of the modifications impressed on the organised tissues by the influence of medicines—that it must be evident to every one who attentively studies the subject, that in the present state of our knowledge no such classification can be satisfactorily effected.

Of the numerous arrangements of this kind which have been attempted, some are founded on the *nature*, *quality*, or *general character* of the effects; as in the following works:—

W. Cullen, M.D. Treatise of the Materia Medica. Edinburgh, 1789.

R. Pearson, M.D. A Practical Synopsis of the Materia Alimentaria and Materia Medica. London, 1808.

C. I. A. Schwilqué, Traité de Matière Médicale, 2 tom. Paris, 1818.

J. Arnemann, Chirurgische Arzneimittellehre, 6 Aufl. vind. A. Kraus. 1818.

J. Arnemann, praktische Arzneimittellehre, 6 Aufl. von L. A. Kraus 1819.

T. Young, M.D. An Introduction to Medical Literature, art. Pharmacology, 2nd edit. 1823.

J. B. G. Barbier, Traité Elémentaire de Matière Médicale, 2nde éd. 3 tom. Paris, 1824.

N. Chapman, M.D. Elements of Therapeutics and Materia Medica, 4th ed. Philadelphia, 1825.

Dr. Nuttall, Lancet, 1825-6, vol. ix. p. 578.

H. M. Edwards, and *P. Vavasseur*, M.D. Manuel de Matière Médicale. Paris, 1826.

C. Sundelin, Handbuch der speciellen Heilmittellehre, 2 Bde. 3te Aufl. 1833.

John Murray, M.D. A System of Materia Medica and Pharmacy, 5th edit. Edinburgh, 1828.

A. Duncan, M.D. Physiological Classification of the Materia Medica. In the Supplement to the Edinburgh New Dispensatory, 11th ed. 1829.

J. Wendt, praktische Materia Medica. Breslau, 1830, 2 Aufl. 1833.

F. Foy, Cours de Pharmacologie, 2 tom. Paris, 1831.

A. T. Thomson, M.D. Elements of Materia and Therapeutics, 2 vols. 1832; 2nd ed. 1 vol. 1835.

E. S. and *K. D. Schroff*, Arzneimittellehre und Receptirkunde. Wien. 1833.

A. Trousseau et *H. Pidoux*, Traité de Thérapeutique. Paris, 1er tom. 1836. 2nd tom. re part. 1837.

C. G. Mitscherlich, Lehrbuch der Arzneimittellehre. 1re Bd. 1te Abl. Berlin, 1837.

The best arrangements of the authors just quoted are, in my opinion, ıose of Drs. Murray, Duncan, and A. T. Thomson. I subjoin that of ›r. Duncan :—

DR. DUNCAN'S PHYSIOLOGICAL CLASSIFICATION OF THE MATERIA MEDICA.

xternal Agents act,		
I. By nourishing the body -	ALIMENTA.	
(*a*) Drink - Potus.		
When they act medicinally - - - -		Diluentia.
(*b*) Food - - Cibi.		
When they act medicinally - - -		Demulcentia.
I. By evacuation - -	EVACUANTIA.	
(*a*) By the skin insensibly - - - - -		Diaphoretica.
———— sensibly - - - -		
(*b*) By the mucous membrane		
Of the nostrils - - - - -		Errhina.
Of the lungs - - - - -		Expectorantia.
Of the stomach - - - - -		Emetica.
Of the intestines - - - - -		Cathartica.
Of the uterus - - - - - -		Emmenagoga.
(*a*) By glandular secretion		
The kidneys - - - - -		Diuretica.
The salivary glands - - - - -		Sialogoga.
I. By exciting the vital powers -	STIMULANTIA.	
(*a*) Chiefly of the parts to which they are applied - -	TOPICA.	
Applied externally		
Causing redness - - - - -		Rubefacientia.
——— serous secretion - - - -		Vesicantia.
——— purulent secretion - - - -		Suppurantia.
Administered internally.		
Condimenta when alimentary.		
When acting medicinally - - -		Carminativa.
(*b*) Of the system generally -	GENERALIA.	
(*a*) Obscurely, but more durably	PERMANENTIA.	
Producing no immediate obvious effect - -		Tonica.
Constricting fibres and coagulating fluids - -		Astringentia.
(*b*) More evidently, but less durably,	TRANSITORIA.	
Acting on the organic functions - - -		Calefacientia.
Acting on the mental functions - - -		Inebriantia.
. By depressing the vital powers	DEPRIMENTIA.	
Acting on the organic functions - - - -		Refrigerantia.
Acting on the mental functions - - -		Narcotica.
. By chemical influence on the fluids,	CHEMICA	
Acidifying - - - - -		Acida.
Alkalizing - - - - - -		Alkalina.

A very cursory examination of the substances placed by the author ıder each of the above classes will satisfy the most superficial observer at this classification does not, in a large number of instances, effect at which it proposes to do; namely, to arrange together "substances cording to the effects which they produce in a state of health." For ample, under the head of diaphoretics and sudorifics we have mustard, paiva, opium, ipecacuanha, alcohol, antimony, ammonia, and mercury; nong narcotics are opium, nux vomica, foxglove, saffron, and colchim; in the class sialogogues we have, horseradish, tobacco, and mercury. Now no one will pretend to affirm that the substances thus ouped together operate in an analogous manner on the system, or that eir effects are similar.

Some physicians have classified the articles of the materia medica in accordance with *Brunonian principles.* I have already mentioned that Brown regarded all medicines as stimulants; that is, as agents causing excitement. But he supposed some of them to produce less excitement than health requires, and, therefore, to be the remedies for sthenic diathesis: hence they were termed *Debilitating* or *Antisthenic.* On the other hand, some agents give more excitement than suits the healthy state, and are, therefore, the remedies for the asthenic diathesis. These he called *Stimulant* or *Sthenic.* (*The Works of Dr. John Brown*, vol. ii. p. 205, 1804.) The following pharmacological works are based on Brunonian principles: (*Encyclopädisches Wörterbuch der medicinischen Wissenshaften*, 3 Bd. art. *Arzneimittellehre.*)

Versuch einer einfachen practischen Arzneimittellehre. Wien. 1797.

Pharmacopœa Browniana, oder Handbuch der einfachsten und Wirksamsten Heilmittel, mit klinischen Bemerkungen im Geiste der geläuterten neuen Arzneilehre. Stuttgart, 1798.

J. S. Frank, Versuch einer theoretisch-praktischen Artzneimittellehre nach den Principien der Erregungstheorie. Erlangen, 1802.

C. F. Oberreich, Umriss einer Arzneimittellehre nach den Grundsätzen der Erregungstheorie. Leipzig, 1803.

J. J Chortet, Traité de Pharmacologie, basée sur la theorie de Brown. Paris, 1806.

F. Wurzer, Grundriss der Arzneimittellehre. Leipzig, 1808.

J. H. Müller, Handbuch der Lebens-und Arzneimittellehre. Leipzig, 1809.

J. A. Neurohr, Versuch einer einfachen praktischen Arzneimittellehre, Zweite Aufl. Heidelberg, 1811.

K. Schöne, praktische Arzneimittellehre für Aerzte und Wundärzte nach den Grundsätzen der Erregungstheorie. 2 Bde. Berlin, 1815.

The partizans of the *theory of contrastimulus* divide medicines into two great classes: one comprehending those agents which augment or depress the excitability—(stimulants and contra-stimulants)—and which on that account are termed *dynamics;* the other contains all mechanical and chemical agents, under the denomination of *irritants.* (*Dict. de Médecine et de Chirurg. pratiq.* art. *Contre-stimulant*, par Andral.) I have already given a list of stimulants and contra-stimulants, and have pointed out some objections to the arrangement.

The followers of Broussais, the founder of what the French denominate the *New Medical Doctrine*, or *Physiological Medicine*, consider all medicines to be either stimulants or debilitants. When a stimulant is applied to the organ affected, it is termed a direct stimulant, but when applied to a part more or less distant from that affected, it is termed a revulsive, or sometimes an indirect debilitant. Hence medicines are divided into *debilitants*, *direct stimulants*, and *revulsives.* This is the plan adopted in the following work:

L. J. Begin, Traité de Thérapeutique, rédigé d'après les principes de la nouvelle Doctrine Médicale, t. ii. Paris, 1825.

Another mode of classifying medicines is on *chemico-physiological principles;* or, to use the phrase of Dr. Osann (*Encyclop. Wörterb. d. med. Wissenschaften*) "on the chemico-therapeutical basis of natural philosophy." This method has been adopted in the following works:

K. F. Burdach, System der Arzneimettellehre. 1807-9. 3 Bde. 2te Aufl. 1817-19. Leipzig.

C. H. C. Bischoff, die Lehre von den chemischen Heilmitteln, oder Handbuch der rzneimittellehre. 3 Bde. 1825-31. Bonn.

W. Grabau, M.D., chemisch-physiologisches Syst. der Pharmakodynamik. 1er Theil iel, 1837.

Another mode of classifying medicines is to arrange them according to ie *particular structure or organ which they affect;* as into medicines ting specifically on the nervous system; medicines acting specifically n the vascular system; and so on. Some authors have formed their rincipal divisions, or classes of medicines, from the parts acted on, nd their orders from the nature or quality of the effect. The following riters have founded their classifications on the particular organs affected y medicines:—

* *J. L. Alibert*, Nouveaux Elémens de Thérapeutique et de Matière Médicale. 5me. l. 3 t. Paris, 1826.

Dr. Granville, Medical and Physical Journal for April, 1822, vol. xlvii.

J. Eberle, M.D., A Treatise on Materia Medica and Therapeutics. 2nd ed. Philadlphia, 1824. 3d ed. 1835.

* *Ph. F. W. Vogt*, Lehrbuch der Pharmakodynamik. 2 Bde. 2te Aufl. 1828.

Dr. Michaelis, Encyclopädisches Wörterbuch der Medicinischen Wissenschaften. rt. Arzneimittel. Berlin, 1829.

Eberle's Classification.

—Medicines that act specifically on the intestinal canal, or upon morbific matter lodged in it	I. Medicines that excite discharges from the alimentary canal	Emetics. Cathartics.
	II. Medicines calculated to destroy or counteract the influence of morbific substances lodged in the alimentary canal	Anthelmintics. Antacids.
—Medicines whose action is principally directed to the muscular system	I. Medicines calculated to correct certain morbid conditions of the system, by acting on the tonicity of the muscular fibre	Tonics.
	II. Medicines calculated to correct certain morbid states of the system, by acting on the contractility of the muscular fibre	Astringents.
—Medicines that act specifically on the uterine system	I. Medicines calculated to promote the menstrual discharge	Emmenagogues.
	II. Medicines calculated to increase the parturient efforts of the womb ..	Abortiva.
—Medicines that act specifically on the nervous system..........	I. Medicines that lessen the sensibility and irritability of the nervous system....................	Narcotics.
	II. Medicines that increase and equalize the nervous energy	Antispasmodics.
—Medicines whose action is principally manifested in the circulatory system	I. Medicines that increase the action of the heart and arteries........	Stimulants.
—Medicines acting specifically upon the organs of secretion	I. Medicines that act on the cutaneous exhalents — General	Diaphoretics.
	— Topical	Epispastics. Errhines. Emollients.
	II. Medicines that increase the action of the urinary organs	Diuretics.
	III. Medicines that alter the state of the urinary secretion	Antilithics.
	IV. Medicines that promote the secretory action of the salivary glands	Sialagogues.
—Medicines that act specifically upon the respiratory organs....	I. Medicines calculated to increase the mucous secretion in the bronchia, and to promote its discharge	Expectorants. Inhalations.
	II. Medicines whose action is truly topical	Emollients. Escharotics.

* I have given a sketch of this classification in the *Medical Gazette*, vol. xvii. p. 164.

11. *Physiological Classes of Medicines.*

In order to prevent repetition in the subsequent parts of this work, have thought it necessary to make a few general observations on some o the more important and generally admitted physiological classes o medicines.

Class 1. Cerebro-Spinants.—I have considered it best to include i one class all those agents whose primary and specific effect is a disord of one or more of the functions of the cerebro-spinal system (the cere bral and true spinal systems of Dr. M. Hall). To this class, therefor are referred all those substances which occasion sleep, insensibilit erroneous perceptions, judgments, and volitions, or delirium, sopor o coma, paralysis, convulsion, &c.

Some of them produce very slight local effects, as opium; others occa sion numbness and tingling, as aconite; conia causes local paralysi the substances termed by toxicologists acro-narcotics or narcotico-acrid (as squills, tobacco, foxglove, &c.) when swallowed, occasion inflamma tion of the gastro-intestinal tube; alcohol, the preparations of arseni of copper, of zinc, of bismuth, and of silver, act as powerful loca irritants or caustics.

The cerebro-spinants may be thrown into groups or orders founded o their effects:—

a. The *first group* includes those cerebro-spinants which occasio *tetanic convulsions*, and which have, in consequence, been termed *tetanic* Here belong strychnia and brucia, and all substances containing one o both of these alkaloids, as the seeds of *Strychnos Nux vomica;* the bar of this plant (commonly termed false Angustura bark); St. Ignatius bean; snake-wood (*lignum colubrinum*); and the *Upas Tieuté* poison; t which probably ought to be added the celebrated Tanghin poison. Th substances of this order are principally employed in certain torpid o paralytic conditions of the muscular system, under regulations whic will hereafter be pointed out.

b. The *second group* is made up of those cerebro-spinants which pro duce *paralysis of the muscles*, and is principally composed of conia, a alkaloid obtained from hemlock, whose physiological effects would poin it out as the remedy for tetanus, and as the counter-poison for strychni and brucia, and for the substances containing these alkaloids.

c. The *third group* includes those agents which occasion *paralysis o the sentient nerves.* Aconite or monkshood belongs to this group. It i the remedy, therefore, for neuralgia.

d. The *fourth group* is made up of those agents which, in large doses occasion sudden loss of sensation and consciousness, with violent con vulsions; in other words, an *epileptic paroxysm.* It includes hydrocyani acid, the cyanurets of zinc and potassium, the bitter almond and its vola tile oil, and the cherry-laurel and its distilled water. In a concentrate form, and in large doses, hydrocyanic acid sometimes occasions deat without convulsions. This order contains the poisons which are th most rapidly fatal of any known. The similarity between the effects o large doses of hydrocyanic acid and an epileptic paroxysm are deservin of especial attention: moreover, we ought not to lose sight of the fac that a condition precisely analogous to, if not identical with, this state, i frequently produced by a large blood-letting. As therapeutic agents, th ıbstances of this group are valuable in certain painful affections of the limentary canal (of the stomach especially) unaccompanied by inflamıation.

d. The *fourth group* includes those cerebro-spinants which occasion eep or *stupefaction*, and, when given in large quantities, *apoplexy*. hey are the *narcotics properly so called*. The most important is opium, which perhaps may be added henbane and lactucarium. In small oses they frequently cause excitement; in larger ones they diminish e contractility of the muscular fibre, or even occasion actual paralysis, ssen the sensibility of the body generally, and give rise to sleep or upor. The apoplectic condition caused by the use of poisonous doses opium has been denominated *narcotism*. In this state the pupils are ually contracted. The uses of this group may be inferred from its fects. In small doses opium is employed as a stimulant: in larger oses opium, henbane, and lactucarium, are employed to relieve pain, in hich case they are denominated *anodynes* (from α, *privitive*, and ὀδύνη, *in*) or *paregorics* (from παρηγορέω, *to soothe* or *alleviate*); they are also ed to diminish inordinate muscular contraction (convulsion or spasm) ıen they are termed *antispasmodics*; and, lastly, to procure sleep, when ey are called *hypnotics* (ὑπνοτικος, from ὕπνος, *sleep*) or *soporifics* (from *por*, a *deep sleep*, and *facio*, *I make*.)

e. The *fifth group* is closely allied to the fourth, from which perhaps ought not to be separated. It includes those agents which cause *ebriation*, followed by *sleep* and *stupefaction*, and, when large doses ve been swallowed, *apoplexy*. This group, therefore, has been nominated *inebriants* or *intoxicants*. It contains alcohol, wine, and ıer. These agents are remarkable for their great exciting properties, well as for the peculiar delirium which they occasion, by both of ıich effects they are principally distinguished from the preceding oup. By long-continued use, alcohol occasions the disease termed *irium tremens*, and which is characterized by wakefulness, delirium, d tremor. Inebriants are used in medicine on account of their mulant qualities.

Musk, valerian, and some other substances usually denominated *rvines*, though closely related to this group, may with more propriety noticed under the head of stimulants.

f. The *sixth group* is a provisional one to contain belladonna and rhaps stramonium, the mode of operation of both of which substances less perfectly understood than of some of the before-mentioned medicaınts. The first of these causes dilatation of the pupil, obscurity of ion, dryness of the throat, difficult or impossible deglutition, aphonia difficulty of articulation, faintings, and delirium, followed by sopor or hargy: convulsions are rare. Laennec (*Dr. Forbes's Translation*, p. 77, 27) says that it relieves dyspnœa by diminishing the necessity for piration. In a case related by my friend Dr. T. Davies (*Lectures Diseases of the Lungs and Heart*, p. 496) a plaster of belladonna plied to the abraded skin cured a severe form of angina pectoris. ulists employ belladonna to dilate the pupil.

g. The *seventh group* includes tobacco and foxglove, both of which are narkable for their depressing influence on the circulating organs, in ısequence of which they are denominated *sedatives*. When taken ernally, in large doses, they give rise to nausea, vomiting, giddiness, feebleness and irregularity of pulse, faintings, convulsions, and insensibility. Tobacco is remarkable for producing excessive feebleness of the muscular system. Foxglove sometimes causes salivation. Both substances have been employed to reduce the frequency and force of the heart's action, and to cause diuresis; tobacco has been used as a purgative in hernia and intus-susception.

h. The *eighth group* contains certain metallic preparations which act specifically on the nervous system, such as the preparations of arsenic, bismuth, copper, silver, and zinc. Their local action is irritant or caustic. Their influence over the cerebro-spinal system is shown by their remedial power in some disorders of this system, as epilepsy and chorea (in consequence of which they have been termed *antispasmodics*) and by the giddiness, cramps or convulsions, paralysis, coma, &c. when taken in poisonous quantities. In small doses they are considered to act as *tonics*, principally on account of their beneficial agency in periodical diseases, especially ague. This group corresponds very nearly to that called by Vogt, *nervino-alterantia.*

i. The *ninth group* contains the plumbeous preparations, which are remarkable for producing colic and paralysis. These compounds are usually called *astringents.*

k. The *tenth group* is formed to include mercurial compounds, which by long-continued action in small quantities, cause a convulsive movement of the muscles (*tremor mercurialis*) as in chorea.

Notwithstanding the numerous groups or subdivisions of the class cerebro-spinants, which I have thought it necessary to make, more probably ought to be added. If, as Dr. Hall believes, the tone of the muscular system is derived from the true spinal system, the substances called *tonics* should form a group of cerebro-spinants rather than a distinct class. Moreover, the medicines known as *antispasmodics* (such as asafœtida) ought perhaps to be placed in this class, on account of their remarkable influence in hysteria and infantile convulsions.

Cause or mode of death.—The immediate cause or mode of death from the use of cerebro-spinants is not always the same,—in some instances it is an affection of the respiratory organs, in others of the heart.

a. Paralysis of the muscles of respiration.—In some cases the respiratory muscles do not receive their proper supply of nervous energy, in consequence of which respiration is performed with increasing difficulty, until, ultimately, asphyxia is produced. This kind of death is caused by opium, and sometimes by dilute hydrocyanic acid. Before the cessation of life we observe the breathing to become laborious or even stertorous, as in cases of apoplexy; and if the body be opened immediately after death, the heart is found beating, oftentimes with considerable force and for some minutes. These are the cases in which it has been proposed to prolong life by artificial respiration until the cerebral disorder has passed off. The proposition is not supported merely by its ingeniousness and plausibility, but by experience. The following is a case in point related by Mr. Whateley, and quoted by Dr. Christison (*Treatise on Poisons*, p. 680, 3d ed.) A middle-aged man swallowed half an ounce of crude opium, and soon became lethargic. He was roused from this state by appropriate remedies, and his surgeon left him. But the poison not having been sufficiently discharged, he fell again into a state of stupor; and when the surgeon returned, he found he face pale, cold, and deadly, the lips black, the eyelids motionless, so s to remain in any position in which they were placed, the pulse very mall and irregular, and the respiration quite extinct. The chest was mmediately inflated by artificial means, and when this had been perse- ered in for seven minutes, expiration became accompanied with a croak, hich was gradually increased in strength till natural breathing was stablished; emetics were then given, and the patient eventually reco- ered. Another most interesting case of recovery, from poisoning by pium, by artificial respiration, has been detailed by Mr. Howship *Medico-Chirurgical Transactions*, vol. xx. p. 86). I have several times estored animals apparently dead from the use of hydrocyanic acid, nerely by keeping up artificial respiration, and Sir Benjamin Brodie as done the same with animals apparently killed by the oil of bitter lmonds.

b. Closure of the larynx.—When an attempt is made to inspire pure arbonic acid, as well as some other gases, the larynx spasmodically loses, and death results from asphyxia. In a case of complete insensi- ility from intoxication related by Mr. Sampson (*Medico-Chir. Trans.* ol. xx. p. 46), the comatose state was thought to arise, not from poplexy, "but from torpor of the brain, in consequence of that organ eing imperfectly supplied with blood not duly oxygenated; for the hrill tone and extreme difficulty of respiration shewed the existence of ollapse of the glottis, and imperfect transmission of air into the lungs, hich might be accounted for by a paralysed state of the eighth pair of erves and recurrent branches." Tracheotomy was performed, and with omplete success: in about half an hour the respiration was regular and asy through the wound.

c. Convulsion or spasm of the respiratory muscles.—Another cause of eath brought on by cerebro-spinants is spasm of the respiratory muscles, hereby the function of respiration is stopped, and asphyxia produced. Ve have an example of this mode of operation in death by strychnia, rucia, and the substances containing these alkaloids.

d. Paralysis of the heart.—In some instances the immediate cause of eath appears to be paralysis of the heart. Thus in some cases of oisoning, the heart ceases to beat before respiration has stopped,—as hen the alcoholic extract of aconite is applied to wounds in dogs. If e chest be opened, the heart does not contract as usual when irritated y a needle. Sir Benjamin Brodie says the infusion of tobacco kills dogs nd cats by paralysing the heart.

In the case of poisons acting in this way, it has been proposed to imulate the heart by slight galvanic shocks in order to avert the fatal rmination. Even acupuncture has been advised, if the patient ppeared *in articulo mortis*. Bretonneau (*Bayle, Travaux Thérapeutiques*, i. p. 432) has repeatedly punctured the brain, heart, lungs, and stomach f young dogs, without the least inconvenience; and Carraro (*Expériences r des animaux asphyxiés et ramenés à la vie par l'acupuncture du eur*, in Bayle, *op. cit.* t. i. p. 495) has successfully tried this prac- ce on a imals in a state of asphyxia.

Seat and nature of the action of cerebro-spinants.—Those cerebro- inants which, by their primary action, occasion lesions of the mental nctions, of sensibility, and of volition or voluntary motion (such as pain insensibility, erroneous perceptions, judgments, and volitions or delirium, or a total deficiency of these faculties, or coma, or continual voluntary actions or paralysis) are presumed to act specifically on the cerebral, or sentient and voluntary system. Opium, alcohol, and aconite, may be mentioned as examples of agents acting on this part of the nervous system.

On the other hand, those cerebro-spinants which occasion convulsions or spasms affect the true spinal or excitomotory system of Dr. Hall. Thus strychnia, hydrocyanic acid, belladonna, and most of the metallic cerebro-spinants, act on this portion of the nervous system.

The precise pathological condition of the brain or spinal marrow produced by cerebro-spinants has not been satisfactorily ascertained. Some of them (as opium) give rise to a congested state of the cerebral vessels, but this may be a secondary effect.

Active principles.—The active principles of each of the cerebro-spinants will be examined separately in a subsequent part of this work; but as several of the vegetables of this group owe their activity to alkaloids, it will be useful to point out here the general properties of these bodies.

The *vegetable* or *organic alkalies*, or the *alkaloids*, have only been recognised during the present century. They are salifiable and inflammable compounds of carbon, hydrogen, nitrogen, and oxygen. Most of them are solid, inodorous, and crystallizable, but conia is odorous and liquid at ordinary temperatures. They are usually fixed; but some of them, as cinchonia and daturia, are volatile at elevated temperatures. They react on vegetable colours as alkalies, and unite with acids, to form salts; but their saturating power is very low, that is, their atomic weights are very high. Each atom contains one equivalent of nitrogen. Those alkaloids which are best known are only slightly soluble in water; but, in general, they readily dissolve in hot alcohol, and frequently separate in a crystalline state from this liquid, as it cools. Their taste is bitter or acrid.

Tannic acid unites with them to form tannates, which usually are very slightly soluble only in water. Hence the infusion of galls (which contains this acid) is employed for detecting the alkaloids, and as an antidote in poisoning by them. Iodic acid, in excess, precipitates several of them; but is decomposed by morphia, iodine being set free. Concentrated nitric acid reddens morphia, strychnia, and brucia, and gives a yellow tinge to narcotine; but a green one to aricina. Bichloruret of mercury precipitates the hydrochlorates of some of these alkaloids, forming with them double salts. The sulphates, nitrates, hydrochlorates, and acetates of the alkaloids, are generally soluble in water. Ammonia and magnesia decompose these solutions, and precipitate the alkaloid.

The usual method of obtaining the vegetable alkalies is to digest and boil the substances yielding them in water, acidulated with hydrochloric acid. To the filtered liquor add ammonia, lime, or magnesia, and subsequently purify (by repeated solutions in alcohol) the precipitated alkaloid.

Raspail (*Nouveau Système de Chimie Organique*, p. 488) maintains that the alkaloids are artificial combinations of a vegetable acid (benzoic?) and excess of ammonia, with perhaps a resinoid substance. But there are no just grounds for such a conclusion. It is, however, eserving of notice that each atom of the alkaloid contains precisely ie quantity of nitrogen which exists in one atom of ammonia.

The vegetable alkaloids act powerfully on the animal economy; but ey present too much diversity in their mode of operation to allow of iy general remarks being made thereon. Some are most energetic bisons; for example, strychnia and aconitina: others, which cannot called poisonous, are powerful and valuable remedies, as quinia.

Class 2. Stimulants, Incitants, or Excitants.—An agent which increases the vital activity of an organ is termed a *stimulant* (from *stimulus*, *goad* or *spur*), or sometimes an *incitant* (from *incito*, to *incite* or *spur* i), or *excitant*. Those which affect all the organs or functions of the stem are termed *general stimulants;* while others, which influence one two organs only, are called *special stimulants.* Those which excite the irts to which they are applied are frequently denominated *local stimunts*, or *irritants;* though the term local is used by Murray (*System of Materia Medica*) to indicate the substances which I have here termed becial stimulants.

The vital or vivifying stimuli (a certain degree of external heat, mospheric air, water, and nutriment) are to be distinguished from the gents used in medicine under the name of stimulants. The former are ssential to vitality: they renovate the tissues, by entering, in a manner dispensable to life, into their composition; and, lastly, their continued tion does not give rise to exhaustion. The latter, on the other hand, re not necessary to life: they have no renovating action; but, by uusing reaction, give rise to exhaustion. Moreover, the so-called imulants do not merely excite; most of them act as alteratives, and any of them, by long-continued use, or by employment in too large iantities, destroy life.

Stimulants, for the most part, produce their effects by the agency of ie nervous system (*i. e.* the true spinal and ganglionic systems), and robably in a considerable number of instances by a reflex action. Many of them become absorbed, and have been recognised in the blood id secretions.

Stimulants are closely related to some other classes, especially to erebro-spinants, tonics, and some of the evacuants. Thus, alcohol and her are at the same time stimulant and narcotic; myrrh, cascarilla, and ie ferruginous compounds, possess both stimulant and tonic qualities; stly, several of the stimulants are sudorific, diuretic, emmenagogue, &c.

Most stimulants are odorous,—many of them indeed powerfully so. Their taste is warm, acrid, and pungent. Swallowed in moderate uantities, they give rise to a sensation of warmth in the stomach, expel aseous matters, and assist digestion. In larger quantities, they excite iirst, and often give rise to nausea or vomiting. Many of them increase ie force and frequency of the heart's action, and promote the warmth of ie surface of the body.

They may be arranged in groups, founded in part on their chemical omposition, and in part also on their effects.

a. The *first group* is one which was termed by the late Dr. Duncan *Supplement to the Edinburgh Dispensatory*, p. 229), *volatile pungent timuli.* It includes the officinal substances belonging to the order *Cruciferæ* (such as mustard and horse-radish) and certain bodies of *Liliaceæ* (garlic, the onion, and the leek). These substances contain a volatile acrid principle (oil) which renders them local irritants. Several of them are employed as condiments. In medicine, we use mustard as a rubefacient and emetic; horse-radish as a masticatory; and garlic as a stimulating expectorant. From their beneficial effects in scurvy, the substances of this group have been denominated *antiscorbutics*.

b. The *second group* contains the aromatic plants of the family *Labiatæ*, several of which are used in cookery under the name of *sweet* or *savoury herbs*, and the carminative fruit of several umbelliferous plants. Volatile oil is the active principle of the whole group. In the labiate plants this resides in small receptacles in the leaves, while in the umbelliferous fruit it is contained in clavate vessels called *vittæ*, situated in the pericarpial coat. Cooks employ some of the substances of this group to form seasoning for certain kinds of dishes or meats. The liqueur-maker uses some of them for flavouring his cordials. In medicine we employ them principally as flavouring or carminative substances. Thus they are added to many other medicaments, the unpleasant odour or taste of which they are intended to cover, and whose nauseating properties they check. They are also useful in flatulency, and in spasmodic affections of the alimentary canal, especially the flatulent colic of children.

c. The *third group* consists of the substances called *spices* (*aromata*.) These are the products of warm climates, as the Molucca or Spice Islands, Ceylon, the West Indies, &c., and are obtained from the orders *Scitamineæ*, *Lauraceæ*, *Myrtaceæ*, *Piperaceæ*, *Myristaceæ*, &c. They owe their strong and grateful odour and taste principally to an acrid volatile oil. When applied to the skin, some of them (as pepper) act as powerful acrids, and excite local inflammation. Taken internally, in moderate quantities, they stimulate the stomach, create a sensation of warmth in this viscus, and promote digestion and assimilation. In larger quantities they occasion thirst, increase the fulness of and accelerate the pulse, and produce a febrile condition of body. In doses of two drachms, nutmegs have acted as narcotics.

Spices are distinguished from the last group of stimulants by their more agreeable flavour, by their greater acridity, by their less tendency to occasion nausea, and by their more powerful agency in promoting the assimilation of substances reputed difficult of digestion. Both groups, however, yield condiments.

In domestic economy spices are employed, partly for their agreeable flavour, and partly to promote the digestion of those kinds of food which, experience has shown, are not by themselves easily or readily digested.

In medicine they are used as flavouring ingredients, as carminatives, as antispasmodics, and as cordials or stimulants. Thus they are added to other medicines to correct their nauseous flavour, or their griping qualities. They are given to relieve flatulency and cramp at the stomach; to assist digestion in enfeebled or relaxed habits; to allay griping pains of the bowels, and to check purging in some mild forms of diarrhœa. Some of them (pepper and ginger) are applied to the skin as rubefacients, or are chewed as masticatories. Pepper has been successfully employed in intermittents, cubebs in gonorrhœa. The volatile oil of some of the spices (as of cloves or allspice) is occasionally placed in the hollow of a carious tooth to allay tooth-ache.

On account of their acrid and heating properties, spices are objection-ble in inflammatory conditions of the alimentary canal, and in febrile nditions of system.

d. The *fourth group* includes four sub-groups formed respectively by e *solid resins*, the *oleo-resins*, the *balsams*, and the *fœtid gum-resins*. s these differ not only in their chemical composition, but also to a rtain extent in their effects and uses, they will require separate caminations. But being so closely related to each other, they could t, with propriety, be formed into distinct groups.

α. Resins (*resinæ*).—Under this head I include elemi, mastic, and guaia-m, obtained respectively from the orders *Burseraceæ*, *Anacardiaceæ*, d *Rutaceæ*. They exude either spontaneously or from incisions made to the stems of the plants yielding them. Common resin obtained as a sidue in the distillation of the turpentines, may, in regard to its chemi-l and medicinal qualities, be placed in the same sub-group with the tural resins. These bodies agree in the following properties:—They e fusible and inflammable, and consist of resin principally combined ith a small quantity of volatile oil: they are insoluble in water, but ssolve either completely, or nearly so, in alcohol, ether, and volatile ls: they combine with alkalies, saturating them as weak acids. Their cal action is irritant: applied to the skin they act as rubefacients, d when swallowed in large doses, produce heat of stomach, nausea, miting, or even purging. Their constitutional effects are those of imulants. Thus they occasion thirst, quicken the pulse, raise the mperature of the surface, and promote the secretions, especially of the in and kidneys. Elemi and mastic are rarely employed in medicine: eir effects are analogous to the turpentines, but much milder. Guaiacum used as a stimulant and sudorific.

β. Oleo-resins (*oleo-resinæ; liquid resins; balsams devoid of benzoic acid; rebinthinates*).—These are oleo-resinous, semi-liquid, or glutinous juices, hich flow spontaneously, or by incisions, from various vegetables, espe-ally those belonging to the orders *Coniferæ*, *Burseraceæ*, *Anacardiaceæ*, d *Amyridaceæ*. Their liquidity or semi-liquidity, their odour, and ost of their medicinal activity, are owing to the volatile oil which they ntain, and which may be procured from them by distillation. From e true balsams they are distinguished by the want of benzoic acid. hey have a strong odour, which, in some, is very fragrant,—in others, peculiar as to be taken as the type of certain odours under the name terebinthinate. Those oleo-resins, employed in medicines, are the rpentines, copaiva, and opobalsamum (commonly termed Mecca balsam). heir taste is hot and acrid. They are all local irritants, causing rube-ction when applied to the skin; and some of them giving rise to active flammation. When swallowed they occasion more or less irritation of e alimentary canal, according to the dose in which they are taken; the mptoms being epigastric heat, loss of appetite, nausea, or even vomit-g; and, sometimes, when the quantity swallowed is large, griping or rging.

The constitutional effects are thirst, dryness of the mucous membranes, creased frequency and fulness of pulse, and great heat of skin, fre-ently accompanied with sweating. The oleo-resins exercise a stimu-nt influence over the urinary organs, which is manifested by uneasiness the region of the kidneys, increased desire of passing the urine, heat in the urethra, and sometimes strangury and bloody urine. Under the influence even of small doses of the oleo-resins the urine acquires a remarkable odour; and when any of the turpentines have been taken, it is that of violets. The mucous membranes generally are stimulated, and have their secretions diminished by the oleo-resins. We observe this not only in the case of the urino-genital mucous membrane, but also in the membrane lining the air-passages. By the repeated use of the oleo-resins an eruption sometimes appears on the skin. In large doses oil of turpentine causes an affection of the nervous system, which will be noticed hereafter.

The oleo-resins are principally employed in medicine to modify diseases of the mucous membranes, especially that lining the urino-genital apparatus. Thus they are employed, and with great benefit, in gonorrhœa, leucorrhœa, gleet, and chronic catarrh of the bladder. In chronic pulmonary catarrhs they are sometimes advantageously employed. Oil of turpentine has been used in neuralgia, against tape worm, in puerperal peritonitis, and in other cases which will be noticed when speaking of that substance in a subsequent part of this work.

γ. *Balsams* (*balsama naturalia: balsams containing benzoic acid*).—The term balsam was formerly applied to all liquid vegetable resins, as well as to many pharmaceutical preparations. But to avoid confusion, the French chemists confine the term balsam to vegetable substances composed of resin and benzoic acid, with more or less volatile oil. The objection to this is, that the substances usually and popularly known by the name of copaiva and Mecca *balsams* are, therefore, excluded from the list of balsams. Hence most of the German chemists retain the old acceptation of the term, and divide balsams into those which do, and those which do not, contain this acid.

Balsams (under which term I include those only which contain benzoic acid) are solid, soft, or liquid substances, according to the quantity of volatile oil which they contain: they have an aromatic, usually agreeable, odour, and a warm, acrid taste. They dissolve in alcohol; and the solution, when mixed with water, becomes milky, owing to the deposition of resin. By sublimation, as well as by other methods, they yield benzoic acid.

Those employed in medicine are benzoin, styrax, tolu, Peruvian balsam, and liquidambar. They are obtained from the orders *Styraceæ*, *Amyridaceæ*, *Balsamaceæ*. They owe the principal part of their medicinal activity to the contained benzoic acid. The liquid balsams (of styrax and Peru) are sometimes applied to chronic indolent ulcers, to allay pain, to improve the quality of the secreted matter (*detergents*), and to promote cicatrization (*epulotics* or *cicatrisantia*). Taken internally the balsams act as stimulants, their operation being principally directed to the mucous membrane of the air-passages; on this account they are termed expectorants, and are employed in chronic catarrhs. MM. Trousseau and Pidoux (*Traité de Thérapeutique*, t. i. p. 467) assert, from their own experience, that "there are few substances in the materia medica so powerful in combating chronic pulmonary catarrhs and old laryngeal inflammations as the balsams." In chronic inflammation of the larynx, whether accompanied or not by ulceration, balsamic fumigations are more serviceable than the internal exhibition of the balsams. The air of the patient's chamber may be impregnated with balsamic vapours by acing a little benzoin or tolu in some live coals, and allowing the pour to escape into the room : or the patient may inhale the vapour of iling water to which a drachm or two of the balsams have been added.

δ. *Fœtid* or *antispasmodic gum-resins (gummi-resinæ fœtidæ)*. The gum-sins, usually denominated fœtid or antispasmodic, are asafœtida, nmoniacum, galbanum, sagapenum, and opoponax, all of which are tained by incision from plants of the order *Umbelliferæ*, growing, for e most part, in Persia. They are composed principally of gum and sin, but with a small quantity of volatile oil, to which they are mainly debted for their odour. Rubbed with water, they form a milky fluid emulsion. They are not completely soluble in pure alcohol, though ey form therewith a clear tincture, which becomes milky on the ldition of water, by the precipitation of the resin as a white powder. hey dissolve, however, in boiling dilute alcohol. They are likewise luble in vinegar. Their odour is strong and remarkable; their taste arm and acrid. Applied to the skin they act as mild stimulants. aken internally they give rise to a sensation of warmth in the stomach, id cause eructations. The odorous particles of asafœtida become osorbed, and may be recognised in the blood and secretions. The tid gum-resins have been principally, and most successfully, employed hysteria, flatulent colic, spasmodic asthma, chronic bronchial affec-ons, and in uterine disorders. From their beneficial influence in the st of these diseases, they are inferred to possess a power of specifically fecting the nervous (the true spinal) system.

Myrrh is a gum-resin procured from a plant of the order *Burseraceæ*. does not possess the antispasmodic power of the fœtid gums, but oproaches nearer to the tonics.

Olibanum is also a gum-resin obtained from the same order as yrrh. Its stimulant properties are principally directed to the mucous embranes; and, in this respect, it is analogous to the resins, or rather the oleo-resins.

e. The *fifth group* includes ammonia and its salts, the empyreumatic ls, phosphorus, musk, and castoreum. It is termed by Vogt (*Lehrb. Pharmakodyn.*) *volatile nervines* (*nervinia volatilia*). All the substances which it is composed agree in producing a primary and specific effect the nervous system, the energy and activity of whose functions they alt. According to Vogt (*op. cit. Bd.* i. p. 186) the more volatile the medy, the more it increases the *activity* of the nervous functions, and e more fixed, the more it raises their *energy*. Thus, according to the me writer, the preparations of ammonia raise the activity more than the ergy of these functions; the empyreumatic oils somewhat less; musk ill less; while castoreum increases the energy of the functions princi-ally. However, I shall hereafter show that the last-mentioned remedy ally possesses very little power.

These remedies act as excitants to the organs of circulation, increas-ig the force and frequency of the pulse, augmenting the warmth of skin, nd promoting diaphoresis. On account of the latter effect they have een termed *diaphoretica calida*. Though the particles of some of them ass into the blood, yet the constitutional effects cannot be regarded, in ll cases, as the result of absorption, since, in several, they occur too eedily to admit of this conclusion. And, as these effects are not lways proportionate to the local irritation and pain produced, they cannot be referred to the latter. We therefore ascribe them to their specific impressions on the nerves of the part to which they are applied.

The effects of the substances composing this group are very quickly produced, and soon disappear. Consequently these remedies are adapted to urgent and acute cases, when the danger is imminent, and an immediate effect desired: for the same reason they require to be frequently repeated in order to keep up their effects. From their exciting operation they are indicated in cases of debility and sinking of the vital powers. Thus they are employed in syncope, low fevers, cholera, &c. On account of their specific influence over the nervous system they are administered in various spasmodic or convulsive diseases, especially in hysteria, and also in epilepsy and chorea.

f. The *sixth group* contains camphor, the roots of serpentary, contrajerva, and valerian, the oil of cajuputi, &c. It corresponds with that division of *volatile excitants* called by Vogt, *ætherio-oleosa;* it is a less perfect group than any of those already mentioned. To a certain extent it agrees in its effects with the last mentioned: thus it specifically stimulates the nervous system, increases the activity of the vascular system, and produces diaphoresis. Its effects, however, are much less powerful, are not so speedily produced, nor are they so fleeting. Some of the substances of this group (for example, serpentary and contrajerva) are serviceable in low nervous fevers; others are used in spasmodic diseases, as valerian in epilepsy.

g. The *seventh* and last *group* is the *spirituosa* of Vogt. It comprehends those substances already mentioned under the head of cerebro-spinants, as inebriating; namely, alcohol, wine, and ether. Their effects and uses will be fully described in a subsequent part of this work.

Active principles.—Volatile oil and resin are the most common constituents of the foregoing groups.

1. *Volatile oil* (*oleum volatile,* vel *æthereum,* seu *essentiale*).—Volatile oil is found in both the inorganised and organised kingdoms of nature: it is most common in vegetables. Petroleum and naphtha are examples of volatile oil in the mineral kingdom. Among animal substances castoreum may be referred to as containing it. It is found in various parts of vegetables—as in the cortical parts of their stems, in cinnamon and cassia; in their rhizomes, as in ginger and *Acorus Calamus;* in the root, as in valerian and horse-radish; in the leaves, as in buchu, *Labiatæ,* and *Myrtaceæ;* in buds, as in the bulbs of garlic and onions; in fruits, as the orange and *Umbelliferæ;* and sometimes, though very rarely, in the seeds, as in the nutmeg. From these different parts it is occasionally obtained by pressure, but more commonly by distillation.

The volatile oils may be solid or liquid at ordinary temperatures; when solid they are crystalline. They may be lighter or heavier than water; their sp. gr. varying from 0·627 to 1·094 (*Gmelin*). They may be coloured or colourless; if the former, the tint is various in different oils. All the essential oils have a strong odour, and a hot acrid taste. They are easily volatilised by heat; are combustible, in consequence of the large quantity of carbon and hydrogen which they contain; and are decomposed by chlorine, iodine, bromine, and the acids. Some of them (as the oil of turpentine) combine with hydrochloric acid. They are very ightly soluble only in water. The *distilled waters* of the Pharmacopœia ·e saturated solutions of them. If the oils be previously rubbed with igar they dissolve more readily in water. The mixtures or compounds ´ volatile oils and sugar are called *elæosacchara*. According to the russian Pharmacopœia they consist of one drop of oil to a scruple of igar. Volatile oils dissolve readily in alcohol, ether, pyroxilic spirit, id naphtha, and easily mix with the fixed oils and resins.

The volatile oils, as ordinarily met with, usually consist of two oils—ıe one liquid, at ordinary temperatures (*volatile oil*, properly so called; ıe *éleoptène* of Berzelius; the *hygrusin* of Bizio)—the other solid *téaroptène* of Bezelius; *stereusin* of Bizio; *camphor* of the German aemists). When the latter predominates, the oil readily concretes in ɔld weather—as the oil of anise and the oil of star-anise. The camphor f the shops is the solid volatile oil (*stéaroptène*) of *Camphora officinarum*.

In regard to ultimate composition the volatile oils vary. Some consist f carbon and hydrogen only—as those of turpentine, juniper, savin, ·mon, and bergamot. Others contain also oxygen—as lavender, anise, ıint, and rosemary: while a third class contain no less than five ingre- ients; namely, carbon, hydrogen, oxygen, sulphur, and nitrogen; as the olatile oil of mustard. It is remarkable that all the volatile oils which ontain carbon and hydrogen only, ($10\ C + 8\ H$) have the same ultimate omposition; or, at least, they consist of the same elements in the ame relative proportion.

The volatile oils undergo chemical changes when exposed to the air. 'hey become deeper coloured and thicker, absorb oxygen, and give rise) the formation of carbonic acid and resin. The resins of turpentine and opaiva appear to be simple oxides of their respective oils.

2. *Resin* (*resina*).—This is rarely found in the mineral kingdom, or ı animal substances; but is common in vegetables. In the latter it xists almost invariably, if not universally, in combination with volatile il, from which, perhaps, it may be formed by the action of the oxygen of ne air. It is a transparent or partially opaque, hard, soft, or elastic solid; oloured or colourless; lighter or heavier than water, its sp. gr. varying rom 0·93 to 1·2 (*Gmelin*); fusible and combustible. It is a bad con- luctor of electricity, and becomes strongly negatively electrical by fric- ion. As commonly met with it is odorous, but probably, if completely leprived of volatile oil, would be inodorous. Its taste is usually more r less acrid; sometimes bitter, and, occasionally, is not perceptible. It s not soluble in water, though some resins form hydrates with this iquid. It is soluble in ether and volatile oil, and frequently more or less o in alcohol; and on the addition of water to the alcoholic solution the esin is thrown down as a white powder, which gives a milky appearance o the fluid.

Most resins possess acid properties; that is, they redden litmus, and ombine with alkalies and other metallic oxides. This is the case with he two resins (pinic and sylvic acids) of which colophony is composed; ıs well as the resin of copaiva (copaivic acid); of guaiacum (guaiacic ıcid); of gamboge (gambogic acid), &c. The compounds formed by he union of resins with alkalies, or other basic substances, are called *esinous soaps*. The *sapo-guajacinus* and *sapo-jalapinus* of the Prussian Pharmacopœia, as well as the *savon de térébinthine* (*Starkey's soap*) of he French Codex, are soaps of this kind, and will be noticed hereafter.

The resins are composed of carbon, hydrogen, and oxygen. In some cases they appear to be oxidized essential oils, (1 oil of turpentine + 1 oxyg.) as will be shown when speaking of turpentine and copaiva resins. It is not improbable that the first degree of oxygenation of the volatile oils forms resins insoluble in cold alcohol, while the most oxygenated are soluble in this liquid.

Class 3, Tonics.—Under the denomination of tonics are usually comprehended those therapeutic agents which, by continued administration in debilitated and relaxed conditions of the body, increase gradually and permanently the tonicity or insensible contractility of the whole system, and thereby render the fibres tenser and stronger, and give greater firmness and density to all the tissues and organs. They have received their names from τόνος, *tone* or *vigour*, on account of their strengthening or invigorating properties; and by some they have been termed *corroborants*.

Tonics produce their proper or real tonic effects in certain conditions of the system only; that is, they do not invariably strengthen. In some cases they give rise to no obvious results—in others they act as irritants and stimulants. In the healthy state moderate doses produce no sensible effects, or, perhaps, a slight excitement of the appetite merely, while large quantities give rise to nausea and vomiting. In irritation or inflammation of the stomach and intestines, and in febrile conditions of system, attended with a hot and dry skin, and a furred and dry tongue, tonics act as local irritants and excitants, and add to the severity of all the morbid symptoms. In a weak and debilitated condition of body, tonics act very differently. Their immediate effects are to increase the appetite and assist digestion. After they have been administered for some time, the soft solids (as the muscles, cellular tissue, &c.) become firmer, the muscular system more powerful, and the pulse stronger, though not quicker. In fact, all the functions are performed with more energy, and the patient is capable of greater exertion.

Tonics sometimes purge, at others constipate. When diarrhœa arises from, or is kept up by, a weakened state of the intestinal tube, tonics, by restoring strength, may produce constipation. On the other hand, when constipation depends on a debilitated and torpid condition of this tube—a circumstance not uncommon in females, tonics, not unfrequently, occasion alvine evacuations. Dr. Cullen having noticed how frequently bitters act as laxatives and purgatives, has inserted them in his list of cathartics.

Tonics are closely connected with the last-mentioned class of medicines: indeed, on many occasions, the so-called tonic substances act really as stimulants. Thus in weak but irritable subjects just recovering from a protracted state of fever, sulphate of quinia will frequently act both as a local irritant and stimulant, and produce nausea, vomiting, furred tongue, a febrile state of system, headache, &c. In fact, the two classes (tonics and stimulants) mutually approach and gradually pass the one into the other, and several substances may with equal propriety be arranged under either.

Tonics are also closely related to the cerebro-spinants. Several of the vegetable bitter tonics specifically affect the cerebro-spinal system (for example, quassia); while some of the cerebro-spinants (as strychnia), in very small doses, act as tonics. Moreover, the beneficial influence of some of the vegetable tonics (as cinchona) in intermittent diseases, should

:obably be referred to the specific effects of these agents on the nervous stem. And, in the same way, we ought to explain the power of tonics increase the tone of the muscular system; for it appears, from Dr. [arshall Hall's experiments, that one function of the true spinal or :cito-motory system is to give tone to the muscles.

The preparations of arsenic, silver, copper, bismuth, zinc, &c., are sually, but, as I think, most improperly, denominated tonics. They are gents which, in small and repeated doses, as well as in large and oisonous doses, specifically affect the nervous system, and I have ready noticed them as cerebro-spinants. They have been called tonics rincipally for the following reason:—cinchona, the most powerful of the egetable tonics, and in fact the type of the class, has long been celebrated s a curative agent in ague and other periodical diseases; hence it has een assumed that any substances capable of fulfilling the same indica-on must be possessed of the same properties, and thus arsenic has been illed a tonic. But the conclusion is erroneous; it is indeed true that nchona and arsenic have, in common, the power of curing an ague, but e same effect is frequently produced by many other very dissimilar ıbstances: for example, by bloodletting, by alcohol, and by mental ıfluences. If, therefore, arsenic be a tonic, so also must bloodletting, c. If we admit this, it follows tonics can no longer be regarded as ıbstances promoting strength, but merely as agents curing particular iseases. Before we have any right to associate arsenic among tonics, e must completely alter our definition of these substances, or show that rsenic improves the appetite and promotes the strength of the body.

Tonics may be arranged in groups, as follow:—

a. The *first group* includes those vegetable tonics which possess ıtterness with little or no astringency; and which have been termed the *itters* (*amara*), or sometimes the *pure* or *simple bitters* (*amara pura* seu *mplicia*). To this group are referred quassia and simaruba, obtained om the order *Simarubaceæ;* gentian, American calumba (*Frasera*), ıirayita, common centaury, and buckbean, from *Gentianaceæ;* calumba ıd *Pareira brava* from *Menispermaceæ;* and *Cetraria Islandica*, from *ichenaceæ*. These remedies are employed to promote the appetite and ssist digestion in atonic and enfeebled conditions of the stomach; as eneral tonics in feebleness and debility of the whole system, and espe-ally of the muscles; as antiperiodics in intermittent diseases; and as ıthelmintics. Their beneficial operation in expelling intestinal worms as been referred to their poisonous influence over these parasitical nimals, but ought perhaps rather to be ascribed to their improvement f the condition of the alimentary canal, and to their removal of those ates which favour the production of these beings. The power which itters possess of retarding the acetous fermentation may, perhaps, con-ibute to their beneficial operation in some dyspeptic cases accompanied ith acidity and flatulence.

b. The *second group* comprehends those vegetable tonics which ossess considerable astringency (from the contained tannic acid) with ttle or no bitterness. These are the *pure astringents* (*astringentia ura*). In this group are contained oak-bark and nut-galls, from e order *Cupuliferæ;* uva ursi, from *Ericaceæ;* catechu and log-ood, from *Leguminosæ;* rhatany, from *Polygalaceæ;* tormentilla, om *Rosaceæ;* the pomegranate-rind, from *Myrtaceæ;* bistort, from

Polygonaceæ; and to these may be added kino. These agents are principally remarkable for causing local contraction and corrugation (or astriction) of the tissues. They contract and give greater density to muscular fibres; diminish the calibre of the blood-vessels and exhalents, and thereby check hæmorrhage (whence their denomination of *styptics*), and diminish secretion and exhalation when applied to mucous membranes or other secreting surfaces. In the mouth they give rise to a peculiar sensation of roughness and stypticity. Some writers have ascribed these effects to a physical or chemical agency. Thus Dr. Cullen places astringents among substances acting on the simple solids, though, in another part of his treatise, he admits that they act on the living, as well as on the simple solids. The late Dr. Adair Crawford (*An Experimental Inquiry into the Effects of Tonics, &c.*, 1816) ascribed the effects of both astringents and bitters to their influence in promoting the cohesion of the animal fibre. He immersed some pieces of intestines, of skin, &c., in various bitter and astringent infusions, while others were placed in water, merely as a standard; and he then observed the comparative weights required to break them, from which he inferred the relative strength of different tonics. But this mode of reasoning naturally leads to erroneous inferences, since the vital powers of the system are quite overlooked. The relaxed state of parts, which astringents are useful in obviating, depends not on a mere mechanical or chemical alteration, but in some change in the state of vital powers; and, therefore, the agents which counteract it, must have some other than a mere physical action. Moreover, the results obtained by Dr. Crawford depended probably on the different degrees of antiseptic power possessed by the substances employed. Astringents produce the constitutional effects of the bitter tonics: administered in moderate doses, they promote the appetite, assist digestion, and increase the tone and vigour of the general system. They are capable of fulfilling the same therapeutic indications as the bitter tonics. Thus they have the power of preventing the occurrence of a paroxysm of intermittent fever, and in cases of debility are often useful, independently of their power of checking debilitating discharges. But this group is principally employed for its local effects; to obviate relaxation of fibres and tissues, and to prevent or check excessive discharges.

c. The *third group* contains those vegetable tonics which possess both bitterness and astringency in an eminent degree; it may, therefore, be denominated *astringent bitters*. It includes cinchona bark, from *Cinchonaceæ;* spigelia, from *Spigeliaceæ;* elm-bark, from *Ulmaceæ;* and willow-bark, from *Salicaceæ.* It combines the effects of both bitters and astringents, and is by far the most important group of the class, since it contains cinchona bark, the most powerful of the vegetable tonics.

d. The *fourth group* contains the *aromatic bitters*, which possess bitterness, with an aromatic flavour (derived from the presence of volatile oil), and, in some cases, astringency likewise. This group contains wormwood and elecampane, from the order *Compositæ*; cascarilla, from *Euphorbiaceæ*; angustura bark, from *Rutaceæ*; and hops, from *Urticaceæ*. They possess the combined properties of aromatics and bitter tonics, and are, therefore, useful where these are indicated.

e. The *fifth group* contains the *acid tonics*; namely, the mineral acids, to which, perhaps, may be added alum. These, taken in the lilute state, allay thirst, promote the appetite and digestive process, and ugment the secretion of urine. By continued use, they reduce the heat f the body, diminish the fulness and quickness, but increase the firmness f the pulse, check the cutaneous and pulmonary exhalation and secre-ion, and heighten the general tonicity of all the fibres and organic issues. If their employment be continued for too long a period, the igestive functions become much disturbed, chronic inflammation of the nucous lining of the alimentary canal is set up, accompanied with wasting nd disorder of the whole system. They are employed as cooling and emperant means in fevers, especially of the hectic kind, and likewise as onics. They are useful adjuncts to some of the bitter infusions.

f. The *sixth group* includes the *metallic tonics*, and consists princi-ally of the preparations of iron. These combine tonic and stimulant roperties, and will be noticed hereafter.

Active principles.—The substances contained in the vegetable tonics, nd on which their activity depends, are alkaloids, crystalline sub-ances analogous to the alkaloids, tannic and gallic acids, and ex-active.

1. *Tonic alkaloids.*—These are quinia, cinchonia, and aricina: their roperties will be examined hereafter.

2. The *crystalline substances analogous to vegetable alkalies* found in ie vegetable tonics, and which possess medicinal activity, are salicine, entianine, quassine, &c. These are too imperfectly known to permit ny general account to be given of them.

3. *Tannic acid* (*acidum tannicum*).—As this substance is employed in edicine, it will be described in a subsequent part of this work. It will e sufficient, therefore, here to state that its presence in the astringent onics is shown by the whitish, or yellowish white precipitate, (*tanno-elatin*) which infusions of these substances form with a solution of inglass, and by the blue or green precipitate (*pertannate of iron*) which iey give on the addition of a perferruginous salt. The following stringents produce a *bluish black* precipitate with the persalts of on: bistort, oak-bark, nutgalls, logwood, pomegranate-rind, red rose aves, and uva ursi. The persalts of iron give rise to a *green* preci-itate with the barks of cinchona, willow, elm, and cinnamom, with itechu, kino, tormentilla, rhatany, and wormwood. Tannic acid sually causes precipitates (*tannates*) with the vegetable alkalies.

4. *Gallic acid* (*acidum gallicum*).—The properties of this acid are very milar to those of tannic acid. From this circumstance, as well as from ie fact that gallic acid is easily produced by the action of air on tannic cid, it is difficult to prove whether certain vegetable substances contain oth these acids, or only tannic acid. Gallic acid agrees with tannic cid in producing a deep blue colour with the persalts of iron, but it oes not precipitate gelatine or the vegetable alkalies. Though obtained om several vegetables, yet it probably either does not exist in many of iem, or is present in very small quantities only: it is to be regarded, in most ises, as a product rather than an educt. Thus, though nutgalls yield ie-fifth of their weight of gallic acid, Pelouze thinks that, originally, iey contain none of it, but that what is procured is obtained by the ction of atmospheric air on the tannic acid. Taken internally, in small oses, gallic acid causes no inconvenience. It was once given in the dose from 15 to 30 grains, against the *Tænia Solium*, but without any

benefit. Swallowed to the extent of 24 grains, it gave rise to a sweeti taste and a slight feeling of internal heat, but no other symptom.—(*Di des Drogues.*)

5. *Extractive.*—Some of the vegetable tonics are said to owe th bitterness and medicinal activity to a principle to which the ter *materia hermaphrodita*, *materia saponacea*, and *extractive matter*, ha been applied. It is described as being of a brown colour, soluble water and alcohol, insoluble in ether, and becoming insoluble in wa by long-continued boiling and by exposure to light and air. Tha substance, or mixture of substances, possessed of these properties, m be obtained from various plants, cannot be doubted, but it is not probal that chemists have yet succeeded in obtaining a proximate principle which the term extractive can with propriety apply. What has hithe been procured is a mixture or compound of several principles, such vegetable acids and their combinations with potash and lime, colouri matter, sugar, gum (rendered soluble in alcohol by its combination wi other substances), vegetable bases, &c.

Class 4.—Emollients.—The substances called emollients dimini the tonicity or insensible contractility of the living tissues to which th are applied, and thereby occasion local relaxation and weakness. Th have an operation diametrically opposite to tonics,—especially to th which are astringent. They relax, soften, and swell the tissues, and re der them more flexible. Applied to inflamed parts they diminish he tension, and pain, and oftentimes assist in producing the resolution of t disease; and when the inflammation is too violent, or too far advanc for this to be effected, they are useful by promoting suppuration. Th have a relaxing effect on the muscular fibre, and are, therefore, e ployed to relieve spasm. These effects have been referred by so to a physical, by others to a vital agency. During life the particles the body are kept in approximation by two forces—attraction and t vital principle; and as emollients render the parts to which they a applied soft and flexible, that is, produce relaxation, it becomes a qu tion whether they operate by overcoming the cohesion of the molecul or by modifying the vital properties. Most writers have regarded th as mechanical agents, and explain their influence just as they would t action of warm water, or oil, on inorganic substances—leather, for exa ple. But we should always be cautious in applying physical expla tions to vital phenomena; and in the present instance this is particula necessary. That emollients act on physical principles on inorganis parts of the body (the cuticle, for example) cannot be doubted, though cannot admit this explanation in reference to living parts. Cold wa diminishes the cohesion of dead parts, and renders softer and more fle ble, but it has not the same effect on living tissues. Moreover, Dr. Crawford (*op. cit.*) ascertained that some medicinal agents diminish t cohesion of dead animal tissues, and have an opposite effect on the livi tissues.

The constitutional effects of emollients are for the most part those nutrients, not of medicines; though the continued use of some is said diminish the tone or vigour of the system generally—an effect ascrib by Barbier (*Traité Elémentaire de Matière Médicale*), to their absorpti and local action on all the fibres of the body. This statement, howev is unsupported by fact in the case of gum, starch, sugar, gelatine, alb nen, and other principles, though it may hold good to a certain extent with respect to the oils.

Emollients are used to prevent the action of irritating matters on the body, by involving them, or by sheathing or defending surfaces from the action of substances capable of acting injuriously. When used for these purposes they are denominated *demulcents* (*demulcentia*, from *demulceo*, *to mitigate* or *soften*). Thus we administer them when acrid poisons have been swallowed. They are applied externally in the form of local baths, poultices, fomentations, &c. both as emollients and demulcents, in local inflammations, painful ulcers, &c. In irritation, inflammation, and ulceration of the alimentary canal, (as in gastritis, enteritis, diarrhœa, dysentery, &c.) they are taken either by the mouth, or in the form of clyster. In catarrh, peripneumony, and pulmonic affections in general, where the cough is dry and harsh, and the expectorated matters are acrid, the use of emollients is often attended with very beneficial effects. By their lubricating and soothing influence on the nerves distributed to the fauces, they probably affect the bronchial membrane and pulmonic structure by a reflex action. In affections of the urinary passages, as ardor urinæ, emollients (especially aqueous fluids) are very serviceable.

Emollients may be arranged in the following groups:—

a. The *first group* contains water, the principal and most important substance of the class. In order, however, that it may act as an emollient, it must have a certain temperature; for neither very cold nor boiling water has any emollient effect. Dr. Cullen fixes 62° F. as the lowest temperature at which this fluid can be emollient; and observes, that the greater its warmth the greater will be its emollient power, provided that pain or scalding be not produced. Aqueous vapour is for two reasons more emollient than liquid water: in the first place it penetrates the organic tissues more powerfully; and, secondly, a greater degree of heat can be applied by it than by liquid water. Dr. Cullen was doubtful whether advantage could be gained by any addition made to water.

b. The *second group* contains the *mucilaginous* emollients. This group has been subdivided into the pure mucilaginous emollients (as gum arabic, tragacanth, mallow, marshmallow, &c.), the sweets (as figs), the bitters (as *Cetraria islandica*, coltsfoot, and sarsaparilla), and the oily (as linseed, sweet almonds, poppy seeds, &c.)

c. The *third group* embraces the *farinaceous* or *amylaceous* emollients; as wheaten flour, oatmeal, barley, arrow-root, sago, tapioca, ordinary starch, &c.

d. The *fourth group* consists of the *saccharine* emollients; as ordinary sugar, honey, liquorice, &c.

e. The *fifth group* includes the *waxy*, *fatty*, and *oily* emollients; such as the animal fats, &c. (as lard, mutton suet, butter, wax, and spermaceti), and the vegetable oils (as olive, almond, sesami, palm, poppy, linseed, &c.)

f. The *sixth group* contains the *albuminous* emollients; as the white and yolk of eggs, and milk. Saliva and gastric juice are employed on the continent for medical purposes.

g. The *seventh group* comprehends the *gelatinous* emollients; as gelatine in its pure form, isinglass, hartshorn shavings, &c.

CLASS 5, REFRIGERANTS OR TEMPERANTS.—Under this head are included those medicinal agents which diminish the temperature of th body when preternaturally increased. The only agent which in all case reduces animal heat is cold, used in the form of ice, cold air, cold baths cold lotions, cold drinks, &c. Its agency is obvious: it abstracts heat and thereby lowers the intensity of the vital movements, diminishes vascular action, and reduces the calorific functions. But there are certain medicinal substances which, by continued internal use, allay febrile heat and usually promote the secretions, though they have no power of diminishing the ordinary or healthy temperature, and to these the term *refrigerant* (or *temperant*) is usually applied. How they act is not completely understood. Dr. Murray thought they furnished oxygen to the system, and in that way prevented so large a quantity of it being consumed in the process of respiration,—an explanation borne out by the observations of Mr. Spalding and Dr. Fyfe, that vegetable diet reduces the consumption of oxygen gas in respiration.

Refrigerants may be arranged in the following groups :—

a. The *first group* contains the mineral and vegetable (sulphuric, hydrochloric, acetic, citric, tartaric, &c.) acids, as well as the acid- or supersalts (alum and bitartrate of potash).

b. The *second group* includes certain neutral salts; namely, the nitrate and chlorate of potash.

c. The *third group* comprehends certain fruits (as oranges, lemons mulberries, tamarinds, prunes, fruit of the dog-rose, &c.), and herbs (as wood sorrel, common sorrel, lettuce, &c.)

d. The *fourth group* comprises the animal refrigerants; as butter-milk (*lac ebutyratum*), and acid whey (*serum lactus acidum*).

Class 6, Evacuants.—These are medicinal agents which provoke a discharge by some emunctory. They are termed *vito-secerning* agents by the late Dr. Nuttall (*Lancet*, vol. ix. for 1825-26, p. 578); and *vital agents which operate on the secerning system*, by Dr. A. T. Thomson (*Elements of Materia Medica and Therapeutics*.)

Evacuants act *by the skin* (diaphoretics or sudorifics); *by the mucous membranes* (errhines, expectorants, emetics, cathartics, emmenagogues) *by the glands* (diuretics, sialogogues).

1. *Diaphoretics or Sudorifics.*—Therapeutic agents, which promote the cutaneous transpiration, are called either diaphoretics or sudorifics. When the insensible perspiration is increased, they are termed *diaphoretics* (*diaphoretica*, from διαφορέω, *to transpire*): when sensible perspiration or sweat is augmented, they are called *sudorifics* (*sudorifica*, from *sudor*, *sweat*, and *facio*, *I make*.) But most modern physiologists regard the insensible perspiration and the sweat as productions of the same set of vessels, and as differing only in their physical form: the one existing as a vapour, the other as a liquid. In fact it is supposed that if the cutaneous transpiration be moderate, it is converted into vapour as fast as it is formed, and hence is termed the insensible perspiration. If, however, it be exhaled more quickly than the atmosphere can take it up an accumulation is the result, and it appears on the skin in the form of drops, called sweat. Adelon (*Physiologie*, tom. iii. p. 517, ed. 2nde) however, states that sweat contains less carbonic acid, and more salts than the insensible perspiration; but the correctness of this assertion is very questionable, on account of the difficulty of obtaining the insensible perspiration for comparison, and, perhaps, from its properties varying

different times. It is highly probable that sweat differs from the insensible perspiration only in its physical form; and, assuming this view to be correct, we easily perceive that sweating may be induced in two ways; first, by increasing the cutaneous transpiration; secondly, by altering the hygrometric state of the air, so as to render this fluid less capable of holding watery vapour in solution. Hence sudorifics and diaphoretics are not essentially different: the former are generally regarded as being more powerful than the latter, or as being the same substances exhibited in larger doses. This statement, however, is not absolutely correct, inasmuch as a diaphoretic may act as a sudorific merely from a change in the hygrometric state of the air.

The most powerful means of exciting the cutaneous exhalation are,—the external application of heat, and the copious use of diluents. A variety of solid substances have been used as media for the application of heat; as hot sand, bran, ashes, earth, plaster, saline mud, dung, refuse of the grape, &c.

The hot sand bath (*arena calida*) is a very old remedy. Celsus (lib. i. cap. 17), Dioscorides, and Galen, speak of it. It is a powerful excitant, reddening the skin, and producing copious perspiration. Schwilgue (*Traité de Matière Médicale*) states that it is used in the maritime departments of the south of France. The saline mud found on the sea-shore has been employed in very hot weather, as a bath, by the inhabitants of Crimea, and especially by the Tartars, against hypochondriasis, scurvy, scrofula, &c. It increases the heat of the body, and excites sweat—(*Bull. des Sc. Méd. de Ferussac*, xiii. 179). Hot dung is sometimes used in France, as a kind of bath, against rheumatism, and by the Poles against syphilis. The husk of the grape and the refuse of the olive, from which the oil has been drawn, undergo fermentation, and in this state have been successfully employed in France against acute rheumatism (*Dict. de Mat. Méd.:* art. *Bain*). Water in a liquid form, or in the state of vapour and dry air, are also used as media for the application of heat. Friction, warm clothing, exercise, and cold affusion, are among the numerous means that may have been resorted to to produce diaphoresis. Most of the medicinal agents administered for the same purpose are stimulants, and, therefore, the constitutional effects (such as excitement of the vascular system, &c.) of the two classes are the same. But the excitement of the system, and the production of sweating, are not always in the same ratio; and it must be admitted that the sudorific effects of the compound powder of ipecacuanha and of the antimonial preparations, considerably exceed their stimulant effects on the system generally.

The agents or means employed to produce diaphoresis are various and even opposite. In febrile complaints, when the skin is hot and dry, the best diaphoretics are cooling drinks, acids, and emollients. But in other diseases, when the skin is cold and dry, and there is great prostration of strength, unaccompanied with any local inflammation, diffusible stimulants (as ammonia) are the best sudorifics. In both of these instances the agents employed are relative; that is, they remove or obviate causes which impede diaphoresis. As the substances usually denominated diaphoretics or sudorifics frequently fail to act as such, that is, to increase perspiration, some writers have been led to doubt the existence of any distinct class of agents of this kind. But on the same ground the existence of several other well-established groups or classes of medicines might be denied.

I ought perhaps here to state that, by the term diaphoretic, or sudorific, I mean a substance which increases the organic or vital action of the cutaneous exhalents. This explanation is necessary, since Dr. Edwards (*De l'Influence des Agens Physiques sur la Vie*, Paris, 1824) has shewn that cutaneous transpiration is effected in two ways; namely by a physical action or evaporation, and by an organic action or transudation. *Evaporation*, or the physical action, is the consequence of the porosity of bodies, and takes place equally in the dead and living state. It is influenced by the hygrometric states of the surrounding air, by its motion or stillness, by its pressure, and by its temperature. Thus dryness, agitation, and diminution of the weight of the air, increase it. *Transudation*, or the organic action of transpiration, being a vital process, depends essentially on causes inherent in the animal economy, although it may be influenced to a certain extent by external agents. Thus elevating the temperature of the surrounding air, preventing its frequent renewal, and covering the patient with warm clothing, are means which promote the organic, but check the physical action of transpiration.

The vital activity of the cutaneous exhalents may be promoted in one or both of two ways,—by increasing the force of the general circulation, or by exciting the cutaneous vessels. Ammonia, violent exercise, and alcohol, operate by increasing vascular action generally, while heat and friction act by exciting the cutaneous vessels. Certain medicinal agents, when swallowed, have been supposed to act as diaphoretics, by entering the blood-vessels, and stimulating the cutaneous vessels by local contact.

The operation of diaphoretics is promoted by the exhibition of large quantities of warm mild diluents, and by keeping the skin warm. Moreover, these agents are more effective when given at bed-time, since there appears to be a greater disposition to sweating during sleep than in the waking state. The exhibition of diuretics and purgatives should be avoided, as they check sweating. The older writers explained the occasional beneficial effects of sudorifics by supposing that some peculiar morbific matter was expelled from the system, the retention of which had produced the disease; and hence sudorifics were enumerated among the Alexipharmaca and Alexiteria. But though cold, applied to the skin, may occasion disorder in some internal organ, it is more consonant with sound physiology to ascribe the internal affection to a metastasis of vital action, than to the retention of any suppositious morbific matter; for although cold diminishes the vital or organic action of the skin (*transudation*) yet it does not prevent the physical action (*evaporation*).

Sudorifics are employed in a great variety of cases,—as catarrhal and rheumatic affections, febrile disorders, chronic diseases of the skin, &c. They are mostly indicated when the cutaneous transpiration has been suddenly checked, and some internal part (as the bronchial membrane) has become affected; also in diseases which usually or frequently terminate by sweating, as fevers.

2. *Errhines* (*errhina*, from ἐν, *in*, and ῥίν, *the nose*) are medicines

hich produce an increased discharge of nasal mucus. When they xcite sneezing they are called *sternutatories* (*sternutatoria*) or *ptarmics* rom πταίρω, *I sneeze*).

Most foreign matters applied to the pituitary membrane promote the cretion of nasal mucus. Sugar and the labiate plants operate mildly; iphorbium and white hellebore with great violence. Some kinds of uff will, in persons unaccustomed to their use, affect the general stem, giving rise to nausea, giddiness, great depression of muscular ower, and slight disorder of the mental functions—effects which I have ersonally experienced on two or three occasions. The continued uployment of snuff injures the sense of smell and alters the tone of the ice. In syphilitic affections of the nose, and where there is a disposi- on to nasal polypus, the continued use of errhines may perhaps be jurious. Errhines have been principally employed to relieve chronic fections of the eyes, face, and brain; for example, chronic ophthalmia, naurosis, headache, &c. They can only be useful on the principle of unter-irritation.

Schwilgué enumerates the following purposes for which sneezing is cited: to excite respiration when this function is suspended; to pro- ote the expulsion of foreign bodies accidentally introduced into the air- ssages; to occasion a general shock at the commencement of dangerous seases which we wish at once to suppress; to augment the secretion of sal mucus, and of tears; to favour the excretion of mucus collected the nasal sinuses; to rouse the action of the encephalon, of the senses, the uterus, &c., and to stop a convulsive or spasmodic state of the spiratory apparatus. We should not, however, forget that the con- ssion occasioned by sneezing is not always free from dangerous sults, especially in plethoric habits, and persons disposed to apoplexy, affected with hernia, prolapsus of the uterus, &c.

3. *Sialogogues* (*sialogoga*, or *sialagoga*, from σίαλον, *the saliva*, and ω, *to convey* or *drive out*) are medicines which excite the salivary scharge. They are of two kinds, local and remote.

a. Local sialogogues.—These are sialogogues which are applied to the outh. When used in a soft or solid state they are called *masticato- s* (*masticatoria*, from *mastico*, to *eat* or *chew*). They act on the ucous follicles of the mouth and the salivary glands. Most solid or ft bodies, when chewed, increase the flow of saliva; thus wax and astic produce this effect. Acrids, however, as horse-radish, mezereon, llitory of Spain, and ginger, possess this property in an eminent gree.

In almost all parts of the world masticatories are more or less ed. In the East Indies betel-nuts (the seeds of Areca Catechu) are ewed, with quick lime and the betel-leaf (the leaf of Piper Betel). ie Indians have a notion that these substances fasten the teeth, clean gums, and cool the mouth (*Ainslie's Materia Indica*). In this country masticatory commonly employed by sailors is tobacco.

As the saliva is generally swallowed, masticatories do not confine eir action to the mouth, but excite likewise the stomach. Peron *oyage aux Terres Australes*) was convinced that he preserved his alth, during a long and difficult voyage, by the habitual use of the tel; while his companions, who did not use it, died mostly of dysentery. r habitual use, and as mere sialogogues, mucilaginous and emollient masticatories might be resorted to, but we find that acrids of various kinds have always been preferred. Masticatories, as therapeutic agents, have been principally used either as topical applications, in affections of the gums, tongue, tonsils, salivary glands, &c., or as counter-irritants in complaints of neighbouring organs, as in ear-ache, rheumatism of the pericranium, affections of the nose, &c. The stronger masticatories, as mustard and horse-radish, excite an increased discharge of nasal mucus and tears, as well as of saliva and mucus of the mouth.

β. *Remote sialogogues.*—Several substances have had the reputation of p oducing salivation or ptyalism by internal use. Of these, the preparations of mercury are the only ones on which much reliance can be placed, and even they sometimes disappoint us. The preparations of gold, of antimony, and of iodine, occasionally have this effect. The continued use of the hydrocyanic or nitric acid has, in several instances, produced salivation. In poisoning by foxglove this has been observed. Lastly, nauseants increase the secretion of saliva.

Mercurials are given in certain diseases to excite ptyalism, and in some cases it is necessary to keep up this effect for several weeks. It is not supposed that the salivation is the cause of the benefit derived, but it is produced in order that we may be satisfied that the constitution is sufficiently influenced by the medicine.

4. *Expectorants* (*expectorantia*) are agents which promote the expulsion of mucus and other secreted or exhaled fluids from the bronchia, trachea, and larynx In the healthy state, the liquids secreted or exhaled by the aerian membrane are got rid of by evaporation and absorption. But when from any circumstance the balance between the two processes of production and removal is destroyed, and an accumulation of mucus takes place, nature endeavours to get rid of it by coughing. Hence some have applied the term expectorant to irritating substances (as chlorine gas, the vapour of acetic or of benzoic acid, &c.), which, when inhaled, produce coughing. "We provoke cough," says Schwilgué (*Traité de Matière Médicale*, tom. ii. p. 296), "to favour the expulsion of foreign bodies introduced from without into the aerian tube, and especially of liquids; we have recourse to it to favour the expectoration of mucus, of mucosities, of membraniform concretions, and of pus, which have accumulated in the aerian passages, whenever the local irritation is not sufficiently great."

It has been thought by some that the mucus secreted may be too tough and viscid to admit of its being easily brought up by coughing, and the term expectorant has been applied to those medicines which have been supposed to render it thinner and less viscid. But as Mr. Moore (*An Essay on the Materia Medica*, 1792) has justly observed, thick phlegm is sometimes more easily expectorated than thin: and if this were not the case, we have no specific means of rendering the phlegm either thicker or thinner. Frequently the term expectorant is applied to substances supposed to increase or promote the secretion of bronchial mucus, and in pharmacological works a long list of medicines, thought to have this effect, is usually given. Most of the agents employed with this view act relatively,—that is, they obviate the causes which checked the healthy secretion. Some are topical agents, as various gases and vapours. There are others, however, which, when taken internally, are supposed to affect the aerian membrane in a specific manner, and are neficially employed in chronic catarrhs. Such are the balsams, the ɔo-resins, the fœtid gums, squills, &c. Many of the substances which ve relief in chronic pulmonary complaints do not promote, but check, secretion of bronchial mucus: as the sulphate of zinc,—to nich Begin (*Traité de Thérap.* t. ii. p. 561) adds the balsams. Yet se agents are usually classed with expectorants. Dr. Paris (*Phar-cologia*) makes one class of expectorants to consist of "medicines nich diminish the inordinate flow of fluid into the lungs, and render expectoration of the remainder more easy."

Most of the substances usually denominated expectorants possess sti-ulant properties. Some of them become absorbed and act on the bron-ial membrane by local contact. They are principally employed in ronic catarrhs.

5. *Emetics* (*emetica*, from ἐμέω, *I vomit*,) are medicinal agents used for purpose of provoking vomiting. They are sometimes called *vomits mitoria.*)

Usually within twenty or thirty minutes after taking an emetic, a gene- feeling of uneasiness and of nausea comes on. The pulse becomes all, feeble, and irregular; the face and lips grow pale, a sensation of axation and coldness of the whole system is experienced, the saliva ws copiously from the mouth, the eyes lose their lustre, and the whole untenance appears dejected. These symptoms, which constitute the t stage of vomiting, continue for a variable period, and are followed by ejection of the contents of the stomach. As soon as actual vomiting nmences, the general phenomena are altered: the pulse becomes fre-ent and full, the temperature of the body increases, and a sweat breaks on the face and other parts of the body. During the act of vomiting, consequence of the pressure made on the abdominal aorta, and the erruption to the circulation through the lungs, from the impeded piration, the blood returns with difficulty from the head, the face ells and becomes coloured, the conjunctiva is turgid and red, the ular veins are gorged, and tears burst from the eyes. The violent ining is often attended with pain in the head and eyes, and with the oluntary expulsion of the urine and fæces. The matters vomited vary ording to circumstances; they may consist of the alimentary and er substances contained in the stomach previous to the exhibition of emetic; of the fluids collected by the action of the emetic; and, ly, of the emetic itself. Sometimes striæ of blood are observed, which ally come from the pharynx. The number of vomitings, and the ease h which they are effected, are liable to considerable variation, arising n the state of the digestive organs, the temperament of the patient, the e of the cerebral functions, &c. When the vomiting has entirely sed, the patient feels languid, oppressed, and drowsy, and the pulse omes weak and slow: the exhaustion is sometimes so great as to be nded with fatal consequences. A case of this kind is alluded to by Paris (*Pharmacologia*) in which an emetic was imprudently given to atient in the last stage of phthisis, with the intention of dislodging the with which the lungs were embarrassed: syncope was produced, n which the patient never recovered. Among other occasional ill sequences of vomiting may be mentioned comatose affections, uterine ulmonary hæmorrhages, hernia, abortion, suffocation, prolapsus of the us, rupture of the abdominal muscles, &c.

The intensity and duration of the different stages of vomiting have n necessary relation to each other. Thus the sulphates of zinc and copp excite speedy vomiting, with but little nausea;—and are, therefor preferred as emetics in narcotic poisoning. Tobacco and tartariz antimony, on the other hand, produce great nausea and depression system.

The causes of vomiting are various. One is, suddenly distending th stomach with warm water or demulcent liquids. In cases of corrosive irritant poisoning, we adopt this method of exciting or promoting vomi ing in preference to the use of acrid substances. Another method provoking vomiting is tickling the fauces with the finger or a feathe this has been shewn by Dr. M. Hall to be a beautiful instance of refle action. We adopt this plan in cases of poisoning until the ordina emetics can be procured,—also in dyspepsia and cardialgia, arisin from the presence of undigested food in the stomach. Acrids and irr tants of all kinds likewise excite vomiting when swallowed. Thu gamboge, mustard, common salt, euphorbium, the mineral acids, &c have this effect when taken in large or poisonous doses. Most of thes however, are dangerous agents, and, with the exception of mustard an common salt, are not given as emetics. The last-mentioned substanc are administered to excite vomiting in cases of narcotic poisoning, i malignant cholera, &c. But there are certain irritants (such as tarta emetic and ipecacuanha) which seem to have some specific power provoking vomiting, since they produce this effect when applied to an part of the body, or when injected into the veins. These are the agen to which the term emetic is more usually applied.

Besides the above, there are many other causes of vomiting, such a acute pain, injuries of the brain, calculi in the kidneys, disagreeab odours, the sight of disgusting objects, whirling, sailing, or swin ing, &c.

The irritation produced by the exhibition of emetics gives rise to a increased secretion from the mucous follicles of the stomach and duod num; as is apparently shewn by the thick, filamentous, and visci matters frequently ejected. We infer, also, that the action of the exha ing vessels must be increased, inasmuch as persons who have taken onl a few spoonfuls of emetic liquids sometimes bring up a very conside rable quantity of water. Darwin mentions a man who vomited si pints of liquid, although he had only swallowed one. Bile is fre quently thrown up, either alone or mixed with other fluids; but we mu not infer from this that it had existed in the stomach previous to th exhibition of the emetic, for bile is not ordinarily rejected in the fir efforts, but only in the subsequent vomitings; and the quantity increas in proportion to the length of time the vomiting continues. It is gen rally supposed that emetics promote the secretion of bile and of pan creatic juice.

6. *Carthartics or Purgatives.*—These are medicinal agents which ex cite alvine evacuations. They do so by increasing the peristaltic motio of the alimentary canal, and by promoting secretion and exhalation fro the mucous lining. It has been supposed that some of them stimulat the muscular coat of the intestine, without increasing the secretions,— and, *vice versâ,* that others stimulate the mucous follicles and exhalin

ssels, thereby occasioning a copious evacuation by stool, without uch increase of peristaltic motion. But all purgatives act in both ays, though sometimes very unequally so:—some affecting the peri- altic motion principally,—others, the secretions and exhalations. Those at excite watery discharges are called *hydragogues;* as elaterium, mboge, and jalap. Certain purgatives do not equally affect all por- ns of the canal. Thus colocynth, gamboge, black hellebore, and oes, principally influence the large intestine. The acrid purgatives omote the secretion of bile and of pancreatic fluid, by the irritation ey produce at the termination of the ductus choledochus.

Most if not all cathartics are local irritants, and, in some instances, e purgative operation seems to depend solely on this, as in the case of mboge. But several others have, in addition, a specific influence over e alimentary canal, shewn by the fact that they purge even when plied to wounds or injected into the veins; as in the case of castor oil, nna, hellebore, &c.

Several purgatives become absorbed. Thus the particles of gamboge, ubarb, sulphate of potash, and oil of turpentine, have been detected in e blood:—senna, rhubarb, and jalap, have communicated purgative alities to the milk:—lastly, cassia pulp, rhubarb, senna, and gamboge, ve been recognised in the urine.

Cathartics may be arranged in groups, as follow:—

a. The first group contains the mild cathartics, denominated *laxatives lenitives;* viz. manna, cassia pulp, tamarinds, prunes, honey, bitartrate potash, and the fixed oils (as castor, almond, and olive oils). These ry gently evacuate the contents of the intestinal canal, and usually thout causing any obvious irritation, or affecting the general system. nna, however, is apt to occasion flatulence and griping. Laxatives employed in any cases where we wish to evacuate the bowels with least possible irritation, as in children and pregnant women, in per- ns afflicted with inflammation of any of the abdominal or pelvic viscera, h hernia, prolapsus of the womb or rectum, piles, or stricture of the tum; and after surgical operations about the abdomen and pelvis.

b. The *second group* is composed of the *saline* or *antiphlogistic* purga- es, such as the sulphates of soda, potash, and magnesia. They rease the peristaltic motion of the alimentary canal, and augment the usion of fluids by the exhalents of the mucous surface, thereby giving to watery stools. They do not appear to possess the power of laming the intestinal tube, nor of heating the general system. They adapted for febrile disorders, inflammatory affections, plethoric con- ions, &c.

c. The *third group* includes the *milder acrid purgatives,* such as senna, ibarb, and aloes. These are more active substances than any of those ntioned in the preceding groups. They are acrids and stimulants, their local action is not sufficiently violent to cause inflammation. nna is employed where we want an active though not very acrid or tant purgative. Rhubarb is administered in relaxed and debilitated nditions of the alimentary canal. Aloes is used in torpid conditions of large intestines, and in affections of the head. It is objectionable in es and diseases of the rectum.

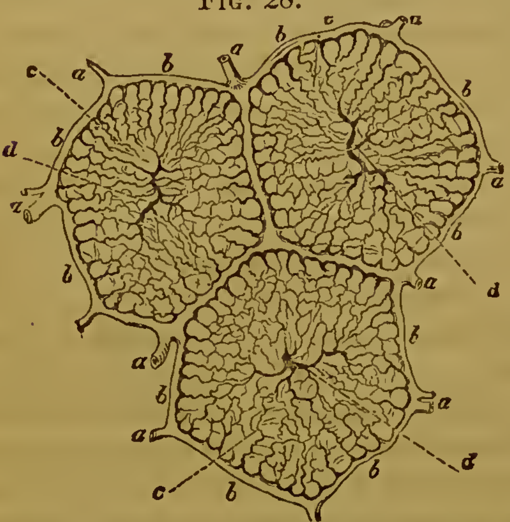
d. The *fourth group* comprehends the *strong acrid* or *drastic purga- es;* such as jalap, scammony, black hellebore, gamboge, croton oil, colocynth, and elaterium. These, when swallowed in large doses, act a acrid poisons. They are employed as purgatives in torpid conditions the bowels; as hydragogues in dropsical affections, and as counte irritants in affections of the brain. They are objectionable remedies inflammatory and irritable conditions of the alimentary canal.

e. The *fifth group* contains the *mercurial purgatives;* as the hydra gyrum cum cretâ, the pilula hydrargyri, and calomel. We employ the as alterative purgatives, and to promote the hepatic functions. A they are uncertain in their operation, they are usually combined wit or followed by, other purgatives.

7. *Cholagogues.*—These are medicines which increase the evacuatio of bile. It is probable that most, if not all, drastic purgatives increase th secretion and excretion both of bile and pancreatic juice, by irritating th opening of the ductus choledochus in the duodenum, just as certain sul stances taken into the mouth provoke an increased discharge of saliv by irritating the mouths of the salivary ducts. Graaf (quoted by Barbie *Traité Elément. de Mat. Méd.* tom. iii. p. 125, ed. 2nde) says, that if purgative be administered to a dog, and when it is beginning to operat the abdomen be laid open, the bile and pancreatic juice will be observ flowing into the duodenum.

When we consider the peculiarities attending the hepatic circulatio and that all the remedial agents whose particles are absorbed have t pass through the portal vein,—the vein by whose branches the bile i secreted,—our astonishment is great that this secretion is not more fre quently affected by the various me dicinal agents put into the stomach I have already mentioned (p. 15 the different substances which hav been detected in the blood of eithe the portal vein, or of veins (splen and mesenteric) opening into it. Th branches of this vein which ramif between the lobules of which th liver is principally made up, are de nominated by Mr. Kiernan (*Philos Trans.* for 1833) *interlobular* veins their minuter ramifications withi the lobules are called *lobular venou plexuses*, and these last inosculat towards the centre with the *intralo bular* ramules of the hepatic veins.

Fig. 28.



Representing the interlobular branches of the portal vein, the lobular venous plexuses, and the intralobular branches of the hepatic veins of three lobules.

a a a. The interlobular veins contained in the spaces.

b b b. The interlobular veins which occupy the fissures, and which, with the veins i the spaces, form venous circles around the lobules. This is the appearance which th venous circles present when examined with a common magnifying glass; they are however, formed by numerous, and not by single, branches, as represented in the figure

c c c. The lobular venous plexuses, the branches of which, communicating with eac other by intermediate vessels, terminate in the intralobular veins. The circular and ovoid spaces, seen between the branches of the plexuses, are occupied by portions o the biliary plexuses, constituting the acini of Malpighi.

d d d. The intralobular branches of the hepatic veins, in which the vessels of th plexuses terminate.

The intralobular veins open into the *sublobular* veins around which the lobules are arranged, and when a longitudinal section is made, these lobules present a foliated appearance. The *sublobular* veins unite into larger branches, called *hepatico-venous trunks*.

Fig. 29.

ngitudinal section of sublobular-hepatic veins, with lobules ar-anged around them.

Fig. 29.

a a. Sublobular hepatic veins.
b b. Longitudinal section of lobules.
c c. Basis of the lobules resting on the sublobular veins.
d. External or capsular surfaces of the lobules.
e e. Intralobular veins.
f. Projecting processes of the lobules.
g. Mouths of intralobular veins opening into the sublobular vein.

Such, then, is the course taken by medicinal agents in order to reach the hepatic vein, and by this the vena cava. Now the lobular plexuses of the portal vein are accompanied by ducts to carry away the bile as it is secreted.

Fig. 30.

esents the intralobular ducts entering he lobules, and forming the lobular bi-iary plexuses.

Fig. 30.

a. Two lobules.
b b b. Interlobular ducts.
c c c. The interlobular cellular tissue.
d d. The external portions of the lobular biliary plexuses injected.
e e. The intralobular branches of the hepatic vein.
f f. The uninjected central portions of the lobules.

But notwithstanding the many substances which must ramify through the veins of the liver, only three or four have, in modern times, been posed to exercise any specific influence in promoting the biliary etion: these are mercurials, aloes, and rhubarb. How far these erve the appellation of cholagogues will be better examined when we ce them individually.

. *Diuretics.*—These are medicines which promote the secretion of ie. They have derived their name from *δία, through; οὖρον, the urine; ῥέω, I flow.*

here are two principal modes of promoting the secretion of urine; one direct, the other indirect. The *indirect* method consists in menting the quantity of fluids taken into the stomach, or in removing cause which checks the secretion. The *direct* mode is to stimulate kidneys by means which specifically affect these organs. These ns are the diuretics, properly so called. But almost all the substances thus denominated are most inconstant in their effects; so much so, indeed, that some persons have doubted whether there a any agents which ought to be so designated.

The quantity of urine secreted in the healthy state is liable to con derable variation. Temperature, season of the year, climate, and time day, are among the common circumstances modifying this secretio Whenever an unusual quantity of aqueous fluid is taken into the syste the kidneys are the organs by means of which the excess is got rid If the customary discharge from the skin or lungs be checked, by col for instance, the kidneys endeavour to make up for the deficiency action in the other organs. Again, if transpiration be promoted, as b external warmth, the secretion of urine is diminished. Hence when w wish to augment the renal secretion, diluents should be freely admini tered, and the skin kept cool.

Mr. William Alexander (*Experimental Essays*, Edinburgh, 176 endeavoured to determine, as nearly as possible, the relative powers different diuretics, and he has given the following tabular views of h results:—

A Table of the different quantities of urine always discharged in an equal time; vi from nine o'clock in the morning till two o'clock in the afternoon, when an equ quantity of the same liquid was drunk, but with different diuretics, in differe quantities, dissolved in it.

		℥	ʒ	℈
By lbj. ℥vijss. simple infusion of bohea tea, standard,		15	4	0
By do.	with ʒij. of salt of tartar - - -	22	7	2
By do.	.. ʒij. of nitre - - - - -	22	0	0
By do.	.. 4 drops oil of juniper - - -	30	3	0
By do.	.. ʒj. salt of wormwood - -	19	7	1½
By do.	.. ʒij. Castile soap - - - - -	19	1	1
By do.	.. a teaspoonful of spt. nitr. dulc. -	17	6	1½
By do.	.. 15 drops of tinct. cantharides -	16	4	0
By do.	.. ʒij. of sal. polychrest - - -	16	3	0
By do.	.. ʒss. of uva ursi - - - -	16	1	0½
By do.	.. ʒj. of magnesia alba - - -	15	5	0
By do.	.. ʒij. of cream of tartar - -	10	2	0½

A Table of the different quantities of urine evacuated in the same space of time, aft drinking the same quantity of different liquors.

		℥	ʒ	℈
By lbj. ℥vijss.	of weak punch, with acid - - -	21	2	3
By do.	.. new cow whey - - - -	18	6	0
By do.	.. decoct. diuret. Pharm. Edin. - -	17	5	0
By do.	.. London porter - - - -	16	7	0
By do.	.. decoct. bardan. Pharm. Edin. -	14	7	0
By do.	.. warm water gruel - - - -	14	6	2
By do.	.. small beer - - - - - -	13	7	1
By do.	.. warm new milk - - - -	11	7	0

These tables are to a certain extent useful, but as diuretics act ver unequally at different times, and cannot, therefore, be relied on, th value of Mr. Alexander's experiments is considerably diminished.

At pages 14 and 15 of this volume I have given a list of the substance which pass off by the urine. Many of these, especially the salts, stimu late the kidneys:—they do this probably by a local action in thei passage through the renal vessels. Several of the vegetable diuretic owe their activity to volatile oil: such are, copaiva, the turpentines juniper, and oil of cajuput. The oil probably acts on the kidneys by local contact, after its absorption. The modus operandi of squills and colchicum may, perhaps, be similar: that is, their active principles may ss into the blood, and act on the kidneys in their passage through ese organs.

9. *Emmenagogues* (*emmenagoga*, from ἔμμηνα, the *menstrual disarge*, and ἄγω, to *lead* or *convey*), are agents supposed to have the perty of exciting the catamenia. As the suppression or retention this discharge may be occasioned by very different circumstances, one agent can be expected to prove emmenagogue in all or even many cases. Deficient menstruation is rarely, perhaps, an idiopathic ease, but usually a morbid symptom merely; and, therefore, those ents which remove it must be relative,—that is, must have reference to disease which produces it. Thus when deficient menstruation is nnected with a deficiency of power in the system, tonics and stimuts are the best remedies. Again, in plethoric habits blood-letting d other debilitating agents are those most likely to be serviceable.

But the term emmenagogue is usually employed in a more limited use, to indicate those substances which are supposed to possess a ecific power of affecting the uterus and of promoting the catamenial charge. There are, however, few bodies to which this definition can strictly applied. Indeed, two reasons have led some pharmacological iters to doubt the existence of any medicines which can be properly med specific emmenagoges, namely, the uncertainty of all the means named, and the uterus not being an organ intended for the excretion foreign matters.

The substances usually regarded as specific emmenagogues are, for most part, medicines which, when taken in large doses, act as drastic gatives, or which stimulate the urinary organs in a very marked man-. Such are savin, black hellebore, aloes, gamboge, cantharides, &c. ey excite the pelvic circulation, give rise to a sensation of bearing wn of the womb, especially in females disposed to procidentia uteri, rease uterine hæmorrhage, or the menstrual discharge, when given ing these conditions,—and when administered in chlorosis or amenorea, sometimes bring on the catamenia.

The only agent possessing an unequivocal specific influence over uterus is the ergot of rye. But this agent seems rather to promote rine contractions than the menstrual function,—though it has on ny occasions been successfully employed in amenorrhœa.

Class 7. Abortiva seu Acceleratores Partus.—These are agents ich increase the parturient efforts of the womb. At present, however, y one substance is known which possesses this property, and that is *ergot of rye*, which will be spoken of hereafter.

Class 8. Caustics (*caustica*, from καίω, *I burn*).—These bodies organise by a chemical action. They are sometimes termed *poten- cauteries* (*cauteria potentialia*), to distinguish them from fire or actual cautery. The stronger caustics, as potassa fusa, have been med *escharotics* or *erodents;* while the milder ones, as sulphate of pper, have been denominated *catheretics* or *cauterants*.

The following substances are those usually employed as caustics:— strong acids (sulphuric, nitric, hydrochloric, phosphoric, and acetic), alkaline substances (potash, soda, ammonia, and lime), and various tallic preparations (as the nitrate of silver, chloride of antimony, sulte and acetate of copper, chloruret of zinc, binoxide and bichloruret nercury, and arsenious acid.) Some of these become absorbed, and thereby affect remote parts; such are arsenious acid, and the bichlorum of mercury.

Caustics are employed for various purposes, the principal of which are the following:—to remove excrescences or morbid growths of various kinds, such as warts, condylomata, some kinds of polypi, and spongy growths or granulations; to decompose the virus of rabid animals and the venom of the viper, and other poisonous serpents; to form artificial ulcers, as issues; to open abscesses; for the cure of hydrocele they have been applied to the scrotum, so as to penetrate through the tunica vaginalis; to change the condition of ulcerated and other surfaces; lastly, caustics are applied to strictures of the urethra.

Class 9. Rubefacients, Vesicants, and Suppurants.—These are agents which, when applied to the skin, cause redness, and sometimes vesication and suppuration. The milder ones, such as friction and warm fomentations, stimulate the skin temporarily, without producing actual inflammation. The stronger ones, such as mustard and cantharides, excite active inflammation. Those that cause the exhalation of a thin serous fluid beneath the cuticle are called *vesicants* or *epispastics*; mustard, euphorbium, mezereon, acetic acid, ammonia, and cantharides are of this kind; while tartar emetic, and some other substances which produce a secretion of pus, are denominated *suppurants*. The medicines of this class are employed as counter-irritants in various diseases. Their general mode of operation has been before investigated (p. 45, *et seq.*)

Class 10. Acids.—The mineral acids, in a concentrated state, are powerful caustics; and, when swallowed, act as corrosive poisons; somewhat diluted and applied to the skin, they produce rubefaction. Administered internally, in moderate doses, they act as tonics, refrigerants, and diuretics; but by long-continued use they disorder digestion, and produce emaciation. When, from any cause—such as disordered digestion, particular kinds of food, or improper medicines—white sand (either phosphate of lime or phosphate of ammonia and magnesia) appears in the urine, the internal use of acids will, in most cases, diminish or remove it. They are improper, however, when there is much irritation in the urinary organs.—[For further observations on the *modus operandi* of the acids, see page 9.]

Class 11. Alkalies.—Applied in a concentrated form, the alkaline substances act as powerful caustics, and, when swallowed, become corrosive poisons. Somewhat diluted and applied to the skin, they are rubefacients. Taken internally they neutralize any acid which may be found in the stomach, and hence have been termed antacids (*antacida*), or absorbents (*absorbentia*), and usually operate, when exhibited in moderate doses, as diuretics. By continued use they disorder digestion, render the urine alkaline, produce general debility, and give rise to symptoms similar to scorbutus. In such cases it is said that the blood drawn from a vein does not coagulate on cooling, but remains in a liquid state; and that if the use of the medicine be suspended, the blood again acquires its power of coagulation. By the continued administration of alkaline medicines the urine loses its acid properties, and occasionally becomes decidedly alkaline; and, in such cases, white sand (the phosphates) is usually deposited: hence, where a phosphatic diathesis already exists, these substances are highly improper. On the contrary, when the urine contains a larger portion than usual of uric acid, the use of alkalies is highly beneficial.

SPECIAL PHARMACOLOGY.

Special Pharmacology (*Pharmacologia specialis*) treats of medicines ıdividually.

Natural-Historical Classification of Medicines.—Having previously :ated that the natural-historical order will be followed in describing the ifferent substances composing the *Materia Medica*, it will not, I conceive, e out of place to offer a few general remarks on the division of natural odies into kingdoms, and on the characteristics of these kingdoms.

Natural bodies were formerly divided into three groups, called kingoms—the *mineral*, the *vegetable*, and the *animal;* but this division has, f late years, been for the most part given up, on account of the impossiility of so characterizing the two latter as to distinguish them from ıeh other. To obviate this difficulty the two have been formed into ıe, under the name of the *organized* or *living* kingdom, while the mineral now called, in contradistinction, the *inorganized* kingdom.

But it has been asserted that no real distinction exists between the :ganized and the inorganized kingdoms. There is an order of animals ılled, on account of their supposed resemblance to a mass of mineral ıatter, the *Lithozoa*, or *stone-animals* (Goldfuss, *Grundriss der Zoologie.*) ı these the skeletons are external, or cutaneous, and consist of carbonate ; lime (sometimes with a little phosphate) agglutinated by gelatinous atter. These beings have been supposed to connect the animal with ıe mineral kingdom. But the calcareous masses of the *Lithozoa* are ostly porous, and in the recent state contain fleshy tubes, constituting ıe soft parts of the animal: a structure nothing analogous to which is und in the mineral kingdom. In the *Nullipora* (a family of the order *ithozoa*) the pores are not evident, and hence these masses have been ıpposed to form the nearest relation to minerals.

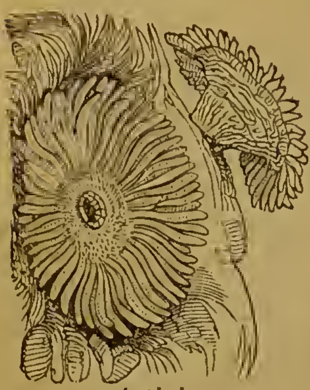
Vegetables also have been stated to be closely related to animals. Here is a drawing of the *Diatoma vulgaris* (Fig. 31), a little vegetable of the family *Algæ:* it varies in its form, and in the mode of connexion of its parts. At one period of its existence it is cylindrical, at another it is composed of quadrangular segments; sometimes connected by their sides, at others by their alternate angles. It will be observed that these segments have somewhat the forms and appearance of crystals; and Agardh has, in consequence, fancied they form a distinct passage from vegetables to minerals; but their active properties, and the changes they undergo at the different periods of their existence, sufficiently distinguish them.

Fig. 31.

iatoma vulgaris.

Some zoologists (as Goldfuss) admit an order of animals which they call *Phytozoa*, or the *vegetable-animals*, (as *Spongia*) and which includes all those animals which resemble plants. In some cases animals resemble flowers in their appearance; as the *Actinia*, or *Sea Anemones* (Fig. 32.) On the other hand, vegetables oftentimes exhibit a close relation, in their external appearances, to animals. The genus *Oscillaria* (of the family *Algæ*) has a cylindrical form analogous to the common earth worm (*Lumbricus terrestris*), and presents a jointed appearance, from the junction of the segments composing its interior tube. Now, individuals of this genus are endowed with the power of motion as if voluntary, like animals. *Tendaridea Pollux* (Fig. 33) is an example of the tribe of plants called *Conjugatæ*, the individuals of which perform some acts analogous to those of animals. Two tubes approach each other, and become connected: we then observe that the green-colouring matter (which in each has a star-like form) passes from the joint of one into the joint of the other, and forms there a roundish gemmiform body, which subsequently becomes a new being. In the *Zoocarpeæ* we have beings in which the vegetable and animal states appear to succeed each other. In *Anthophysis dichotoma* (Fig. 34) the tubular filaments produce, at their extremities, little globules, which when detached from their support, possess a locomotive power and (according to Bory St. Vincent) become a multitude of *Zoocarpeæ*, or animated monads.

Fig. 32.

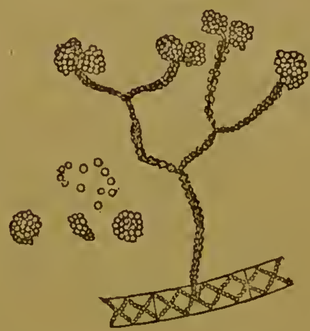


Actinia.

Fig. 33.

Tendaridea Pollux.

Fig. 34.



Anthophysis dichotoma.

The accompanying diagram will explain in what way it has been supposed the mineral, vegetable, and animal groups approach each other:—

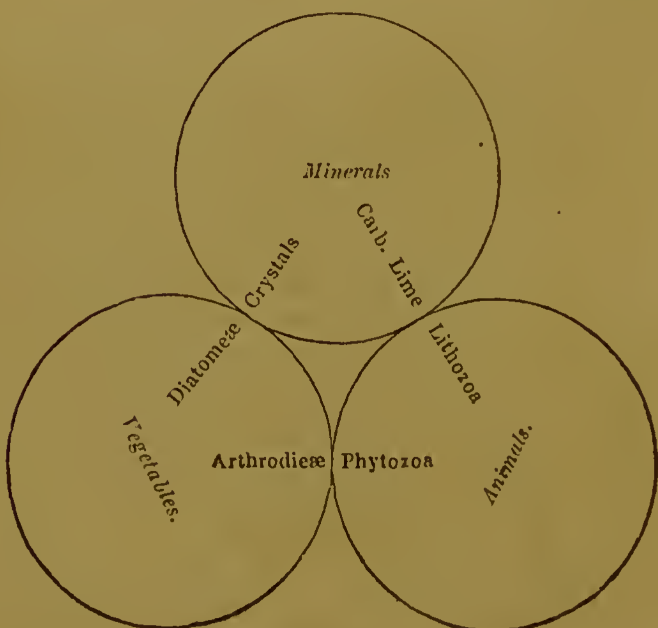


Fig. 35.

The organized and inorganized kingdoms are distinguished from each ther by peculiarities of chemical composition, of form and structure, and f actions or functions.

1. *Peculiarities of Chemical Composition.*

Inorganized Bodies.

1. The undecomposed or elementary ıbstances are fifty-four in number,—ımely, *oxygen, chlorine, bromine, iodine, ıorine, hydrogen, carbon, nitrogen, phos-ıorus, sulphur, selenium, boron, silicon, ıtassium, sodium, lithium, magnesium, cal-ım, barium, strontium, aluminum, gluci-ım, zirconium, yttrium, cerium, thorium, llurium, arsenicum, antimony, chromium, ·anium, molybdenum, tungsten, columbium, ·anium, gold, silver, platinum, palladium, odium, iridium, osmium, mercury, bismuth, pper, tin, lead, cadmium, zinc, cobalt, ckel, manganese, iron, and vanadium.*

2. Are sometimes simple, or elementa- ; and, when compound, sometimes ntain only two elements.

3. The compound atoms are capable of ·composition and of recomposition.

4. Are incapable of undergoing fermen-tion and putrefaction.

Organized Bodies.

1. The undecomposed or elementary substances are about twenty—namely, *oxygen, chlorine, bromine, iodine, fluorine, hydrogen, carbon, nitrogen, phosphorus, sulphur, silicon, potassium, sodium, calcium, magnesium, aluminum, iron, manganese, gold,* and *copper.* Of late it has been asserted that *titanium* is present in the renal capsules. Of the above-mentioned twenty elements in organized beings, only three or four are met with in considerable quantity—namely, *oxygen, hydrogen, carbon,* and *nitrogen.*

2. Are never simple. Every living part contains three or four elements at least, and frequently more.

3. Organised or living parts may be decomposed, but cannot be recomposed.

4. Are capable of undergoing fermentation and putrefaction.

2. *Peculiarities of Form and Structure.*

Inorganized Bodies.

1. The volume is variable and inde-·ite.

2. The exterior form may be regular or ·egular. When regular, these bodies ·bounded by straight lines, and have ·gles; in other words, the *regular form* inorganized bodies is *crystalline.*

3. The internal arrangement of the ·rts, or the *structure,* may be regular or ·egular. If solid and regular, it is crys-·lline.

4. Are generally composed of solid, li-·id, or gaseous matter, exclusively: ·me exceptions, however, to this state-·nt exist. Dr. Brewster has discovered ·lourless and transparent liquids in some ·azes, chrysoberyl, &c.

5. The separate parts are generally ·mogeneous, though sometimes hetero-·neous.

6. The separate parts are independent ·each other.

Organized Bodies.

1. The volume is variable, but definite. Thus though animals vary in their size, there is a limit to the variation.

2. The exterior form is regular, and generally rounded. To this, however, we have exceptions in some of the *Diatomeæ,* which, at one period of their existence, are angular.

3. The internal arrangement of the parts, or structure, is regular. This regular arrangement is vesicular or tubular.

4. Always consist of both solids and fluids. Mosses and certain animals (as the *Vorticella rotatoria* and *Vibrio Anguilla*) may be dried without destroying their vitality; and hence form exceptions to this statement. But they are probably never so dried as to be wholly deprived of moisture; and, in the next place, in this dried state they give no sign of life; for it is only by moistening them that the vital phenomena become apparent. Moreover, Ehrenberg denies that animals can revive after desiccation.—(*Müller's Physiol.* p. 33.)

5. The separate parts are essentially heterogeneous: that is, they possess different properties.

6. The separate parts are always related, and in some cases are dependent on each other. This subserviency of one part to the other constitutes what is termed *organization,* the parts being called *organs.*

3. *Peculiarities of Actions or Functions.*

Inorganized Bodies.	*Organized Bodies.*
1 Are produced by the agency of cohesion and affinity, at the expense of other previously existing bodies.	1. Are produced by other similarly co stituted bodies, which we call parent There are, indeed, many cases in whic we cannot demonstrate the existence of parent; and several arguments may b adduced in support of the doctrine o equivocal generation ; but the majority o physiologists are opposed to it, and adop as an axiom the statement of Harve "*Omne vivum ex ovo.*" Cohesion an affinity are insufficient to account for th production of organized beings, and henc we call to our aid another power, whic we denominate "*the vital force.*"
2. Are preserved or exist solely by cohesion and affinity.	2. Are preserved or exist frequentl in opposition to the usual operation o cohesion and affinity by the agency o "*the vital force.*"
3. Are in a state of rest.	3. Are in a continual state of activit taking in from the external world certai solid, liquid, and gaseous substances, as similating them to their own prop fluids, and converting them into solids, o preparing peculiar liquids from them These phenomena constitute the proces called *nutrition.*
4. Undergo no alterations in their nature, except such as result from the operation of attraction and repulsion.	4. Are incessantly undergoing change so that at different periods of their exi tence their properties are somewhat di ferent. Thus they increase, become de veloped, arrive at maturity, and, lastl decrease. The phenomena of *age*, there fore, are peculiar to organized beings.
5. Have active properties which are always the same in degree and kind.	5. Have active properties which vary i degree and kind: the distinction of *heal* and *disease* which depends on this variatio is, therefore, peculiar to organized being
6. Have an existence which is not necessarily limited or definite.	6. Exist only for a limited period. Th cessation of their existence is denominate *death*. The oldest organized beings on ou planet are probably the *Baobab* trees (*Adan sonia digitata*) described by Adanson ; th ages of some of which have been compute to be five or six thousand years! Thoug there is, perhaps, great exaggeration i this calculation, yet these trees are un doubtedly very aged.
7. Perform actions referrible to repulsion and attraction only.	7. Present phenomena which cannot b explained by reference to attraction an repulsion merely: we, therefore, adm other properties, called *vital*, which w refer to *life*, or the *vital force.*

REGNUM INORGANICUM.—THE INORGANIC KINGDOM.

ORDER I.—OXYGEN AND ITS AQUEOUS SOLUTION.

Oxyge'nium.—Ox'ygen.

HISTORY, SYNONYMES, and ETYMOLOGY.—Oxygen gas was discovered n the 1st of August, 1774, by Dr. Priestley, who denominated it *dephlogis-cated air.* In the following year, Scheele also discovered it, without nowing what Priestley had done, and he called it *empyr'eal air.* Con-orcet termed it *vital air.* Lavoisier called it *oxygen,* from (ὀξὺς, *acid;* nd γεννάω, *to engender* or *produce.*)

NATURAL HISTORY.—(*a.*) *In the inorganized kingdom.*—Oxygen is, of ll substances, that which is found in the largest quantity in nature, or it constitutes at least $\frac{3}{4}$ of the known terraqueous globe. Thus, water, hich covers about three-fourths of the surface of the earth, contains of its weight of oxygen; and the solid crust of our globe probably onsists of at least $\frac{1}{3}$ part, by weight, of this principle; for silica, car-onate of lime, and alumina, the three most abundant constituents of the arth's strata, contain nearly half their weight of oxygen. Mr. De la eche (*Researches in Theoretical Geology,* p. 8) calculates that silica lone constitutes "forty-five per cent. of the mineral crust of our globe." f the atmosphere, oxygen constitutes 20 or 21 per cent. by volume, r about 23 per cent. by weight, to which must be added $\frac{8}{9}$, by weight, of e atmospheric aqueous vapour.

(*b.*) *In the organized kingdom.*—Oxygen is an essential constituent of ll living bodies. Vegetables, in the sun's rays, absorb carbonic acid ecompose it, retain the carbon, and emit the oxygen. Hence they have een supposed to be the purifiers of the atmosphere.

PREPARATION.—There are several methods of procuring this gas, but shall notice three only:—

1. *By heating chlorate of potash in a glass retort.*—This method ields pure oxygen gas. One equivalent, or 124 parts of chlorate of otash, yield six equivalents or 48 parts of oxygen, and one equivalent r 76 parts of chloride of potassium.

SUBSTANCES USED.			RESULTS.
q. Chlorate Pot^{h}. 124	1 eq. Chlo^{c}. Acid 76	5 eq. Oxy. 40	6 eq. Oxygen 48
		1 eq. Chlo. 36	
	1 eq. Potash . . 48	1 eq. Oxy. 8	
		1 eq. Pot^{m}. 40	1 eq. Chloride Potas^{m}. 76

2. *By heating binoxide of manganese in an iron bottle.*—This is the cheap-st method, and, for ordinary purposes, it yields oxygen gas sufficiently ure. To free the gas from carbonic acid, wash it with lime-water or ith a solution of caustic potash. One pound of the commercial binoxide sually yields from 30 to 40 pints of gas: but, from fine samples, 40 50 pints may be procured. Two equivalents or 88 parts of pure inoxide yield one equivalent or 8 parts of oxygen, and two equivalents r 80 parts of the sesquioxide of manganese.

SUBSTANCE USED.	RESULTS.
2 eq. Binoxide Manganese=88	1 eq. Oxygen 8
	2 eq. Sesquioxide Manganese 80

3. *By heating binoxide of manganese with about its own weight of strong sulphuric acid in a glass retort.*—The quantity of acid to be employed should be sufficient to form with the binoxide a mixture having the consistence of cream. This method is followed only when an iron bottle cannot be procured, or when a small quantity of gas is wanted at a very short notice. One equivalent, or 44 parts, of the binoxide, yields one equivalent or 8 parts of oxygen, and one equivalent or 36 parts of the protoxide of manganese: the latter substance forms, with an equivalent or 40 parts of anhydrous sulphuric acid, one equivalent or 76 parts of sulphate of the protoxide of manganese.

SUBSTANCES USED.			RESULTS.
1 eq. Binox. Mang.	44	1 eq. Oxygen 8	1 eq. Oxygen 8
		1 eq. Protox. Mang. 36	
1 eq. Sulphuric Acid	40		1 eq. Sulph^te. Protox. Mang. 76

PROPERTIES.—It is elastic, colourless, odourless, tasteless, incombustible, but a supporter of combustion. According to Dr. Thomson, 100 cubic inches of this gas weigh, at the temperature of 60° Fah., and when the barometer stands at 30 inches, 34·60 grains: hence its specific gravity is 1·111. According to Berzelius and Dulong, the spec. grav. is 1·1026. Its atomic weight is 8: its atomic volume 0·5, hydrogen being in both cases unity.

1 eq. Hydr. =1	1 eq. Oxyg. =8

CHARACTERISTICS.—If a taper or match be plunged into this gas after the flame has been blown out, but while the wick or charcoal is yet glowing, the flame is instantly reproduced. The only gas likely to be confounded with oxygen in this respect is the protoxide of nitrogen, from which oxygen is distinguished by exploding it with hydrogen. A mixture of one volume oxygen and two volumes hydrogen, yields, by explosion, water only, whereas a mixture of one volume of the protoxide of nitrogen with one volume hydrogen, yields water and one volume of nitrogen.

PHYSIOLOGICAL EFFECTS.—(*a.*) *On vegetables.*—Oxygen gas is essential to the germination of seeds, and to the existence and growth of plants. In the shade vegetables absorb it from the atmosphere, and evolve an equal volume of carbonic acid; while in the solar rays the reverse changes take place; carbonic acid being absorbed and oxygen expired. The vigorous growth of plants in inclosed cases, as originally proposed and practised by my friend Mr. N. B. Ward (*Companion to the Botanical Magazine for May*, 1836), does not invalidate the above statements; since the cases are never completely air-tight, but allow the ingress and egress of air consequent on changes of temperature.

The effects of pure oxygen gas on germination and vegetation have been examined by Theod. de Saussure (*Recherches Chimiques sur la Végétation*, 1804). He found that the period of germination is the same in oxygen gas as in atmospheric air, but that seeds evolve more carbonic acid in the former than in the latter (pp. 11 and 12). Plants do not thrive so well in an atmosphere of oxygen gas in the shade as in one of common air; they give out more carbonic acid, which is always injurious to vegetation in the shade. When exposed in oxygen gas to the direct rays of the sun, they augment in weight about as much as in atmospheric air (p. 93, *op. cit.*).

(*b*). *On animals generally.*—It is usually asserted that all animals ·quire the influence of oxygen, or rather of air, to enable them to exist: ut this assertion cannot be proved in the case of some of the lower nimals. Thus intestinal worms seem to dispense with respiration Müller's *Physiology*, p. 295). Some animals which respire have no rgans specially devoted to this function; in these the cutaneous surface ffects respiration; as in the *Polypifera*. In the *Infusoria* the respiratory rgans are delicate cilia. Many animals have branchiæ or gills for espiration, as some *Mollusca*, some *Annelida*, and fishes. Leeches espire by subcutaneous sacs which open externally. The respiratory rgans of insects are ramifying tracheæ. Lastly, the higher classes of nimals respire by means of lungs. Whenever respiration is effected a ortion of oxygen disappears, while a quantity of carbonic acid, nearly qual in volume to the oxygen consumed, is produced.

The continued respiration of oxygen gas is injurious, and even fatal to nimal life: this has been observed by all experimenters. Animals live nger in a given volume of oxygen than in the same quantity of atmo- pheric air, but the continued employment of it causes death. Mr. roughton confined rabbits, guinea-pigs, and sparrows, in glass jars con- aining oxygen, and inverted over water. At first they suffered no incon- enience, but in about an hour their breathing became hurried, and the rculation accelerated. This state of excitement was followed by one of ebility; the respirations became feeble, and were more slowly performed; oss of sensibility and of the power of voluntary motion supervened, till the nly remaining visible action was a slight one of the diaphragm, oc- urring at distant intervals. On opening the body, the blood (both enous and arterial) was found to be of a bright scarlet hue; it was thin, nd rapidly coagulated. The gas in which animals had thus been con- ned till they died, retained its power of rekindling a blown-out taper, nd of sustaining, for a time, the life of another animal introduced into ; and Mr. Broughton hence deduced the inference that it does not ontain so great an excess of carbonic acid as the gas left when animals ave perished by confinement in atmospheric air, and he considered the rain of symptoms induced by the respiration of pure oxygen gas as nalogous to those which follow the absorption of certain poisons into the ystem (*Medical Gazette*, vol. iii. p. 775). Injected into the pleura, oxygen as is very quickly absorbed, without producing inflammation. Cau- ously injected into the veins of dogs, it has no sensible effect on the ystem (*Nysten, Recherches de Physiologie*, p. 60).

(*c*.) *Effects on man.*—If pure oxygen be inspired a few times it does ot produce any remarkable phenomena; though some have ascribed arious effects to it, such as agreeable lightness in the chest, exhilaration, ncreased frequency of pulse, a sensation of warmth in the chest, gentle erspiration, and an inflammatory state of system. But several of these esults arise probably from mental influence, others from the mode of nhaling the gas, and perhaps some might depend on the employment of mpure oxygen.

Uses.—Oxygen gas was formerly employed in medicine in certain iseases supposed to depend on a deficiency of oxygen in the system; nd the beneficial results obtained by the use of acids (especially the itric acid) of the oxides of mercury, chlorate of potash, vegetable food, &c. were referred to the oxygen which these substances contained, and which they were supposed to communicate to the system. These notions are now exploded.

In asphyxia arising from a deficiency of atmospheric air, or from breathing noxious vapours, the inhalation of oxygen gas has been said to be, and probably is, useful. On the same principle, it may be employed during an attack of spasmodic asthma, when there is danger of suffocation, but it is at best only a palliative, and has no power of preventing the occurrence of other attacks. Chaussier has recommended its use in children apparently still-born. To combat the asphyxia of malignant cholera, inhalations of oxygen were tried in Russia, Poland, Prussia, and France, but without success (Merat and De Lens, *Dict. Mat. Méd.* tom. 5me p. 143).

A'qua Oxyge'nii.—Ox'ygen Water.

At the mean pressure and temperature of the atmosphere, 100 vols. of water dissolve, according to Dalton and Henry (*Elem. Experim. Chem.*), 3·7 vols. of oxygen gas, according to Saussure (*ibid.*) 6·5 vols. By pressure in a proper machine, water may be charged with a much larger quantity (Jourdan, in the *Pharmacopée Universelle*, says with half its volume) of gas. This solution has been termed *oxygenated water*, but is a very different substance to the peroxide of hydrogen, which also has been known by this appellation. It has been used to the extent of one or two bottlefuls daily, as a slight excitant. It is said to increase the appetite and promote the secretions; and to be serviceable in spasm of the stomach, amenorrhœa, hysteria, atonic dropsy, &c.

ORDER II.—CHLORINE AND ITS AQUEOUS SOLUTION.

Chlorin'ium.—Chlo'rine.

HISTORY, SYNONYMES, AND ETYMOLOGY.—This gas was discovered by Scheele in 1774, who termed it *dephlogisticated muriatic acid.* Berthollet, in 1785, named it *oxygenated muriatic acid.* Sir H. Davy called it *chlorine* (from χλωρὸς, *green*), on account of its colour.

NATURAL HISTORY.—It is found in both kingdoms of nature. (*a.*) *In the inorganized kingdom* it exists principally in combination with sodium, either dissolved in the water of the ocean or forming deposits of rock salt. Chlorine also occurs native, in combination with magnesium, calcium, lead, silver, &c. Free hydrochloric acid is met with in the neighbourhood of volcanoes, and is probably produced by the decomposition of some chloride. (*b.*) *In the organized kingdom,* it is found in combination, in both animals and vegetables. Sprengel (*Decand. Physiol. Vég.* tom. i. p. 220), says maritime plants exhale chlorine, principally during the night. Hydrochloric acid, in the free state, exists, according to Dr. Prout, in the stomach of animals during the process of digestion.

PREPARATION.—There are several methods of procuring chlorine gas:—

1. *By adding sulphuric acid to a mixture of common salt and binoxide of manganese.*—This is the cheapest and most usual method of preparing it. Mix intimately three parts of dried common salt with one part of the binoxide of manganese, and introduce the mixture into a retort. Then add as much sulphuric acid, previously mixed with its own weight of water, as will form a mixture of the consistence of cream. On the

plication of a gentle heat, the gas is copiously evolved, and may be llected over either warm or cold water.

In this process two equivalents, or 80 parts of sulphuric acid, react on e equivalent or 44 parts of the binoxide, and on one equivalent or 60 rts of chloride of sodium, and yield one equivalent or 36 parts of lorine, one equivalent or 76 parts of the sulphate of the protoxide of nganese, and one equivalent or 72 parts of the sulphate of soda.

NGREDIENTS USED.			PRODUCTS.
1. Chlo^{de}. Sodium 60	1 eq. Chlorine 36		1 eq. Chlorine 36
	1 eq. Sodium 24	1 eq. Soda 32	
q. Binox. Mang. 44	1 eq. Oxygen 8		
	1 eq. Protoxide Mang. 36		
1. Sulphuric Acid 80	1 eq. Sulphuric Acid . 40		1 eq. Sulphate Soda . . 72
	1 eq. Sulphuric Acid . 40		1 eq. Protosulph^{te}. Mang. 76

2. *By heating a mixture of equal weights of common hydrochloric acid d binoxide of manganese in a glass retort over a lamp.*

In this process two equivalents or 74 parts of hydrochloric acid react one equivalent or 44 parts of the binoxide, and yield one equivalent or parts of chlorine, one equivalent or 9 parts of water, and one equivat or 64 parts of protochloride of manganese.

NGREDIENTS USED.		PRODUCTS.
1. Hydrochl. Acid 74	1 eq. Chlorine 36	1 eq. Chlorine 36
	1 eq. Chlorine 36	
	2 eq. Hydrog. 2	
1. Binox. Mang. 44	2 eq. Oxygen 16	2 eq. Water 18
	1 eq. Mangan. 28	1 eq. Protochlo. Mang. 64

3. *By the action of hydrochloric acid on chloride of lime.*—This method y be resorted to when binoxide of manganese cannot be procured. e products of the reaction of the ingredients are, chlorine, water, and oride of calcium.

PROPERTIES.—Chlorine, at ordinary temperatures and pressures, is a seous substance, having a yellowish green colour, a pungent, suffocat- odour, and an astringent taste. 100 cubic inches weigh between 76 l 77 grains. Its sp. gr. is, according to Dr. Thomson, 2·5. Its uivalent by weight is 36, by volume 1;—hydrogen being unity.

1 eq. Hydrog. =1	1 eq. Chlor. =36

It is not combustible, but is a supporter of combustion. Phosphorus and powdered antimony take fire spontaneously when introduced into it,—a taper burns in it with the evolution of a red light and much smoke. When ter is present it destroys vegetable colours, organic odours, and infecus matters.

By a pressure of 4 atmospheres at the temperature of 60° F., chloe is a yellow liquid, having a sp. gr. of 1·33 (water being 1·).

CHARACTERISTICS.—The colour, odour, and bleaching property of chloe readily distinguish it from other gases. It forms a white curdy preitate (chloride of silver) with the nitrate of silver: this precipitate ckens by exposure to light, from the escape of a little chlorine and the mation of a sub-chloride of silver (Wetzlar, in Landgrebe's *Versuch r das Licht.* p. 53, 1834); is insoluble in nitric acid, readily dissolves liquid ammonia, and when heated in a glass tube fuses, and on cooling cretes into a gray, semi-transparent mass (*horn silver* or *luna cornea*). aqueous solution of chlorine dissolves leaf gold. The *chlorides* react the solution of nitrate of silver as free chlorine. They evolve hydrochloric acid when heated with liquid sulphuric acid. If a watery solution of a chloride, coloured blue by sulphate of indigo, be submitted the action of a galvanic battery, the chlorine is evolved at the positive pole (*anode*) and destroys the colour of the sulphate of indigo in the neighbourhood of that pole.

The *chlorates* when heated evolve oxygen, and are converted into chlorides. When mixed with strong sulphuric acid they become orange red, and give out the peroxide of chlorine. They do not precipitate the salts of silver.

The *perchlorates* evolve oxygen, and are converted into chlorides when heated. They do not become red or give out peroxide of chlorine by the action of sulphuric acid. The soluble perchlorates precipitate the salts of potash.

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—The germination of seeds has been said to be promoted by watering them with a weak solution of chlorine, but the statement is probably erroneous. (*Decand. Phys. Végét.* t. ii. p. 632.)

b. On animals generally.—Nysten (*Recherches*, p. 140,) injected a small quantity of chlorine gas into the jugular vein of a dog, and the only effect was howling. A larger quantity occasioned difficult respiration, apparently great agony, and death in three minutes. The body was opened four minutes afterwards: the blood was fluid and venous in the auricles and ventricles, which contained neither gas nor coagula. On another occasion he threw this gas into the pleura, and thereby produced inflammation of this membrane and death. From these experiments, Nysten (*op. cit.* p. 143) concludes that it is a local irritant, but has no specific effect on any part of the system.

c. On man.—Chlorine gas acts as a *local* irritant. Mr. Wallace (*Researches respecting the Medical Powers of Chlorine, particularly in Diseases of the Liver*, 1822), tells us, that diluted with air, or aqueous vapour, of 116° F., and applied to the skin, it produces peculiar sensations, similar to those caused by the bite or sting of insects: this effect is accompanied with copious perspiration, and a determination of blood to the skin, sometimes attended with an eruption of minute papulæ, or even vesicles. Applied to the skin in a pure form, its action is similar, but more energetic.

If an attempt be made to inspire undiluted chlorine gas, it produces spasm of the glottis. If the gas be mixed with air, it enters into the bronchial ramifications, causes a sensation of tightness and suffocation, and violent cough. Twice I have suffered most severely from the accidental inhalation of it; and each time it gave me the sensation of constriction of the air-tubes, such as might be produced by a spasmodic condition of the muscular fibres of the bronchial tubes. The attack usually goes off in increased secretion from the mucous membrane. When diluted with a large quantity of air, chlorine may be inhaled without exciting cough: it occasions a sensation of warmth in the respiratory passages, and promotes expectoration.

The irritating effects of chlorine are less powerful on those accustomed to inhale it; as I have repeatedly seen in patients who were using the gas, and which is also shewn by the following statement made by Dr. Christison, (*Treatise on Poisons*, p. 736):—"I have been told (says he) by a chemical manufacturer at Belfast, that his workmen can work with ıpunity in an atmosphere of chlorine, where he himself could not remain ›ove a few minutes."

The constitutional or *remote* effect caused by inhalations of chlorine, increased frequency of the pulse and of respiration. But this effect ay be in part owing to the increased muscular efforts of the patient. r. Wallace states that the application of chlorine to the skin also occa- ɔns soreness of the mouth, fauces, and œsophagus, increased vascula- ty, and even minute ulcerations of these parts, and an alteration in the ıantity and quality of the salivary and biliary secretions. He thinks at it has a tranquillizing, and at the same time exciting power, with spect to the nervous system. Dr. Christison tells us that at the Belfast anufactory above alluded to, the chief consequences of exposure to an mosphere of chlorine are acidity and other stomach complaints, which e men generally correct by taking chalk. Absorption of fat is said to : an effect observed in the manufactories at Glasgow, Manchester, and elfast. (Cogswell's *Essay on Iodine*, p. 82.)

When applied to the skin or bronchial membrane, does chlorine gas come absorbed? If Mr. Wallace's observation be correct, we must fer that it does, and that it is thrown out of the system by the kidneys; r he says the urine acquires bleaching properties.

USES.—(*a.*) *As a fumigating agent, disinfectant, and antiseptic*, chlorine, believe, stands unrivalled. Hallé, in 1785, appears to have been the st person who employed it as a disinfectant; but we are greatly in- bted to Guyton-Morveau for the zeal and energy he manifested in his empts to introduce it into use. For destroying miasmata, noxious luvia, and putrid odours, it is the most powerful agent known; and is, erefore, well adapted for disinfecting prisons, ships, hospitals, dissect- g-rooms, and all other places, the air of which requires purification. ıe best method of fumigating a large building is that adopted by Dr. raday, at the General Penitentiary at Milbank. One part of common salt ıs intimately mixed with one part of the black or binoxide of manga- se; then placed in a shallow earthen pan, and two parts of oil of triol, previously diluted with two parts by measure of water, poured over and the whole stirred with a stick. Chlorine continued to be liberated ›m this mixture for four days. The quantities of the ingredients con- med were 700 lbs. of common salt, 700 lbs. of binoxide of manganese, d 1400 lbs. of sulphuric acid. The disinfecting power of chlorine is sup- sed to depend on its affinity for hydrogen, by which it effects the composition of water or aqueous vapour, with the hydrogen of which it ites, while the nascent oxygen oxidizes the organic matter: or it may t merely by abstracting hydrogen from the putrid miasmata.

(*b.*) *As an antidote in poisoning by hydrocyanic acid, sulphuretted hydro- n, or hydrosulphate of ammonia*, chlorine gas is a very valuable agent. ›elieve, however, that the chloride of lime will be found a more con- nient, safe, and opportune substance; of course its activity depends on e chlorine which it contains or gives out. The beneficial influence of lorine in the treatment of animals asphyxiated by sulphuretted hydro- n, doubtless arises in part at least from its chemical properties; for ıen mixed with sulphuretted hydrogen, it forms chloride of sulphur and drochloric acid. The best method of applying the remedy is to diffuse little chlorine in the air, and then to effect artificial respiration.

(*c.*) *Inhaled in chronic pulmonary diseases* it is sometimes a useful remedy. I have carefully watched its effects in phthisis and other chr[onic] diseases of the lungs; and the result of my observation is, that chlori[ne] is rarely serviceable. Frequently, after the first and second inhalation[s] the patients fancy their breathing much relieved, while the expector[a]tion is promoted, but the amendment is seldom permanent. I ne[ed] hardly say it has no pretensions to the cure of phthisis, but it may [be] useful as a palliative (sometimes diminishing the sweating); and I e[asily] readily believe that occasionally in chronic bronchitis it may be of esse[n]tial service, though, I confess, I have never found it so.

I have before described the mode of administering the gas (p. 51[)]. Either the aqueous solution of chlorine, or a small portion of the chlori[de] of lime, may be placed into the inhaling bottle: if the latter be not suffi[]ciently strong, a few drops of muriatic acid are to be added, to devel[op] free chlorine.

(*d.*) *In diseases of the liver*, not attended with active inflammation, M[r.] Wallace has successfully employed baths of gaseous chlorine, either [in] the pure state or diluted with air or aqueous vapour. The benefit [of] chlorine in these cases has been confirmed by others. The temperatu[re] of the bath, and the time the patient ought to remain in it, will vary [in] different instances; but Mr. Wallace thinks, that, in the greater numbe[r,] 115° Fah. will be found to answer best, and the proper time about ha[lf] an hour. The benefit obtained is in part referrible to the heat employe[d,] in part to the irritant effect of the chlorine on the skin, and (according [to] Mr. Wallace) in part to the specific influence of chlorine on the live[r.] Ziese, an apothecary at Altona, has also employed chlorine baths in the[se dis]eases with advantage.

Antidotes.—The inhalation of ammoniacal gas, of the vapour of war[m] water, of spirit of wine, or of ether, has been recommended, to relieve t[he] effects of chlorine. I tried them all when suffering myself, but witho[ut] the least apparent benefit. In a case related by Kastner, and which [is] reported in Wibmer's work (*Die Wirkung der Arzneim. u. Gifte.* 2er. B[d.] 109), sulphuretted hydrogen gave great relief. If this agent be em[]ployed, it must be done cautiously, as it is itself a powerful poison.

A'qua Chlorin'ii.—Chlo'rine Water.—Ph. Dub.

History.—This compound has been known by the various names [of] *liquid oxymuriatic acid, aqua oxymuriatica*, and *liquor chlori.* In t[he] Dublin Pharmacopœia it is termed *aqua chlorinii*, or *chlorine water*.

Preparation.—In the Dublin Pharmacopœia this compound is pr[e]pared as follows:—add 87 parts of sulphuric acid to 124 of water, a[nd] when the mixture has become cold, pour it on a mixture of 100 parts [of] dried common salt, intimately mixed with 30 parts of binoxide of mang[a]nese, and placed in a retort. Transmit the gas which is evolved on t[he] application of a moderate heat, through 200 parts of water, placed in [a] Woolfe's bottle: but in the absence of this a wide-mouthed bottle close[d] by a cork with two perforations, through which pass two glass tubes, bot[h] dipping into the water, but one of which communicates with the retor[t.] A Florence flask, to which a curved tube is adapted by means of a cork, [is] a more convenient vessel for generating the gas in, than a retort.

Properties.—At the temperature of 60° F. and common pressure of th[e] atmosphere, water takes up about twice its bulk of the gas (*Gay-Lussac* 'he solution has a greenish yellow colour, the strong and peculiar odour ' the gas, and an astringent taste. Its sp. gr. is 1·003. It bleaches ·getable colours—as tincture of litmus, turmeric, &c. By exposure to ght, the water is decomposed, the oxygen is evolved, while the ·drogen unites with the chlorine to form muriatic acid. Hence the ›lution should be kept in bottles excluded from the light.

CHARACTERISTICS.—Its odour, its action on a solution of nitrate of silver s before described for chlorine gas), its power of dissolving leaf gold, ıd its bleaching properties, readily distinguish this solution. It estroys the blue colour of iodide of starch and of sulphate of indigo. A ece of silver plunged into it is immediately blackened.

PHYSIOLOGICAL EFFECTS.—In a concentrated form, the aqueous solution ' chlorine acts as a corrosive poison. Somewhat diluted it ceases to be a ıustic, but is a powerful local irritant. Administered in proper doses, ıd sufficiently diluted, it acts as a tonic and stimulant. The continued se of it is said to have caused salivation. Applied to dead organic mat-r it operates as an antiseptic and disinfectant.

USES.—Chlorine water has been employed in medicine both as an xternal and internal remedy.

(*a.*) *Externally.*—It has been used in the concentrated form as a caus-c, applied to wounds caused by rabid animals; diluted, it has been nployed as a wash in skin diseases, namely, in the itch and porrigo; as gargle in putrid sore-throat; as a local bath in liver diseases; and as ı application to cancerous and other ulcers attended with a fœtid dis-ıarge. In the latter cases I have repeatedly employed it with advan-ge, though I give the preference to a solution of the chloride of soda.

(*b.*) *Internally.*—It has been administered in those diseases denomi-ıted putrid; for example, in the worst forms of typhus, in scarlet fever, ıd in malignant sore throat. It has also been employed in venereal aladies, and in diseases of the liver.

DOSE.—The dose of this solution varies with the degree of concentra-on. I have frequently allowed patients to drink, *ad libitum*, water, to hich some of this solution has been added. If made according to the rections of the Dublin Pharmacopœia, the dose is from one to two achms properly diluted.

ANTIDOTES.—According to Devergie, the antidote for poisoning by a ›lution of chlorine is albumen. The white of egg, mixed with water ' milk (the caseum of which is as effective as the albumen of the egg) to be given in large quantities. The compound which albumen forms ith chlorine has little or no action on the animal economy, and may be adily expelled from the stomach. In the absence of eggs or milk, flour ight be exhibited: or if this cannot be procured, magnesia or chalk. he gastro-enteritic symptoms are, of course, to be combated in the sual way.

ORDER III.—IODINE.

Iodin'ium.—I'odine.

GENERAL HISTORY.—Iodine was discovered in 1811 by M. Courtois, a ltpetre manufacturer at Paris. It was first described by Clement in 813, but was afterwards more fully investigated by Davy and Gay-ussac. It was named *Iodine*, from *ἰώδης*, *violet-coloured*, on account of e colour of its vapour.

NATURAL HISTORY.—It exists in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Vauquelin met with iodide of silv in a mineral brought from Mexico, and Mentzel found iodine in an ore zinc which contained cadmium. It has also been met with in an ore lead—(*Journ. de Pharmacie*, tom. xxiii. for 1837, p. 29.) In sea-water has also been discovered, where it probably exists as an iodide of sodiu or of magnesium. Many mineral waters likewise contain it. It w detected by Mr. Copeland in the carbonated chalybeate of Bonningto About one grain of iodine was found by Dr. Daubeny in ten gallons the water of Robbin's Well at Leamington, in Warwickshire. In the o well at Cheltenham the quantity was not more than one grain in six gallons. In a brine-spring at Nantwich, in Cheshire, there was about grain of iodine in twelve gallons. In the sulphurous water of Cast Nuovo d'Asti, iodine was discovered by Cantu. In some of the miner waters of Germany, Bavaria, and South America, it has also been d tected—(*Gairdner on Mineral and Thermal Springs*, p. 27.) Fucl found it in the rock-salt of the Tyrol—(*Gmelin, Handbuch der Chemie.*)

(*b.*) *In the organized kingdom.*—Of animals containing iodine I ma mention the genera *Spongia*, *Gorgonia*, *Doris*, and *Venus:* likewise *Sepi* the envelopes of the eggs of which contain it. An insect has been foun near Ascoli, in Italy, which Savi has described under the name of *Jul fœtidissimus*, containing iodine. The animal emits, when disturbed, yellow fluid strongly smelling of iodine, and which immediately strike the characteristic violet colour with starch—(*British and Foreign Medic Review* for January, 1838, p. 163.) Recently iodine has been detecte in the oil of the cod's liver—(*Journ. Pharm.* tom. xxiii. p. 501.) A ve considerable number of vegetables, particularly those belonging to th family *Algæ*, yield it. The following are some instances: *Fucus vesicu losus*, F. *serratus*, and F. *nodosus;* (fig. 36, *a*, *b*, *c*.) *Laminaria saccharin*

FIG. 36.

a. Fucus vesiculosus. *c.* F. serratus.
b. F. nodosus. *d.* Laminaria digitata.

and *L. digitata;* (fig. 36 *d*) *Halidrys siliquosa; Chorda Filum; Gelidiu cartilagineum; Halyseris polypodioides; Phyllophora rubens; Rhodome nia palmata; Ulva Linza; Porphyra umbilicalis; Padina Pavonia; Gi gartina Helminthocorton*, and some of the marine *Confervæ*.

It has been found in several species of phænogamous plants, as *Zos*

·*a marina*, and, more recently, in two growing in Mexico; namely, a spe- ·s of *Agave* and a species of *Salsola*—(*Journ. Pharm.* tom. xxiii. p. 31.)

PREPARATION.—Iodine is obtained from the *Fucoideæ* (one of the divi- ›ns of the family *Algæ*). The plants of this tribe, by combustion, yield ash or cinder, commonly denominated *kelp*, which contains iodine. ıvy states that French kelp is more productive than British; and :lond, from experiments made at the Cape of Good Hope, concludes ıt the *Laminaria buccinalis* yields more than any European *Algæ*.

Kelp is a very heterogeneous substance. Its soluble parts are the lorides of sodium and potassium, carbonate of soda, sulphates of soda :l potash, and the sulphuret and iodide of potassium or of sodium. › these must be added a small quantity of alkaline bromide. The quan- ·y of iodide, however, is very small in comparison with some of the ıer salts, and, therefore, the first object in the manufacture of iodine is separate as much of these as possible. By repeated crystallizations readily attain this, since the iodide being very soluble is left in the ›ther liquor, along with the sulphuret and a portion of the other salts. This liquor is introduced into a stoneware still, sulphuric acid and the ıoxide of manganese are added, and heat applied. Iodine distils :r, and after being washed with water, is dried between folds of bibu- ıs paper.

In this process two equivalents, or 80 parts of sulphuric acid, react on e equivalent, or 44 parts of binoxide of manganese, and on one equiva- t, or 166 parts of iodide of potassium, and yield one equivalent, or 126 rts of iodine, one equivalent, or 88 parts of sulphate of potash, and one ıivalent, or 76 parts of the sulphate of the protoxide of manganese.

·NGREDIENTS USED.				PRODUCTS.
·.IodidePotas^{m}. 166	1 eq. Iodine	126		1 eq. Iodine 126
	1 eq. Potassium . .	40	1 eq. Pot^{h}. 48	
·.Binox. Mangan. 44	1 eq. Oxygen . . .	8		
	1 eq. Protox. Mang.	36		
·. Sulph^{c}. Acid 80	1 eq. Sulphuric Acid.	40		1 eq. Sulph^{te}. Potash . 88
	1 eq. Sulphuric Acid.	40		1 eq. Protosulph^{te}. Mang. 76

Bussy (*Journ. Pharm.* t. 23, p. 17) has proposed another mode of pro- ring iodine.

PROPERTIES.—Iodine is a crystallizable solid, its primary form being a ›mbic octahedron. It is usually met with in micaceous, soft, friable ıles, having a greyish black colour, a metallic lustre, an acrid hot taste, :l a disagreeable odour somewhat similar to that of chlorine. It fuses about 225° F., and at 347° is volatilized, though the vapour rises along th that of water at 212°. Iodine vapour has a beautiful violet colour, :l a great specific gravity; namely, 8·716, according to Dumas. Iodine quires 7000 times its weight of water to dissolve, but alcohol and ether : much better solvents for it. Its atomic weight is about 126.

CHARACTERISTICS.—In the free state iodine is distinguished from most ıer bodies by its forming an intense blue colour with starch. So deli- .e is this test, that Stromeyer says, water which does not contain more ın one four-hundred-and-fifty thousandth of its weight of iodine, ac- ıires a perceptibly blue tinge on the addition of starch. This blue our is destroyed by heat, and, therefore, in testing for iodine the liquids ployed should be cold: an excess of alkali also destroys it by forming two salts, an iodate and an iodide, but by supersaturating with acid t colour is restored.

The blue compound of iodine and starch is usually designated t iodide of starch, but Raspail, (*Nouveau Système Chimie Organiqu* objects to the term, as grains of starch consist of two parts—an extern envelope, within which is a soluble gummy substance. Now the iodi says Raspail, attaches itself to the envelope only, giving it a blue colo just as it gives a yellow colour to other organic textures.

Iodine forms a blue compound with narceine (see *Opium*). The min ral acids (sulphuric, nitric, and hydrochloric) have the same effect narceine.

When iodine is in combination with oxygen, starch will not recogni it. For example, if a little starch be added to a solution of iodic aci no change of colour is observed; but if some deoxidating substance l now employed (such as sulphurous acid or morphia) the blue colour immediately produced. The iodates give out oxygen when heated, an are converted into iodides. They deflagrate when thrown on red h coals. The soluble iodates produce with a solution of the nitrate silver, a white precipitate of iodate of silver soluble in ammonia. If t iodine be combined with a base (as with potassium, or sodium), chlori or sulphuric or nitric acid must be employed to remove the latter; and t iodine being then set free, will react on the starch. This is the mode proceeding to detect iodine in the urine of a patient; for the mere additi of starch will not suffice. Nitric or sulphuric acid or chlorine must be em ployed to remove the base with which the iodine is combined.

The soluble iodides produce, with a solution of nitrate of silver, a ye lowish precipitate (iodide of silver) very slightly soluble only in ammoni They precipitate the salts of lead yellow, and bichloride of mercu scarlet.

Purity.—We are told that iodine is much adulterated, but I doubt i There are two properties which will, in most instances, determine its pu rity—namely, its solubility in alcohol, and, when heated, its conversi into violet vapour, leaving no residuum. Coal, plumbago, peroxide manganese, sand, and charcoal (all of which, it is said, have been foun in iodine), would be in this way readily distinguished. But Dr. O'Shaugh nessy (*Translation of Lugol's Essays*, p. 210) states that he met with on specimen so artfully adulterated, that the foreign ingredients were at th same time soluble in alcohol and volatilizible by heat. A little impos tion may be, and indeed is, practised by some dealers in iodine, by sellin it in a moist state. An ounce, if very moist, may contain one drachm, o perhaps even a drachm and a half, of water. The easiest way of detectin this is by compression between folds of blotting paper.

Physiological Effects.—(*a.*) *On vegetables.* Cantu states that see placed in pure sand and moistened with a solution of iodine, germina more readily than seeds sown in the usual way. Vogel, however, asser that iodine, so far from promoting, actually checks or stops germinatio (*Decandolle, Physiolog. Végét.* tom. 3me. p. 1337).

(*b*). *On animals generally.*—Hitherto no examination has been mad of the effects of iodine on the different classes of animals, for, with th exception of man, the only animals on which experiments have hither been made with it, are horses, dogs, and rabbits. On these it operat as an irritant and caustic poison, though not of a very energetic kin agendie threw a drachm of the tincture of iodine into the veins of a g without causing any obvious effects (*Formulaire*). Dr. Cogswell has ɔeated this experiment: the animal was slightly affected only (*Experi-ntal Essay on Iodine*, p. 31, 1837). The last-mentioned writer found ıt two drachms of the tincture caused death. But something must be cribed to the alcohol employed. Orfila (*Toxicologie générale*) applied grains of solid iodine to a wound on the back of a dog: local inflam-ation, but no other inconvenience, resulted. One or two drachms ministered by the stomach caused vomiting, and when this was evented by tying the œsophagus, ulceration of the alimentary canal and ath took place. Mr. Dick (*Cogswell's Essay*, p. 24) gave iodine, in y large doses, to a horse for three weeks, but the only symptom which uld be referred to its influence was an unusual disregard for water. e average daily allowance was two drachms, administered in quantities ending from a drachm up to two ounces. Dr. Cogswell (*op. cit.* p. 60) e 73 grains of iodine to a dog in nine days. Five days after the sation of the iodine the dog was killed: the urine contained a highly oreciable quantity of iodine—and a trace, and but a trace, of iodine s found in the blood, brain, and stomach.

c.) *On man.*—The *local* action of iodine is that of an irritant. Applied the skin it stains the cuticle orange-yellow, causes itching, redness, l desquamation. If the vapour of it, mixed with air, be inhaled, it ites cough and heat in the air-passages, and promotes bronchial retion. Swallowed in large doses it irritates the stomach, as will presently mentioned.

The effects produced by the internal administration of iodine may be sidered under the two heads of those arising from the use of small,— l those produced by large doses.

. *In small, medicinal doses*, we sometimes obtain the palliation, or even removal of disease, without any perceptible alteration in the functions the body. Thus, in a case of chronic mammary tumor which fell ler my observation, iodine was taken daily for twelve months, without ng rise to any perceptible functional change, except that the patient was usually thin during this period. Sometimes it increases the appetite, effect noticed both by Coindet (*Biblioth. Univers.* tom. 14, Sciences et s), and by Lugol (*Essays*, translated by Dr. O'Shaughnessy), from ch circumstance it has been denominated a *tonic*. But the long-con-ued use of it, in large doses, has, occasionally, brought on a slow or onic kind of gastro-enteritis; an effect which I believe to be rare, and met with when the remedy has been incautiously administered.

n irritable subjects, and those disposed to dyspepsia, it occasions nausea, ness, heat of stomach, and loss of appetite, especially after its use has n continued for some days: the bowels are oftentimes slightly relaxed, it least they are not usually constipated. More than one-third of the ents treated by Lugol experienced a purgative effect; and when the ctions were numerous, colics were pretty frequent (*op. cit.* p. 20). drin (*Dict. de Mat. Méd.* t. 3me, p. 628), and Manson (*Medical Re-ches on Iodine*), however, observed a constipating effect from the use odine.

he action of iodine on the *organs of secretion* is, for the most part, of a stimulant; that is, the quantity of fluid secreted is usually eased, though this effect is not constantly observed. Jörg (*Material zu* *einer Arzneimittell*, Leipsic, 1824) and his friends, found, in their experiments on themselves, that small doses of iodine increased the secretion of nasal mucus, of saliva, and of urine, and they inferred that the similar effect was produced on the gastric, pancreatic, and biliary secretions. "Iodine," says Lugol, (*Essays*, p. 19) "is a powerful *diuretic*. All the patients using it have informed me that they pass urine copiously." Coindet, however, expressly says that it does not increase the quantity of urine. In some cases in which I carefully watched its effects, I did not find any diuretic effect. Iodine frequently acts as an *emmenagogue*. Coindet, Sablairoles (*Jour. général de Méd.* tom. 97), Brera (quoted by Bayle in his *Bibliothèque de Thérapeutique*, tom. I, p. 129), Magendie (*Formulaire*), and many others, agree on this point; but Dr. Manson (*Medical Researches on the Effects of Iodine*, London, 1825) does not believe that it possesses any emmenagogue powers, further than as a stimulant and tonic to the whole body. In one patient it occasioned so much sickness and disorder of stomach that the menstrual discharge was suppressed altogether. On several occasions iodine has caused *salivation* and soreness of mouth. In the cases noticed by Lugol the patients were males. In the *Medical Gazette*, vol. xvii. for 1836, two instances are mentioned, one by Mr. Winslow (p. 401), the other by Dr. Ely (p. 480). Other cases are referred to in Dr. Cogswell's work. This effect, however, I believe to be rare. De Carro (quoted by Bayle, *op. cit.* p. 50) denies that iodine causes salivation, but says it augments *expectoration*. Lastly, *diaphoresis* is sometimes promoted by iodine.

Two most remarkable effects which have been produced by iodine are *absorption of the mammæ* and *wasting of the testicles*. Of the first of these (absorption of the mammæ) three cases are reported in *Hufeland's Journal* (quoted by Bayle, *op. cit.* p. 162), one of which may be here mentioned. A healthy girl, twenty years of age, took the tincture of iodine during a period of six months, for a bronchocele, of which she became cured; but the breasts were observed to diminish in size, and notwithstanding she ceased to take the remedy, the wasting continued, so that at the end of two years not a vestige of the mammæ remained. Sometimes the breasts waste, though the bronchocele is undiminished. Reichenau (*Christison*, p. 180) relates the case of a female, aged twenty-six, whose breasts began to sink after she had employed iodine for four months, and within four weeks they almost wholly disappeared; yet her goître remained unaffected. With regard to the other effect (wasting of the testicle) I suspect it to be very rare. I have seen iodine administered in some hundreds of cases, and never met with one in which atrophy of either of the breast or testicle occurred. Magendie also says he never saw these effects, though they are said to be frequent in Switzerland.

A disordered condition of the cerebro-spinal system has in several instances been caused by iodine. Thus slight headache and giddiness are not unfrequently brought on. Lugol tells us that, by the use of ioduretted baths, headache, drowsiness, intoxication, and even stupor are produced. Analogous symptoms were observed in some of Dr. Manson's cases; and in one there were convulsive movements.

A specific effect on the skin is sometimes produced by iodine, besides the diaphoresis before alluded to. Thus Dr. C. Vogel (*Rust, Magazin*, Bd. 14, p. 156) gives an account of a lady, twenty-eight years of age, of a yellow complexion, who from the internal employment of the tincture iodine, became suddenly brown, besides suffering with other morbid :nptoms. After some days the skin had the appearance of having been oked! Mr. Stedman (*Medical Gaz.* vol. xv. p. 447) says that in some ·ofulous patients it improves the condition of the hair and scalp.

The rapid emaciation said to have been occasionally produced by line, as well as the beneficial influence of this substance in scrofulous ;eases, and the disappearance of visceral and glandular enlargements der its use, have given rise to an opinion that iodine *stimulates the phatic vessels and glands.* Manson, however, thinks that it exerts no uliar or specific influence over the absorbent system, which only ticipates in the general effects produced on the whole body. And gol asserts, that instead of producing emaciation, it encourages growth l increase of size.

There can be no doubt that the continued use of iodine must e some effect over the general nutrition of the body, and by difying the actions previously performed by the various organs and tems, it may at one time cause the *embonpoint* described by Lugol, l at another may have the reverse effect: in one case it may promote activity of the absorbents, and occasion the removal of tumours of siderable size, in another check ulceration (a process which Mr. Key, he 19th vol. of the *Medico-Chirurgical Transactions,* denies to be one bsorption, but considers to be one of degeneration or disorganization) cause the healing of ulcers.

ome have ascribed to iodine an *aphrodisiac* operation. Kolley (*Journ. plém.* tom. 17, p. 307), a physician at Breslau, who took it for a ichocele, says it had the reverse effect on him.

n some instances, the continued use of iodine has given rise to a rdered state of system, which has been designated *iodism.* The ptoms (termed by Dr. Coindet, *iodic*) are violent vomiting and purging, ı fever, great thirst, palpitation, rapid and extreme emaciation, aps, and small and frequent pulse, occasionally with dry cough, terminating in death. This condition, however, must be a rare occurrence, for it is now hardly ever met with, notwithstand- the frequency and the freedom with which iodine is employed. it has been noticed by Coindet (*op. cit.*), Gairdner (*Essay on the of Iodine*), Zink (*Journ. Complém.* xviii. p. 126), Jahn (quoted by istison, p. 181), and others. The daily experience of almost every titioner proves that the dangers resulting from the use of iodine have ı, to say the least of them, much exaggerated, and we can hardly help ecting that many symptoms which have been ascribed to the injurious ation of this remedy ought to have been referred to other causes; sionally, perhaps, they depended on gastro-enteritis. In some cases, emarkable activity of iodine may have arisen from some idiosyncracy he part of the patient. Dr. Coindet attributes the iodic symptoms ıe *saturation* of the system with iodine—an explanation, to a certain nt, borne out by the results of an experiment made by Dr. Cogswell, which I have before mentioned: I allude now to the detection of ıe in the tissues of an animal five days after he had ceased taking substance.

In very large doses iodine has acted as an irritant poison. In a fatal nce recorded by Zink (*Journ. Compl.* tom. xviii.) the symptoms were ssness, burning heat, palpitations, very frequent pulse, violent priapism, copious diarrhœa, excessive thirst, trembling, emaciation, a occasional syncope. The patient died after six weeks' illness. (another occasion this physician had the opportunity of examining t body after death. In some parts the bowels were highly inflamed, others they exhibited an approach to sphacelation. The liver was v large, and of a pale rose colour.

Such cases, however, are very rare. In many which might be referr to, enormous quantities of iodine have been taken with very slight effec only, or perhaps with no marks of gastric irritation. Thus Dr. Kenned of Glasgow (quoted in Dr. Cogswell's *Essay*), exhibited within eigh days, 953 grains of iodine in the form of tincture: the daily dose was first two grains, but ultimately amounted to 18 grains. The health of t girl appeared to be unaffected by it. It should here be mentioned th the presence of bread, potatoes, sago, arrow-root, tapioca, or other amyl ceous matters, in the stomach, will much diminish the local action iodine, by forming an iodide of starch, which, as will hereafter be me tioned, is a very mild preparation.

Modus Operandi. — That iodine becomes absorbed, when employ either externally or internally, we have indisputable evidence, by detection not only in the blood but in the secretions. Cantu (*Journn. Chimie Méd.* tom. ii. p. 291) has discovered it in the urine, sweat, saliv milk, and blood. In all cases it is found in the state of iodide, hydriodate; from which circumstance he concludes that its influence the body is chemical, and consists in the abstraction of hydrogen. Be nerscheidt (*Journ. de Chim. Méd.* tom. iv. p. 383) examined the serum the blood of a patient who had employed for some time iodine ointmen but he could not detect any trace of iodine. In the crassamentum, how ever, he obtained evidence of its existence, by the blue tint communicat to starch.

Uses.—(*a.*) In *bronchocele.* Of all remedies yet proposed for bro chocele, this has been by far the most successful. Indeed, judgi only from the numerous cases cured by it, and which have been publishe we should almost infer it was a sovereign remedy. However, it is to recollected that of those who have written on the use of iodine in th complaint, some only have published a numerical list of their su cessful and unsuccessful cases. Bayle (*Bibliothèque de Thérapeutiq* tom. 1er, p. 394) has given a summary of those published by Cost Irmenger, Baup, and Manson, from which it appears that of 364 cas treated by iodine, 274 were cured. Dr. Copland (*Dict. of Pract. Me* observes that of several cases of the disease which have come before hi since the introduction of this remedy into practice, "there has not be one which has not either been cured or remarkably relieved by it." much regret, however, that my own experience does not accord with th statement. I have several times seen iodine, given in conjunction wi iodide of potassium, fail in curing bronchocele; and I know others who experience has been similar. Dr. Bardsley (*Hospital Facts and Observ tions*, p. 121) cured only nine, and relieved six, out of thirty cases, wi iodide of potassium. To what circumstance, then, ought we to attribu this variable result? Dr. Copland thinks that where it fails it has be given "in too large and irritating doses, or in an improper form; an without due attention having been paid to certain morbid and constit tional relations of the disease during the treatment."

But, in two or three of the instances before mentioned, I believe the lure did not arise from any of the circumstances alluded to by Dr. Copid, and I am disposed to refer it to some peculiar condition of the nor, or of the constitution. When we consider that the terms *bronocele*, *goître*, and *Derbyshire neck*, are applied to very different conions of the thyroid gland, and that the causes which produce them involved in great obscurity, and may, therefore, be, and indeed obably are, as diversified as the conditions they give rise to, we can sily imagine that while iodine is serviceable in some, it may be useless even injurious in others. Sometimes the bronchocele consists in pertrophy of the substance of the thyroid gland,—that is, this organ is arged, but has a healthy structure. In others, the tumefaction of the nd took place suddenly, and may even disappear as suddenly, from ich it has been inferred that the enlargement depends on an accumuion of blood in the vessels, and an effusion of serum into its tissue. indet mentions a goître which was developed excessively during the t pregnancy of a young female: twelve hours after her accouchement nad entirely disappeared. The same author also relates the circumstance a regiment composed of young recruits, who were almost every man icked with considerable enlargement of the thyroid gland, shortly after ir arrival at Geneva, where they all drank water out of the same pump. their quarters being changed the gland soon regained its natural size every instance. A third class of bronchoceles consists in an enlargent of the thyroid gland from the developement of certain fluid or solid stances in its interior, and which may be contained in cells, or be ltrated through its substance. These accidental productions may be ous, honey-like, gelatinous, fibrous, cartilaginous, or osseous. Lastly, imes the enlarged gland has acquired a scirrhous condition. Now it npossible that all these different conditions can be cured with equal lity by iodine; those having solid deposits are, of course, most difficult get rid of.

Colley, the physician before alluded to, who was himself cured of a ge goître of ten years' standing, says, that for iodine to be useful, the nchocele should not be of too long standing, nor painful to the touch; swelling confined to the thyroid gland, and not of a schirrous or caromatous nature, nor containing any stony or other analogous concres; and that the general health be not disordered by any febrile or ammatory symptoms, or any gastric, hepatic, or intestinal irritation. he swelling be tender to the touch, and have other marks of inflamion, let the usual local antiphlogistic measures precede the employnt of iodine. When this agent is employed we may administer it both ernally and internally. The most effectual method of employing ne externally is that called *endermic*, already described; namely, to ly an ioduretted ointment (usually containing iodide of potassium) to cutis vera, the epidermis being previously removed by a blister. But *epidermic*, or *iatroleptic* method, is more usually followed—that is, ioduretted ointment is rubbed into the affected part, without the lermis being previously removed. On the agency of galvanism in noting the passage of iodine into the system, I have already made e observations (see pp. 55-6).

With respect to the internal use of this substance, some think that the cess depends on the use of small doses largely diluted,—while others consider that as large a quantity of the remedy should be administered as the stomach and general system can bear.

(*b.*) *Scrofula* is another disease for which iodine has been extensive used. Dr. Coindet was, I believe, the first to direct public attention to this remedy in the disease in question. Subsequently, Baup, Gimell, Kolley, Sablairoles, Benaben, Callaway, and others, published cas illustrative of its beneficial effects.—(See Bayle's *Bibliothèque de Théra* tom. i.) Dr. Manson (*op. cit.*) deserves the credit of having first tried on an extensive scale. He treated upwards of eighty cases of scrofu and scrofulous ophthalmia by the internal exhibition of iodine, sometim combined with its external employment; and in a large proportion cases, where the use of the medicine was persevered in, the disease wa either cured or ameliorated, the general health being also improve Three memoirs on the effects of iodine in scrofula have been subsequentl published by Lugol, physician to the Hospital St. Louis, serving to con firm the opinions already entertained of its efficacy. From the first me moir it appears, that in seventeen months—namely, from August, 1827, t December, 1828—109 scrofulous patients were treated by iodine only, and that of these 36 were completely cured, and 30 relieved; in 4 case the treatment was ineffectual, and 39 cases were under treatment at th time of the report made by Serres, Magendie, and Dumeril, to the Aca demie Royale des Sciences. In his illustrative cases we find glandula swellings, scrofulous ophthalmia, abscesses, ulcers, and diseases of th bones, were beneficially treated by it. Lugol employs iodine internall and externally: for internal administration, he prefers iodine dissolved i water by means of iodide of potassium, given either in the form of *drop* or largely diluted, under the form of what he calls *ioduretted minera water*, presently to be described. His external treatment is of two kinds one for the purpose of obtaining local effects only, the other for procur ing constitutional or general effects. His local external treatment con sists in employing ointments or solutions of iodine: the *ointments* ar made either with iodine and iodide of potassium, or with the protiodid of mercury; the *solutions* are of iodine and iodide of potassium in water and according to their strength are denominated caustic, rubefacient, stimulant: the rubefacient solution is employed in making cataplasm and local baths. His external general treatment consists in the employ ment of *ioduretted baths*. Of these different preparations more will be said hereafter.

The successful results obtained by Lugol in the treatment of this dis ease cannot, I think, in many instances, be referred to iodine solely. Man of the patients were kept several months (some as much as a year) unde treatment in the hospital, where every attention was paid to the improve ment of their general health by warm clothing, good diet, the use of vapour and sulphureous baths, &c.; means which of themselves are suffi cient to ameliorate, if not cure, many of the scrofulous conditions befor alluded to. Whether it be to the absence of these supplementary mean of diet and regimen, or to some other cause, I know not, but most prac titioners will, I think, admit that they cannot obtain by the use of iodin the same successful results which Lugol is said to have met with, thoug in a large number of cases this agent has been found a most usefu remedy.

(*c.*) Iodine has been eminently successful when employed *in chroni* *'iseases of various organs, especially those accompanied with induration nd enlargement.* By some inexplicable influence, it sometimes not only uts a stop to the further progress of disease, but apparently restores the art to its normal state; hence it is placed by some pharmacologists (as 'ogt and Sundelin) among the *resolventia.* It is usually given with the iew of exciting the action of the absorbents, but its influence is not mited to this set of vessels: it exercises a controlling and modifying ifluence over the blood-vessels of the affected part, and is in the true ense of the word an *alterative.*

In chronic inflammation, induration, and enlargement of the liver, fter antiphlogistic measures have been adopted, the two most important nd probable means of relief are iodine and mercury, which may be used ither separately or conjointly. If the disease admit of a cure these are ie agents most likely to effect it. Iodine, indeed, has been supposed to ossess some specific power of influencing the liver, not only from its fficacy in alleviating or curing certain diseases of this organ, but also om the effects of an over dose. In one case pain and induration of the ver were brought on;—and in another, which terminated fatally, this rgan was found to be enlarged, and of a pale rose colour.—(Christison, *'reatise on Poisons*, pp. 180-1.)

Several cases of enlarged spleens relieved or cured by iodine have been ublished.

In chronic diseases of the uterus, accompanied with induration and nlargement, iodine has been most successfully employed. In 1828 a markable instance was published by Dr. Thetford (*Trans. of the King nd Queen's College of Phys.* Ireland, vol. v). The uterus was of osseous ardness, and of so considerable a size as nearly to fill the whole of the elvis: yet in six weeks the disease had given way to the use of iodine, id the catamenia were restored. In the *Guy's Hospital Reports*, No. I. 336, is an account by Dr. Ashwell of seven cases of "hard tumours" of ie uterus successfully treated by the use of iodine, in conjunction with casional depletion and regulated and mild diet. Besides the internal se of iodine, this substance was employed in the form of ointment (comosed of iodine gr. xv. iodide potassium ℈ij. spermaceti oint. ℥iss). of which portion (about the size of a nutmeg) was introduced into the vagina id rubbed into the affected cervix for ten or twelve minutes every night. may be applied by the finger, or by a camel-hair pencil, or sponge ounted on a slender piece of cane. The average time in which resoluon of the induration is accomplished varies, according to Dr. Ashwell, om eight to sixteen weeks. "In hard tumors of the walls or cavity of e uterus, resolution, or disappearance, is scarcely to be expected;" but hard tumors of the cervix, and indurated puckerings of the edges of the (conditions which most frequently terminate in ulceration) may be elted down and cured by the iodine."—(pp. 152-3.)

In ovarian tumors iodine has been found serviceable. In the chronic ammary tumor, described by Sir A. Cooper, I have seen it give great lief—alleviating pain and keeping the disease in check. In indurated ilargements of the parotid, prostate, and lymphatic glands, several sucssful cases of its use have been published.

(*d.*) As an *emmenagogue* iodine has been recommended by Coindet, rera, Sablairoles, Magendie, and others. The last-mentioned writer tells us that on one occasion he gave it to a young lady, whose propriety of conduct he had no reason to doubt, and that she miscarried after using it for three weeks. I have known it given for a bronchocele during pregnancy without having the least obvious influence over the uterus.

(*e.*) In *gonorrhœa* and *leucorrhœa* it has been employed with success after the inflammatory symptoms have subsided.

(*f.*) *Inhalation* of *iodine vapour* has been used in phthisis and chronic bronchitis. In the first of these diseases it has been recommended by Berton, Sir James Murray, and Sir Charles Scudamore. I have repeatedly tried it in this as well as in other chronic pulmonary complaints but never with the least benefit. The apparatus for inhaling it has been already described (see p. 51.) The liquid employed is a solution of iodnretted iodide of potassium, to which Sir C. Scudamore adds the tincture of conium.—(*Med. Gaz.* vol. viii. p. 157.)

(*g.*) *Chronic diseases of the nervous system*, such as paralysis and chorea, have been successfully treated by iodine, by Dr. Manson.

(*h.*) In some forms of *the venereal disease*, iodine has been found a most serviceable remedy. Thus Rochond (quoted by Bayle, *op. cit.*) employed it, after the usual antiphlogistic measures, to remove buboes. De Salle cured chronic venereal affections of the testicles with it. Mr. Mayo (*Med. Gaz.* vol xi. p. 249), has pointed out its efficacy in certain disorders which are the consequences of syphilis, such as emaciation of the frame, with ulcers of the skin ; ulcerated throat ; and inflammation of the bones or periosteum,—occurring in patients to whom mercury has been given.

(*i.*) *In checking or controlling the ulcerative process*, iodine is, according to Mr. Key (*Medico-Chirurg. Trans.* vol. 19), one of the most powerful remedies we possess. "The most active phagedenic ulcers, that threaten the destruction of parts, are often found to yield in a surprising manner to the influence of this medicine, and to put on a healthy granulating appearance."

(*k.*) Besides the diseases already mentioned there are many others in which iodine has been used with considerable advantage: for example—*chronic skin diseases*, as lepra, psoriasis, &c. (Cogswell, *Essay*, p. 81):—*dropsies* (*ibid*) ; *in old non-united fractures*, to promote the deposition of ossific matter (*Med. Gaz.* vol. vi. p. 512, 1830) ; *in chronic rheumatism*; but in this disease iodide of potassium is more frequently employed. *As an antidote in poisoning* by *strychnia*, *brucia*, and *veratria*, iodine has been recommended by M. Donne (*Journ. de Chim. Méd.* tom. v. p. 494), because the compound formed by the union of these alkalies with iodine is less active than the alkalies themselves ; *as an injection for the cure of hydrocele*, Velpeau (*Med. Gaz.* vol. xx. p. 90), has employed a mixture of the tincture of iodine with water, in the proportion of from one to two drachms of the tincture to an ounce of water : of this mixture from one to four ounces are to be injected and immediately withdrawn ; lastly, to *check mercurial salivation* iodine has been successfully used.—(*Med. Gaz.* vol. xiii. p. 32, and vol. xx. p. 144.)

Administration.—Iodine is rarely used alone, but generally in combination with the iodide of potassium: formulæ for the conjoint exhibition of these I shall give when describing the iodide: at present I shall confine myself to those preparations into which iodine alone enters.

Before noticing these, however, it may not be amiss to mention that th the view of preventing gastric irritation, we should avoid giving line on an empty stomach. If administered immediately after a meal topical action of this substance is considerably diminished. This is ecially the case if potatoes, bread-pudding, sago, tapioca, or other ylaceous substances, have been taken, since an iodide of starch (which ssesses very slight local influence) is immediately formed in the mach.

(a.) *In substance*, iodine has been given in the form of pills, in doses half a grain, gradually increased. But this mode of exhibition is now ely resorted to.

(b.) *Tincture of iodine.*—This is a simple solution of iodine in rectified rit, and may be made of various strengths. In the Dublin Pharmaco- ia the proportions are two scruples of iodine to one ounce (by weight) spirit. It is, however, an objectionable preparation: for, in the first ce, by keeping, part of the iodine is deposited in a crystalline form, so t the strength is apt to vary; secondly, it undergoes decomposition, ecially when exposed to solar light; the iodine abstracts hydrogen m the spirit, and forms hydriodic acid, which, acting on some spirit, ms a little hydriodic ether. These are not the only objections: when led to water, the iodine is deposited in a solid state, and may thus tate the stomach. It is used both externally and internally: exter- ly it may be mixed with the soap liniment, and internally it is exhi- ed in doses of from five or six drops to half a drachm. Each drachm ntains five grains of iodine. The best mode of exhibiting it, to cover flavour, is in sherry wine. Where this is inadmissible, sugared water y be employed.

c.) *Combined with starch*, iodine has been given in enormous quantities Dr. Buchanan (*Med Gaz.* vol. xviii. p. 515.) His formula for mak- the iodide of starch is the following:—"Rub 24 grs. of iodine with a le water, and gradually add one ounce of finely-powdered starch: dry a gentle heat, and preserve the powder in a well-stoppered vessel." persons not labouring under any dyspeptic ailment or constitutional icacy of habit, Dr. Buchanan commences with half an ounce for a e, and increases this to an ounce three times a day,—equivalent to 72 ins daily. It frequently caused costiveness, attended with griping ns of the bowels and pale-coloured evacuation. In some cases, but ely, it produced purging. Though starch diminishes or nearly destroys irritant properties of iodine the prudent practitioner will commence h small doses, (ʒss.), of the iodide, and carefully watch the effect of dually and cautiously increased doses. I have found the colour of s preparation objected to by patients.

d.) *Combined with hydrogen*, forming *hydriodic acid*, Dr. Buchanan . *cit.*) has given iodine in very large quantities. His formula for mak- this acid is the following:—"Dissolve 264 grs. of tartaric acid in 1½ nces of distilled water, and to this add a solution of 330 grs. of iodide potassium also dissolved in 1½ ounces of distilled water. When the artrate of potash has subsided, strain, and, to the strained liquor, add ficient water to make fifty drachms (℥vj. ʒij.) of solution." Of this ution Dr. Buchanan has given as much as an ounce three times a day, two drachms of iodine daily: and he regards half an ounce as the ordinary dose. But I would advise it to be given at first in very much smaller quantity (ʒss.), and to be gradually increased.

(*c.*) *Ointment of iodine.*—This is composed, according to the Dublin Pharmaeopœia, of a seruple of iodine to an ounce of lard. If this be too irritating, the quantity of lard must be increased. The eolour of the eompound is brown, but, by keeping, it becomes paler; and hence should always be made when wanted. It is employed as a local application to serofulous tumors, bronchoeele, &c.

Antidotes.—In the event of poisoning by iodine, or its tineture, the first objeet is to evacuate the poison from the stomach. For this purpose, assist the vomitings by the copious use of tepid demuleent liquids—especially by those containing amylaceous matter; as starch, wheaten flour, sago, or arrow-root, which should be boiled in water, and exhibited freely. The efficacy of these agents depends on the iodide of starch which they form, possessing very little local action. In their absence other demulcents, such as milk, eggs beat up with water, or even tepid water merely, may be given to promote vomiting. Magnesia is also reeommended. Opiates have been found useful. Of course the gastro-enteritis must be combated by the usual means.

Order IV. Bromine.

Bromin'ium.—Bro'mine.

History and Etymology.—This substance was discovered by M. Balard, of Montpelier, in 1826. He at first termed it *muride* (from *muria, brine*), in allusion to the substance from whence he procured it; but, at the suggestion of Gay-Lussac, he altered this name to that of *brome*, or *bromine*, (from *βρῶμος, a stench* or *fetor*,) on aeeount of its unpleasant odour.

Natural History.—It is found in both kingdoms of nature, but never in the free state.

(*a.*) *In the inorganized kingdom.*—Hollander detected it in an ore of zinc, and Coehler reeognised it in Silesian cadmium (Gmelin, *Handbuch der Chemie.*) It exists in sea water and many mineral waters, in combination with either magnesium or sodium, or sometimes with both. Thus it has been found in the waters of the Mediterranean, the Baltic, the North Sea, the Frith of Forth, the Dead Sea, many of the brine springs of Europe and America (as those of Middlewich, Nantwich, Ashby-de-la-Zouch, and Shirleywich, in England), and in many other mineral springs of Europe and America (as the Pittville spring at Cheltenham, the water of Llandridod and of Bonnington.) It has been justly observed by Dr. Daubeny (*Phil. Trans.* 1830), that the detection of bromine in brine-springs is a fact interesting in a geological point of view, as tending to identify the product of the ancient seas, in their most minute particulars, with those of the present ocean.

(*b.*) *In the organized kingdom.*—Bromine has been found in the sea-plants of the Mediterranean, and in the mother-waters of Kelp. It has likewise been detected in marine animals, and in the sea-sponge (*Spongia officinalis*), in the stony concretion found in this animal, and in the ashes of the *Janthina violacea*, one of the gasteropodous mollusca.

Preparation.—Bromine is usually procured from *bittern* (the mother quor of sea-water, from which the chloride of sodium has been sepa-rted by crystallization). A current of chlorine gas is passed through iis liquid in order to decompose the bromide of magnesium, and thereby) form chloride of magnesium and set free the bromine, as shown by this iagram :—

INGREDIENTS USED.		PRODUCTS.
eq. Bromide Magne-sium 90	1 eq. Bromine 78	1 eq. Bromine 78
	1 eq. Magn^{m}. 12	
eq. Chlorine 36		1 eq. Chloride Magn^{m}. 48

The liquid through which the bromine is diffused is then to be strongly gitated with ether, by which an etherial solution of this substance is btained, which floats on the water. To the decanted etherial solution ld caustic potash : six equivalents, or 468 parts of bromine, react on six quivalents or 288 parts of potash, and produce five equivalents or 600 arts of bromide of potassium, and one equivalent or 168 parts of bro-ate of potash, as shown by the following diagram :—

INGREDIENTS USED.			PRODUCTS.
eq. Bromine. 390			5 eq. Brom^{de}. Pot^{m}. 590
eq. Bromine. 78			
eq. Potash 240	5 eq. Pot^{m}. 200		
	5 eq. Ox. . 40	1 eq. Bromic acid 118	
q. Potash 48			1 eq. Brom^{te}. Pot^{h}. 166

In order to convert the bromate of potash into bromide of potassium e mass is exposed to a dull red heat, by which six equivalents or 48 arts of oxygen are evolved. The bromide of potassium is then dis-lled with sulphuric acid and binoxide of manganese, and the disen-ged bromine condensed in water. One equivalent or 118 parts of the omide react on one equivalent or 44 parts of the binoxide of manga-se, and on two equivalents or 80 parts of sulphuric acid; and by this iction one equivalent or 78 parts of bromine, one equivalent or 88 rts of sulphate of potash, and one equivalent or 76 parts of the sul-iate of the protoxide of manganese, are produced.

INGREDIENTS USED.			PRODUCTS.
eq. Brom^{de}. Pot^{m}. 118	1 eq. Brom. 78		1 eq. Bromine 78
	1 eq. Pot^{m}. 40	1 eq. Potash 48	
eq. Binox. Mang. 44	1 eq. Oxyg. 8		
	1 eq. Protox. Mang. 36		
Sulphuric Acid 40			1 eq. Sulph. Potash . 88
Sulphuric Acid 40			1 eq. Protosu^{te}. Mang. 76

PROPERTIES.—At ordinary temperatures bromine is a dark-coloured ry volatile liquid, which, seen by reflected light, appears blackish red; it viewed in thin layers, by transmitted light, is hyacinth red. Its odour strong and unpleasant, its taste acrid. Its sp. gr. is about 3; water ing 1. When exposed to a cold of —4° F. it is a yellowish brown, ittle crystalline solid. At ordinary temperatures liquid bromine olves ruddy vapours, so that a few drops put into a small vessel imme-ately fills it with the vapour of bromine. At 116½ F. bromine boils. ie vapour is not combustible: a lighted taper plunged into it is imme-ately extinguished, but before the flame goes out it becomes red at the per and green at the lower part. Antimony or arsenicum take fire ien dropped into liquid bromine: when potassium or phosphorus is opped in, a violent explosion takes place. Bromine is a nonconductor electricity: it is a bleaching agent: it dissolves very slightly only in water, more so in alcohol, and much more so in sulphuric ether. It communicates a fine orange colour to starch.

Characteristics.—Liquid bromine is recognised by its colour, odour, volatility, and the colour of its vapour. To these characters must be added its powerful action on antimony, arsenicum, and potassium, before mentioned, its dissolving in ether, forming a hyacinth red liquid, and the orange colour which it communicates to starch. It causes a yellowish white precipitate with a solution of the nitrate of silver. The only substances which resemble in their external appearance liquid bromine, are the terchloride of chromium and the chloride of iodine.

The soluble *bromides* cause white precipitates with the nitrate of silver, acetate of lead, and protonitrate of mercury. The precipitates are bromides of the repective metals. Bromide of silver is yellowish white, clotty, insoluble in boiling nitric acid, and in a weak solution of ammonia (by which it is distinguished from chloride of silver), but dissolves in a concentrated solution of this alkali. Heated with sulphuric acid it evolves vapours of bromine. If a few drops of a solution of chlorine be added to a solution of a bromide, and then a little sulphuric ether, we obtain an ethereal solution of bromine of a hyacinth red colour, which floats on the water.

The *bromates* when heated evolve oxygen, and become bromides. The bromates cause white precipitates with the nitrate of silver, the protosalts of mercury, and with strong solutions of the acetate of lead. Bromate of silver is not soluble in nitric acid, but dissolves readily in solution of ammonia. If a few drops of hydrochloric acid be added to a bromate, and then some ether, a yellow or red ethereal solution of brome is obtained.

Physiological effects.—(*a.*) *On vegetables.*—I am unacquainted with any experiments made with bromine on plants.

(*b.*) *On animals generally.*—The action of bromine on animals has been examined by Franz, (quoted by Wibmer, *Die Wirkung d. Arzneim.* 1er. Bd. p. 433; also in *Journ. Chim. Méd.* t. v. p. 540;) by Barthez, by Butske, and by Dieffenbach (Christison, *on Poisons.* p. 187.) The animals experimented on were leeches, fishes, birds, horses, rabbits, and dogs. But notwithstanding the numerous experiments which have been performed, nothing satisfactory has been made out with respect to its mode of operation, beyond the fact of its being a local irritant and caustic, and, therefore, when swallowed, giving rise to gastro-enteritis. Injected into the jugular vein it coagulates the blood, and causes immediate death, preceded by tetanic convulsions. No positive inferences can be drawn as to the specific influence of bromine on any organs of the body. Some of the symptoms (such as dilated pupil, insensibility, and convulsions) would seem to indicate a specific affection on the brain. Franz frequently observed inflammation of the liver.

(*c.*) *On man.*—Bromine stains the cuticle yellowish brown, and by continued application acts as an irritant. Its vapour is very irritating when inhaled, or applied to the mucous lining of the nose or to the conjunctiva. Franz, by breathing the vapour, had violent cough, and a feeling of suffocation followed by headache. Butske swallowed a drop and a half of bromine in half an ounce of water, and experienced heat in the mouth, œsophagus, and stomach, followed by colicky pains.

'wo drops occasioned nausea, hiccup, and increased secretion of ucus.

The constitutional effects resulting from the continued use of bromine ave not been determined. They are probably analogous to those of odine.

Hitherto no cases of poisoning with it in the human subject have been een.

Uses.—It seems to possess the same therapeutic influence as iodine, nd has been administered in bronchocele, in scrofula, in tumors, in menorrhœa, and against hypertrophy of the ventricles. It is usually egarded as possessing more activity than iodine.

Administration.—It may be administered dissolved in water. An queous solution, composed of one part by weight of bromine and forty arts of water, may be given in doses of five or six drops properly diluted nd flavoured with syrup. This solution has also been used as an exter-al agent in lotions.

The bromides of potassium, iron, and mercury, have been employed in edicine, and will be described hereafter. An ointment containing romide of potassium and liquid bromine has been used, and will be oticed when speaking of the bromide.

Antidotes.—The treatment of cases of poisoning by bromine should e the same as for poisoning by iodine. Barthez has recommended agnesia as an antidote.

Order 5.—Hydrogen, and its Compounds with Oxygen and Chlorine.

Hydrogé'nium.—Hy'drogen.

History and Synonymes.—Cavendish may be considered as the real iscoverer of hydrogen, though it must have been occasionally procured, d some of its properties known, previously. He termed it *inflammable ir.* Lavoisier called it hydrogen (from ὕδωρ, *water*, and γεννάω, I *beget r produce*), because it is the radicle or base of water.

Natural History.—It is found in both kingdoms of nature, but lways in combination.

(*a.*) *In the inorganized kingdom.*—Next to oxygen, it may be regarded s the most important constituent of the terraqueous globe. It consti-tes 11·1 per cent. by weight of water, presently to be noticed. It is an ssential constituent of some minerals (as coal and sal ammoniac) in hich it does not exist as an element of water. Lastly, it is evolved from lcanoes or from fissures in the earth, in combination with carbon, sul-hur, chlorine or nitrogen, under the forms of light carburetted hydrogen, ulphuretted hydrogen, hydrochloric acid, and ammonia.

(*b.*) *In the organized kingdom*—Hydrogen is an essential constituent f all organized beings (animals and vegetables), either combined with xygen, to form water, or otherwise. Certain fungi exhale both night nd day hydrogen gas (Decandolle, *Phys. Vég.* tom. i. p. 459.)

Preparation.—Hydrogen is always procured by the decomposition of ater, but this may be effected in three ways—by the action of electricity, of heat and iron, or of sulphuric acid and a metal (zinc or iron). The latter method only will require notice here.

Add some granulated zinc to a mixture of 1 part sulphuric acid and 5 or 6 parts of water by measure. One equivalent or 32 parts of zinc decomposes one equivalent or 9 parts of water, and unite with one equivalent or 8 parts of the oxygen, forming one equivalent or 40 parts of the oxide of zinc, while an equivalent or 1 part of hydrogen is evolved from the water. This equivalent of oxide of zinc combines with an equivalent or 40 parts of sulphuric acid, and forms one equivalent or 80 parts of the sulphate of zinc.

INGREDIENTS USED.			PRODUCTS.
1 eq. Water . 9	1 eq. Hydrogen 1		1 eq. Hydrogen . 1
	1 eq. Oxygen . . 8	1 eq. Oxide Zinc 40	
1 eq. Zinc 32			
1 eq. Sulphuric Acid 40			1 eq. Sulp^{te}. Zinc 80

It is remarkable that zinc alone does not decompose water, but sulphuric acid enables it to do so.

Properties.—Hydrogen is a colourless, tasteless, and, when pure, odourless gas. Its sp. gr. is 0·0694,—so that it is 14·4 times lighter than atmospheric air. Its refractive power is very high. It is combustible, burning in atmospheric air or oxygen gas with a pale flame, and forming water. It is not a supporter of combustion. It is a constituent of some powerful acids, as the hydrochloric, and of a strong base, ammonia. Its atomic weight or equivalent is 1. Its atomic volume is also 1.

Characteristics.—It is recognised by its combustibility, the pale colour of its flame, its not supporting combustion, and by its yielding when exploded with half its volume of oxygen, water only.

1 eq. Hydr. =1	1 eq. Oxyg.=8	forming 1 *eq. Water*=9.

Physiological Effects. (*a.*) *On vegetables.*—Plants which are deprived of green or foliaceous parts, or which possess them in small quantity only, cannot vegetate in hydrogen gas: thus seeds will not germinate in this gas: but vegetables which are abundantly provided with these parts vegetate for an indefinite time in hydrogen (Saussure, *Recherches Chém. sur la Végét.* pp. 195 and 209). Applied to the roots of plants in the form of gas, it is injurious (*ibid.* p. 105,) but an aqueous solution of it seems to be inert (Decandolle, *Physiol. Végét.* t. iii. p. 1360). It has been said that when plants are made to vegetate in the dark their etiolation is much diminished, if hydrogen gas be mixed with the air around them; and in proof of this Humboldt has mentioned several green plants found in the Freyberg mines (Thomson's *Syst. of Chemistry*, 6th ed. p. 347-8.)

(*b.*) *On animals generally.*—Injected into the jugular vein of a dog hydrogen produces immediate death, probably from its mechanical effects in obstructing the circulation and respiration (Nysten, *Recherches*, p. 10.)

(*c.*) *On man.*—It may be breathed several times without any injurious effects. Scheele made twenty inspirations without inconvenience. Pilatre de Rozier frequently repeated the same experiment, and to shew that his lungs contained very little atmospheric air he applied his mouth to a tube, blew out the air, and fired it, so that he appeared to breathe flame. If much atmospheric air had been present detonation must have taken ıce in his lungs (Beddoes, *New Method of treating Pulmonary Consump-n*, p. 44). If we speak while the chest is filled with hydrogen, a narkable alteration is perceived in the tone of the voice, which becomes fter, shriller, and even squeaking. That this effect is, in part at least, not wholly, physical, is shewn by the fact that wind instruments (as flute, pitchpipe, and organ) have their tones altered when played th this gas. The conclusion which has been drawn by several expe-nenters as to the effects of breathing hydrogen is, that this gas ssesses no positively injurious properties, but acts merely by excluding ygen.

Uses.—(*a*). In *pulmonary consumption* Dr. Beddoes recommended in-lations of a mixture of atmospheric air and hydrogen gas, on the ound that in this disease the system was hyperoxygenised. The in-lation was continued for about fifteen minutes, and repeated several nes in the day (*New Method of treating Pulmonary Consumption*). genhousz fancied that it had a soothing effect when applied to wounds d ulcers.

(*b*.) In *rheumatism and paralysis* it has been used by Reuss as a olvent.

(*c*.) A *flame of hydrogen* has been employed in Italy as a cautery, to p caries of the teeth (*Dict. Mat. Méd.* par Merat et De Lens).

(*d*.) *Hydrogen water* (an aqueous solution, prepared by artificial pres-re) has been employed in diabetes (*ibid*).

A'qua.—Water.

History.—The ancients regarded water as an elementary substance, d as a constituent of most other bodies. This opinion, apparently pported by numerous facts, was held until the middle of the last cen-y, when the Hon. Mr. Cavendish proved that this liquid was a com-und of oxygen and hydrogen. It is, however, only doing justice to Watt to say, that he had previously inferred this to be the composition water, but was deterred from publishing his opinion in consequence of ne of Dr. Priestley's experiments being apparently opposed to it.

Natural History.—(*a*.) *In the inorganized kingdom.* Water exists the atmosphere; forms seas, lakes, and rivers; it is mechanically disse-nated among rocks; and, lastly, it constitutes an essential part of some nerals.—*In the atmosphere* it is found in two states: as a vapour hich makes about one-seventieth by volume, or one one-hundredth by ight, of the atmosphere) it is supposed to be the cause of the blue our to the sky; and, in a vesicular form, it constitutes the clouds. rrestrial water forms about three-fourths of the surface of the terra-eous globe. The average depth of the ocean is calculated at between o or three miles. Now, as the height of dry land above the surface of sea is less than two miles, it is evident, that if the present dry land re distributed over the bottom of the ocean, the surface of the globe uld present a mass of waters a mile in depth. On the supposition t the mean depth of the sea is not greater than the fourth part of a le, the solid contents of the ocean would be 32,058,939$\frac{3}{4}$ cubic miles homson's *System of Chemistry*, 6th ed. vol. iii. p. 195). The quantity water disseminated through rocks must be, in the aggregate, very nsiderable, although it is impossible to form any correct estimate of it.

Water enters into the composition of many minerals, either as *water crystallization*, or combined as a *hydrate*.

(*b*.) *In the organized kingdom*, water is an essential constituent vegetables and animals.

Preparation.—Absolutely pure water may be procured by combinin its elements. For all practical purposes it is obtained sufficiently pu by the distillation of common water. But water which has been re peatedly distilled gives traces of acid and alkali when examined by th agency of galvanic electricity. Distilled water remains unchanged o the addition of any of the following substances:—solutions of the causti alkalies, lime water, oxalic acid, the barytic salts, nitrate of silver, an solution of soap. If any turbidness, milkiness, or precipitate, be occ sioned by any of the above, we may infer the existence of some impuri in the water. But the most delicate test of the purity of water is ga vanism, as before mentioned. The purest natural water is snow and rai water; then follow river, spring, and well waters.

Properties.—Pure water has the following properties:—at ordina temperatures it is a transparent liquid, usually described as being bot odourless and colourless; but it is well known that the camel can sce water at a considerable distance, so that to this animal it is odorous and as regards its colour, we know that all large masses of water have bluish-green colour, though this is usually ascribed to the presence o foreign matters. When submitted to a compressing force equal t 30,000 lbs. on the square inch, 14 volumes of this liquid are condense into 13 volumes; so that it is elastic. A cubic inch of water, at 60° F weighs 255·5 grains; so that this fluid is about 815 times heavier tha atmospheric air: but being the standard to which the gravities of solid and liquids are referred, its specific weight is usually said to be 1·. At temperature of 32°, it crystallizes, and in so doing expands. The funda mental form of crystallized water (ice) is the rhombohedron. Water eva porates at all temperatures, but at 212° boils, and is converted into stean whose bulk is about 1700 times that of water, and whose sp. gr. is 0·62 (that of hydrogen being 1). Water unites with both acids and base but without destroying their acid or basic properties. Thus the crysta lized vegetable acids, tartaric, citric, and oxalic, are atomic combination of water with acids. Potassa fusa and slacked lime may be instanced a compounds of water and basic substances: these are called *hydrate* It is a chemical constituent of some crystallized salts; for exampl alum, sulphate of soda, and sulphate of magnesia. Here it exists a *water of crystallizatian*. It rapidly absorbs some gases—as fluoride o boron, ammonia, &c. It is neither combustible nor a supporter of com bustion.

Characteristics.—In the liquid state it is recognized by being vola tile, tasteless, odourless, neither acid nor alkaline, and not combustibl nor a supporter of combustion: it is miscible with alcohol, but not wit the fixed oils; if potassium be thrown on it in the open air, the meta takes fire. Lastly, water may be decomposed into oxygen and hydroge by the galvanic agency. The most delicate test of aqueous vapour in any gas, is fluoride of boron (commonly called fluoboric acid gas), whic produces white fumes with it.

Composition.—The composition of water is determined both by analysis and synthesis. If this liquid be submitted to the influce of a galvanic battery, it is decomposed into two gases—mely, one volume of oxygen, and two volumes of hydrogen. These gases, in the proportions just mentioned, may be made to recombine, and form water, by heat, electricity, or spongy platinum.

1 eq. Hydrog. = 1 | 1 eq. Oxyg. = 8 = 1eq. Steam = 9

	Eq. or At.	Eq. Wt.	Per Cent.	Berz.&Dulong.
drogen	1	1	11·11	11·1
ygen	1	8	88·88	88·9
ter	1	9	100·00	100·0

	Vol.	Sp. Gr.
Hydrogen gas	1	0·0694
Oxygen gas	0·5	0·5555
Aqueous vapour	1	0·6249

PHYSIOLOGICAL EFFECTS.—Water is a vital stimulus; that is, it is one the external conditions essential for the manifestation of life. It con-utes four-fifths of the weight of the tissues, and is the source of their ysical properties, extensibility and flexibility. Considered in a *diete-il* point of view, it serves at least three important purposes in the mal economy: namely, it repairs the loss of the aqueous part of the od, caused by the action of the secreting and exhaling organs; ondly, it is a solvent of various alimentary substances, and, therefore, ists the stomach in the act of digestion, though, if taken in very large ntities, it may have an opposite effect, by diluting the gastric juice; dly, it is probably a nutritive agent, that is, it assists in the formation he solid parts of the body.

n a *medicinal* point of view, the physiological effects of water are h modified by its temperature.

1.) *Effects of tepid water.*—Water moderately warm, and which her cools nor heats the body, acts locally as an emollient, softening relaxing the various tissues to which it is applied. When swallowed lays thirst, becomes absorbed, mixes with, and thereby attenuates, the od, and promotes exhalation and secretion, especially of the watery ls. Administered in large quantities it excites vomiting. The con-ed excessive use of water has an enfeebling effect on the system, both he relaxing influence on the alimentary canal and by the excessive etion which it gives rise to.

njected into the veins in moderate quantities, tepid water has no rious effects; it quickens the pulse and respiration, and increases etion and exhalation. Large quantities cause difficulty of breathing an apoplectic condition. Thrown with force into the carotid artery ills by its mechanical effect on the brain. I have already (p. 23) e some observations on the action of water on the sanguineous ules out of the body.

.) *Effects of ice, snow, and ice-cold water.*—The temperature of these its is not higher than 32° F. When brought in contact with a living , they produce two series of effects—the first of which may be deno-ated *direct, primary,* or *immediate;* while the second may be termed *ect, secondary,* or *mediate,* since they are developed by the vital ons, after the cold agent has ceased to act.

Of the primary effects.—When ice is applied to the body, it racts heat, causes pain, reduces the volume of the part, and diminishes vital action; and, if applied for a sufficient period, occasions mortification—an effect which is hastened by the previously weakened condition of the part. If applied to a large surface of the body, and for a sufficient length of time, the processes of secretion, circulation, and respiration, are checked, and stupefaction, followed by death, ensues.

When taken *internally*, the sensation of cold which it produces is not so obvious as that occasioned by its external application, and the effect is more temporary, from the greater heat of the internal parts, by which the ice is sooner melted, and the resulting liquid quickly raised to the temperature of the body. If, however, it be taken in large quantity, the effects are of the same general kind as those already described; namely, a sensation of cold in the epigastrium, sometimes attended with shivering; diminished frequency of pulse; temporary contraction of the alimentary canal; diminution of irritability, and of secretion. Employed in small quantities, these effects are not at all perceived, or are only momentary; and the second stage, or that of reaction, almost immediately follows. Baglivi (quoted by Wibmer) found that the injection of four ounces of cold water into the jugular vein of a dog caused shivering of the whole body.

β. *Secondary effects.*—When the application of cold is temporary, more especially if the subject be young and robust, reaction follows the removal of the cold agent. The vascular action of the part is increased, the pulse becomes full and more frequent, and the animal heat is restored to its proper degree, or is even increased beyond its natural standard. These effects, more or less modified, are observed both from the internal and external employment of ice. Thus, after the internal use of it, a feeling of warmth at the epigastrium soon succeeds that of cold, and this extends shortly over the whole body; the secretions of the alimentary canal, of the kidneys, and of the skin, are increased; and the circulation is accelerated. Sometimes these secondary effects are attended with those of a morbid character: thus, inflammation of the stomach has been brought on by the employment of ice.

γ. *Effects of hot, but not scalding, water.*—Hot, but not scalding water increases the temperature and volume of living parts, relaxes the tissues, and augments vital activity. Applied to the skin it causes rubefaction.

δ. *Effects of boiling water and steam.*—Both of these are local irritants, and, if sufficiently long applied, caustics, giving rise to extensive and deep eschars. Steam contains more specific heat than boiling water, but its conducting power is less than the latter.

Uses.—These may be subdivided into internal and external.—1. *Internal.* (*a.*) *Of ice and ice-cold water.*—Sometimes we administer ice internally, for the purpose of obtaining its primary effects; thus, in hæmorrhage from the stomach we use it for the purpose of causing contraction of the vessels of the gastric surface, and thereby of checking or stopping sanguineous exhalation. So also in violent pulmonary, or bronchial, or nasal hæmorrhage, ice-cold water, taken into the stomach, has been found beneficial. In most cases, however, we use it on account of its secondary effects. Thus, in relaxed and atonic conditions of the stomach—in dyspepsia and cardialgia, it is employed to check vomiting, and to allay spasmodic pain. In those forms of fever denominated

nated putrid, the internal use of small quantities of ice is sometimes ghly serviceable.

(*b*.) *Of cold water.* α. *Taken into the stomach.*—Cold water was em- oyed as a drink in fevers in the time of Hippocrates, who, as well as lsus, Galen, and other ancient writers, strongly recommended its use. lsus, in speaking of ardent fever, says, "Cum vero in summo incre- nto morbus est, utique non ante quartum diem, magna sit antecedente, gida aqua copiose præstanda est, ut bibat etiam ultra satietatem."

Cold water constitutes the *febrifugum magnum* of Dr. Hancock. We indebted to Dr. Currie for examining the circumstances under which exhibition is proper. According to him, it is inadmissible during the d or sweating stage of fever, but may be employed with safety and vantage when the skin is dry and burning. In other words, the regu- ions for its administration are precisely the same as for the cold usion presently to be noticed. When exhibited under proper circum- nces it acts as a real refrigerant, reducing preternatural heat, lowering pulse, and disposing to sweating. I ought not, however, to omit icing, that serious and even fatal consequences have resulted from the ployment of large quantities of cold water by persons who have been dered very warm by exercise and fatigue.

Besides fever, there are many other affections in which cold water is a ful remedy. For example, to facilitate recovery from an attack of epsy or hysteria, and also in fainting, a draught of cold water is ntimes beneficial. There are also various morbid states of the nentary canal in which cold water may be administered with antage; as, to diminish irritable conditions of the stomach, and llay vomiting and gastrodynia. Large quantities of cold water e sometimes caused the expulsion of intestinal worms (both *Tænia Ascaris vermicularis*, or small thread-worms, commonly termed *urides*, and which are found in the large intestines of children, icularly in the rectum). Salt-water acts more efficaciously, as I shall eafter have occasion to notice.

. *Injected into the rectum.*—Cold water is thrown into the rectum etimes to check hæmorrhage; to cause the expulsion of worms (the ll thread-worm); to allay pain; in poisoning by opium; in inflam- ion of the bowels; and in various other cases.

. *Injected into the vagina.*—Dr. A. T. Thomson speaks very fa- rably of the effects of cold water when applied in uterine hæmorrhages neans of the stomach pump, and he says he has seen it used in several s most successfully.

.) *Tepid and warm water.* α. *Taken into the stomach.*—*Tepid* and *m* drinks are employed for various purposes; as, for promoting vomit- to dilute the contents of the stomach and to render them less acrid, 1 cases of irritant poisoning; but in poisons acting by absorption, ents are objectionable, since they facilitate this process, and, efore, ought not to be given unless vomiting be present, or the nach-pump be at hand. Warm aqueous drinks are administered with view of exciting diaphoresis, in gout, rheumatism, catarrh, &c., and ssist their operation the patient should be kept warm in bed, in r to promote the cutaneous circulation. Warm liquids are often- s used as emollients; as to allay irritable and troublesome cough, parti- rly when this appears to depend on irritation at the top of the larynx.

β. Injected into the rectum, warm water is sometimes employed t promote the hæmorrhoidal flux, and thereby to relieve affections of di tant organs; as an emollient, to diminish irritation either in the lar intestine itself, or in some neighbouring organ, namely, the bladd prostate gland, or uterus; to promote the catamenial discharge, &c Clysters of tepid water are frequently employed to excite alvine evacu tions. I have before (p. 53) expressed my opinion as to the improprie of frequently introducing several pints of fluid into the rectum, since t gut, by dilatation, becomes less susceptible to the natural stimulus of t fæces.

γ. Injected into the vagina, warm water may be used to dimini irritation or pain in the womb,—to promote the lochial discharge, &c.

δ. Injected into the bladder, warm water is sometimes employ either to diminish irritation in this viscus, or to distend it previously the operation of lithotrity.

ε. Injected into the urethra, it has been used to allay irritation, or check discharges from the mucous membrane.

ζ. Injected into the veins, warm water was proposed by Magendie a remedy for hydrophobia, but it has neither theory nor experience recommend it. However, in a disease which has hitherto resisted a known means of cure, practitioners are glad to try any remedy that m be proposed, however improbable, or unlikely of success. I have alrea (p. 55) mentioned a case in which I tried warm water injections, but wit out much benefit. Vernière (Christison's *Treatise on Poisons*, p. 35) h proposed to distend the venous system with warm water, to check or st absorption in poisoning, by those agents whose operation depends their absorption; for example, opium. I am not acquainted with a case in which it has been tried on the human subject. Warm water sometimes a medium for the introduction of other more powerful age into the circulating system; as, for example, tartar emetic.

d. Vapour.—The *inhalation of aqueous vapour* acts as a serviceal emollient in irritation or inflammation of the tonsils, or of the membra lining the larynx, trachea, or bronchial tubes. It may be employed means of Mudge's inhaler, or by merely breathing over warm wat Various narcotic and emollient substances are frequently added to t water, without increasing its therapeutical power. In some pulmona complaints, Dr. Paris states he has been long in the habit of reco mending persons confined in artificially warmed apartments to evapor a certain portion of water, whenever the external air has become exc sively dry by the prevalence of the north-east winds which so frequen infest this island during the months of spring; and the most mark advantage has attended the practice.

II. *External.—a. Ice and ice-cold water.*—Ice is sometimes a plied externally to check hæmorrhage, more especially when t bleeding vessel cannot be easily got at and tied. Thus, after operati about the rectum (more especially for piles and fistula) hæmorrha sometimes occurs to a most alarming extent; and in such cases t principal reliance must be on cold. In two instances that have fal under my own observation, I believe the lives of the patients were p served by the introduction of ice within the rectum. In many other ca of hæmorrhage, the external application of cold (either in the form of or ice-cold water) is exceedingly useful. Thus, applied to the chest ingerous pulmonary hæmorrhage, to the abdomen in violent floodings, is oftentimes most beneficial. In some of these cases, especially in erine hæmorrhage, more benefit is obtained by pouring cold water from height, than by the mere use of ice.

Pounded ice, tied up in a bladder, has been applied to hernial tumors, diminish their size and facilitate their reduction; but notwithstanding at the practice has the sanction and recommendation of Sir Astley ooper, it is, I believe, rarely followed, not having been found successful; d if too long continued, it may cause gangrene. In this, as well as in her cases where ice or snow cannot be procured, a freezing mixture y be substituted. For this purpose, five ounces of muriate of amonia, five ounces of nitre, and a pint of water, are to be placed in a adder, and applied to the part. Ice has also been applied in prolapsus the rectum or vagina, when inflammation has come on which threatens ortification.

In inflammation of the brain, ice, pounded and placed in a bladder, y be applied to the head with a very beneficial effect. In fever also, iere there is great cerebral excitement, with a hot dry skin, I have seen advantageously employed. In apoplexy, likewise, it might be useful. the retention of urine to which old persons are liable, ice-cold water plied to the hypogastrium is sometimes very effective, causing the acuation of this secretion.

In the above-mentioned local uses of ice, we either apply it directly to e part, or inclose it in a bladder: the latter is to be preferred, since e patient is not wetted with the melted water, while the effect is less olent.

In the last place, I must notice the employment of ice or snow in the m of *friction*. Whenever it is used in this way, the ultimate object is the oduction of the secondary effects, or those which constitute the stage reaction. Thus this practice has been resorted to in diminished senility of the skin, in the rheumatism or gout of old and enfeebled rsons, in order to produce excitement of the skin; but its most comon use is as an application to parts injured by cold. The affection us induced is called *pernio*, or the *chilblain;* and the parts affected e said to be *frost-bitten*. The feet, hands, tip of the nose, and nna of the car, are the organs most frequently attacked. Now, with e view of preventing the mortification and other ill consequences ising from the application of cold, great care must be used to avoid dden changes of temperature. The frost-bitten part, or the chilblain, ould be rubbed with snow or pounded ice, or bathed in ice-cold water, ry gradually raising the temperature of the applications until the part quires its natural heat.

(*b.*) *Cold, cool, tepid, and hot water.*—Water of various degrees of temerature is employed for baths, affusion, washing or sponging, the *douche*, id for various local purposes.

a. Baths.—History.—The practice of bathing is of great antiquity, id, in fact, precedes the date of our earliest records. It was employed, metimes for the purpose of cleanliness, sometimes for the preservation health, and frequently as a means of sensual gratification. Ablutions ere practised by the ancient Hebrews, as you will find mentioned in the ld Testament. Baths were used by the Egyptians, as well as by the

Hindoos, the Syrians, the Medes, the Persians, and other inhabitants of the East. The most ancient of the Greek writers also frequently mention them: thus Homer speaks of them in the Iliad and Odyssey. In the writings attributed to Hippocrates, you will find baths alluded to, and their effects noticed. Celsus describes the different parts of baths, and the mode of employing them; but the best description will be found in the works of Galen.

The following is a sketch of the baths of the Romans, copied from a painting found at the *thermæ* of Titus. (De Montfaucon, *l'Antiquité expliquée et répresentée en figures*, tom. 3me, part 2de, p. 204).

Fig. 37.

Ancient Baths.

On the right is the *eleotherium* (ἀλειπτήριον) where the oils and perfumes are kept in vases: next to this is the *frigidarium* (ἀποδυτήριον) or dressing-room: the third is the *tepidarium:* the fourth is the sudatory (*concamerata sudatio*) in which are seen the *laconicum* (so called from being first used in Laconia), a brazen furnace to heat the room, and persons sitting on the steps: the fifth is the *balneum*, with its huge basin (*labrum*) supplied by pipes communicating with three large bronze vases, called *milliaria*, from their capaciousness; the lower one contained hot, the upper one cold, and the middle one tepid water. The bathers returned back to the frigidarium, which sometimes contained a cold bath. The subterranean portion of the building, where the fires were placed for heating the baths, was called *hypocaustum*.

For further information on the ancient baths, consult "*An Account of the Ancient Baths*, by Thomas Glasse, M. D. 1752;" or Dr. Parr's "*Medical Dictionary*." All the remarks made on baths by the Greeks, Latins, and Arabs, have been brought together in one volume, folio, under the following title:—"*De Balneis omnia quæ extant apud Græcos, Latinos, et Arabos*, 1553."

Effects and uses of baths.—The effects of baths depend, for the most part, on the temperature of the fluid employed, on its conducting power, and, in part also, on its pressure. We may, therefore, conveniently arrange them thus:—

(*a.*) LIQUID BATHS.

(1.) *The cold bath.*
(2.) *The cool bath.*
(3.) *The temperate bath.*
(4.) *The tepid bath.*
(5.) *The warm bath.*
(6.) *The hot bath.*

(*b.*) VAPOUR BATHS.

Writers are not agreed on the precise temperature of the above baths; but the order in which I have arranged them, according to their respective degrees of heat, is that which is generally admitted.

(1.) *The Cold Bath.*—The temperature of this ranges from 33° F. to

)out 60° F.: when it is below 50°, it is sometimes termed a *very cold* :*th.* The *effects* of immersion in the cold bath are analogous to those. ready described as being produced by the application of ice or snow to e body, and, therefore, may be conveniently subdivided into primary d secondary.

(*a.*) *Primary effects.*—(*The shock.*)—The sudden abstraction of heat om the surface, and the pressure of the water, produce a powerful shock the system: a sensation of cold, (speedily followed by a sensation of armth) contraction of the cutaneous vessels, paleness of the skin, dimi- ition of perspiration, and reduction of the volume of the body, are the mediate effects. Shivering, and, as the water rises to the chest, a kind convulsive sobbing, are also experienced. Continued immersion ren- rs the pulse small, and, ultimately, imperceptible—the respiration diffi- lt and irregular; a feeling of inactivity succeeds—the joints become gid and inflexible—pain in the head, drowsiness, and cramps, are perienced—the temperature of the body falls rapidly, and faintness, llowed by death, comes on. Many of these symptoms are readily mprehended: the contracted state of the superficial vessels produced the cold, together with the pressure of the water, causes the blood to cumulate in the internal vessels. The heart makes great efforts to get d of this increased quantity of blood, and hence palpitations occur; but the arteries remain contracted, the pulse continues small. The inter- l veins, therefore, being gorged with blood, the brain necessarily suf- rs:—hence the headache, the drowsiness, the cramps, and, in some ses, apoplexy. The difficult respiration depends on the accumulation blood in the lungs. The contracted state of the superficial vessels counts for the diminished perspiration; while the increased secretion urine is referrible to the blood being driven towards the internal gans.

(*b.*) *Secondary effects.*—(*Re-action or glow.*)—In general, the immersion ing only temporary, re-action quickly takes place; a sensation of armth soon returns; the cutaneous circulation is speedily re-esta- ished; a glow is felt; perspiration comes on; the pulse becomes full d frequent; and the body feels invigorated. In weakly and debilitated bjects, however, this stage of re-action may not occur, or at least may imperfectly effected; and usually, in such cases, the cold bath will be und to act injuriously.

The *uses* of the cold bath may be in part comprehended from the fects just detailed. It is employed with the view of obtaining one of e three following effects: the nervous impression or shock,—the refri- eration,—the re-action or glow. (*Cyclopædia of Practical Medicine*, art. *athing*, by Dr. J. Forbes.) It is evident that it ought not to be ap- lied unless there be a sufficient degree of tone and vigour in the ystem to cause a perfect state of re-action; and, therefore, in weak sub- cts, its use is to be prohibited. So also, in visceral inflammation, more pecially peripneumonia, it is a dangerous remedy; since the determina- on of blood to the internal organs is increased by the cold, and it seems ven within the range of probability that death might be the result. poplectic subjects, who are unaccustomed to cold bathing, had also, for similar reason, better avoid trying it. In some affections of the ner- ous system it has been found highly useful; for example, in tetanus and insanity. So also, in any cases where we wish to increase the tone and vigour of the body, and where the before-mentioned objections do not exist, the cold bath may be used advantageously. It is a common opinion that immersion in cold water is dangerous when the body is heated by exercise, or other exertion; and hence it is customary with bathers to wait until they become cool. Dr. Currie has strongly combated both the opinion and the practice: the first, he says, is erroneous, the second injurious.

(2.) *The Cool Bath* (whose temperature is from 60° to about 75°) is analogous in its operation to the cold bath, but less powerful. It is commonly employed for the purposes of pleasure and cleanliness; but it may be resorted to, therapeutically, in the same diseases as the cold bath, where we are in doubt as to the power of the patient's constitution to establish full re-action. It is frequently used as a preparatory measure to the cold bath.

(3.) The *Temperate Bath* ranges from 75° F. to 85° F. Its effects and uses are similar to the cool bath.

(4.) The *Tepid Bath* gives rise to a sensation of either heat or cold, according to the heat of the body at the time of immersion. The temperature of this bath ranges between 85° and 92°. It cleanses the skin, promotes perspiration, and is used as preparatory to either of the before-mentioned baths. It is said to allay thirst. Where there is a tendency to apoplexy, it has been recommended to immerse the body in the tepid bath, and at the same time to pour cold water over the head.

(5.) The *Warm Bath* varies in its *effects* on different individuals. Its temperature is about that of the body, or a little below it: we may say from 92° to 98°. In general it causes a sensation of warmth, which is more obvious when the body has been previously cooled. It renders the pulse fuller and more frequent, accelerates the respiration, and augments the perspiration. It gives rise to languor, loss of muscular power, faintness, and disposition to sleep. The *uses* of it are various. Sometimes it is employed to cause relaxation of the muscular system; as in dislocation of the larger joints: and also in hernia, to assist the operation of the taxis. In the passage of calculi, either urinary or biliary, it is applied with the greatest advantage: it relaxes the ducts, and thereby facilitates the passage of the foreign body. As a powerful antiphlogistic, it is employed in inflammation of the stomach, bowels, kidneys, bladder, &c. With the view of increasing the cutaneous circulation, it is used in the exanthemata, when the eruption has receded,—and to promote perspiration, in chronic rheumatism, and various chronic skin diseases.

(6.) The *Hot Bath* (the temperature of which is somewhat above that of the body, as from 98° to 112°) gives rise to a sensation of heat, renders the pulse fuller and stronger, accelerates the respiration, occasions intense redness of the skin, and copious perspiration,—causes the vessels of the head to throb violently—brings on a sensation of fulness about the head, with a feeling of suffocation and anxiety,—and, if the immersion be continued, may even induce apoplexy. Being a powerful excitant, it must be used very cautiously. Paralysis, rheumatism, and some chronic diseases, are the principal cases in which it is employed.

(*b*.) The *Vapour Bath*.—The vapour bath differs somewhat in its effects

m the warm or hot bath: hot air and vesicular water being much
rse conductors of heat than water in its usual liquid form, the tempe-
ure of the bath is neither so quickly, nor so powerfully felt, so that the
dy can support a higher heat, and for a longer period; moreover, the
essure is less. Dr. Forbes (*Cyclop. Pract. Med.*, art. *Bathing*) gives the
lowing comparative view of the heating powers of water and of vapour,
stinguishing the latter according as it is or is not breathed:—

	Water.	*Vapour*	
		Not breathed.	Breathed.
Tepid bath .	85° — 92°	96° — 106°	90° — 100°
Warm bath .	92° — 98°	106° — 120°	100° — 110°
Hot bath . .	98° — 106°	120° — 160°	110° — 130°

ie vapour bath acts as a stimulant to the skin; it excites the cutaneous culation, softens and relaxes the tissue, produces copious per- ration, accelerates the pulse, quickens the respiration, and induces feeling of languor, and a tendency to sleep. There are two modes of ploying it; either by immersing the whole body in the vapour, which consequently inhaled; or inclosing the body in a chest or box, so that head is not exposed to the vapour, which, therefore, is not inspired. ie aqueous vapour is conveyed into the chamber or box by a pipe mmunicating with a steam boiler. Sometimes it is made to pass ough various vegetable substances, with the odour of which it becomes pregnated, and from which it has been supposed to gain an increase modification of therapeutical power. These are the *medicated vapour hs.* Sometimes the common vapour bath is accompanied by a process friction, kneading and extension of the muscles, tendons, and liga- ments, constituting the *massing* of the Egyptians, or the *sham- pooing* of the Indians. Here is the account of the process, as given by Dr. Gibney (*Treatise on the Vapour Bath,* p. 84):— "After exposure to the bath, while the body is yet warm from the effects of the vapour, the shampooman proceeds, according to the circumstances of the case, from gentle friction gradually increased to pressure, along the fleshy and tendinous ts of the limb; he kneads and grasps the muscle repeatedly, presses with points of his fingers along its course, and then follows friction, a greater or less degree, alternating one with the other, while the hand meared with a medicated oil, in the specific influence of which the erator has considerable confidence. This process is continued for a orter or longer space of time, and, according to circumstances, is either ceeded or preceded by an extension of the capsular ligament of each it, from the larger to the smaller, causing each to crack, so as to be tinctly heard, which also succeeds from the process being extended to h connecting ligament of the vertebræ of the back and loins. The isation at the moment is far from agreeable, but is succeded by effects

Fig. 38.

Egyptian Bath.

not dissimilar to what arise from brisk electrical sparks, taken from th joints in quick succession."

The application of vapour to particular parts of the body is sometim accompanied with the simultaneous removal of atmospheric pressu constituting the *air-pump vapour bath*, which has been employed in cas of gout, rheumatism, and paralysis. I must refer, for a further accou of it, to Dr. R. Blegborough's "*Facts and Observations respecting t Air-pump Vapour Bath.*"

The vapour bath is applicable to a great variety of cases, a few only which can be noticed here. Whenever it is desired to excite the vascul system, more especially the cutaneous portion of it, this remedy may resorted to with advantage. The cold stage of an intermittent, and m lignant cholera, are cases which readily suggest its employment. rheumatism and gout, in old paralytic cases unaccompanied with signs vascular excitement about the head, in various atonic affections of t uterine system—such as some forms of chlorosis and amenorrhœa, dropsy of old debilitated subjects, in various skin diseases, in scrofula, chronic liver complaints of long standing, &c. this remedy may be e ployed, and frequently with advantage.

I ought not to leave this subject without alluding to the extensive u made of vapour baths in some parts of the world, particularly Russi where, we are told, it is customary for the bathers to issue from the bat ing-houses while quite hot, and to roll themselves naked in the sno and then return to the bath, not only without any hurtful, but apparent with beneficial, effects.

β. Affusion.—Another mode of employing water externally is *affusion;* that is, the pouring of water over some portion of the body. is the κατάχυσις of Hippocrates.

History.—This practice is of very ancient date: as a hygienic age and luxury it was practised by the Greeks and Orientalists at a ve early period, and allusions to it will be found in the Odyssey of Hom Hot, tepid, and cold affusions, are mentioned by Celsus, in the four chapter of the first book, and are recommended in some affections of t head. This last writer also states, that Cleophantus (a physician w lived about 300 years before Christ) employed the affusion of hot wat in intermittents. For an account of the effects and uses of cold af sion, I must refer to the *Medical Reports* of Dr. Currie, and to a pap by Dr. Copland, in the *Medical Gazette*, vol. x.

Mode of applying affusion.—In many cases the object is to u affusion to the *head* merely. If the patient be able to sit up, let hi incline his head over a large vessel, say a pan or tub, and then pour t water from a height of two or three feet from an ewer or large pitch If, however, he be too ill to be removed, he must incline his head ov the side of the bed. In children it will be sufficient to squeeze a lar sponge at some height above the head, as recommended by Dr. Coplan In some cases it is necessary to guard against the cold water coming contact with the chest.

When the object is to apply the affusion to the *whole body*, the patie must be placed in a large tub or pan—for example, a bathing-tub washing-pan—and then an attendant, standing on a chair, may readi effect it. The time that the affusion should be continued will va according to circumstances, from a quarter to two or three minutes: b some cases it has been employed for twenty minutes. After the affun the body should be carefully wiped dry, the patient wrapped up rm, and placed in bed.

Effects.—The effects of affusion depend partly on the temperature of water, and partly also on the sudden and violent shock given to the tem by the mechanical impulse of the water; hence the reason why effects vary, according to the height from which the liquid is ured.

1. *Of the affusion of cold water*—that is, of water whose temperature is tween 32° F. and 60° F. To a certain extent the effect of this agent analogous to that of the cold bath, but modified by two circumstances, mely, the short period during which the cold is applied, and the meanical influence of the stream: hence, its primary effects are very nsient, and re-action follows very speedily. By a long continuance of usion, however, the heat of the body is very considerably reduced, and same diminution of vital action occurs as when the cold bath is ployed. The sensation of cold, the constriction of the skin, and the ntraction of the superficial vessels, first experienced in the part to ich the water is applied, is very speedily communicated to the rest of system by sympathy, in consequence of the shock; the effects of ich are perceived in the nervous, vascular, secreting, and cutaneous stems. The temperature of the whole body falls, the pulse becomes luced in volume and frequency, the respiration is irregular, and conlsive shiverings take place, faintness, and, in fact, all the effects already scribed of the cold bath are produced. During this condition the cretions are suspended. "When," says Dr. Copland, "the stream of ter is considerable, and falls from some height upon the head, the ect on the nervous system is often very remarkable, and approaches re nearly than any other phenomenon with which I am acquainted to ctro-motive or galvanic agency."

After the affusion, re-action is soon set up, the heat of the body is reablished, the pulse becomes full and regular, though sometimes luced in frequency, the thirst is diminished, and frequently perspiran and tendency to sleep are observed.

Cold affusion is used principally in those cases where it is considered sirable to make a powerful and sudden impression on the system: for a mere cooling agent it is inferior to some other modes of applying ter. Thus it is employed, for the most part, in fevers, and affections the nervous system. It is objectionable in visceral inflammation, on count of the determination of blood which it produces to the internal rts. Cold affusion has been employed with great benefit in *fevers*, th continued and intermittent. It may be used with safety, according Dr. Currie and others, "when there is no sense of chilliness present, hen the heat of the surface is steadily above what is natural, and when ere is no general or profuse perspiration." It is inadmissible during ther the cold or the sweating stage of fever, as also in the hot stage, hen the heat is not greater than ordinary. In some instances it seems act by the shock it communicates to the system; for the effect is most immediate, the disease being at once cut short. The patient has llen asleep immediately afterwards, profuse perspiration has succeeded, d from that time recovery begun to take place. This plan of extinishing a fever, however, frequently fails; and in that event the patient may be in a worse condition; hence the practice is not often adopted. I think the cases best adapted for the use of cold affusion are those in which there is great cerebral disorder,—either violent delirium or a soporose condition. My friend, Dr. Clutterbuck, (*Inquiry into the Seat and Nature of Fever*, 2d ed. p. 451), says he has seen pulmonic inflammation and rheumatism brought on by cold affusion in typhus; but he adds, "I have not, in general, observed that the situation of the patient was rendered materially worse by the combination."

In the *exanthemata*, cold affusion has been applied during the fever which precedes the eruption, as also after this has been established; it has been used in scarlet fever, and also in small-pox; likewise in measles; but its employment in the latter disease is objectionable, on account of the tendency to pulmonary inflammation, in which cold affusion is prejudicial.

Croup is another disease in which cold affusion has been used with advantage, principally with the view of removing the spasm of the glottis, which endangers the life of the patient.

In *inflammatory affections of the brain*, especially of children, after proper evacuations have been made, it is useful. In many cases of *narcotic poisoning*, cold affusion is of the greatest service; as in poisoning with hydrocyanic acid, and in asphyxia caused by the inhalation of carbonic acid; so also in poisoning with opium, belladonna, and other narcotic substances, in intoxication, in asphyxia from the inhalation of sulphuretted hydrogen gas or of the vapours of burning charcoal, this practice is most advantageous. In *hysteria* and *epilepsy* it is oftentimes serviceable: it diminishes the duration of the paroxysms, and relieves the comatose symptoms. In *puerperal convulsions* Dr. Copland relies on cold affusion and blood-letting. In *mania* it is oftentimes serviceable, as also in *tetanus*.

2. *Cool affusion* has been employed instead of the cold; and in weak irritable subjects it is always preferable. Dr. Currie regards it as a milder form of the cold affusion, as a preparatory means to which it is sometimes used. It has been applied in febrile diseases and paralysis.

3. *Tepid affusion.*—The affusion of tepid water is frequently resorted to as a substitute for that of cold water, where great dread is entertained of the latter agent, or where there is doubt as to the production of a perfect reaction after the application of cold water, or where there is some pulmonary disease. It may be regarded as a safer, though less powerful means. Thus it is very useful in febrile complaints, especially of children. It is very beneficial in scarlet fever, as I have seen on several occasions. Dr. Currie thinks that it reduces the temperature more than cold affusion; first, because the evaporation is greater; secondly, because it does not excite that reaction by which heat is evolved. It diminishes the frequency of the pulse and of respiration, and causes a tendency to sleep. The same writer tells us that he has not found its effects so permanent as those of the cold affusion; and that he never saw it followed by the total cessation of regular fever. In other words, it produces a much less powerful shock to the system, and therefore is less influential over disease. In hectic fever, however, the paroxysm is sometimes completely extinguished by the affusion of tepid water at the commencement of the hot stage.

4. *Warm affusion* excites very pleasant sensations, but which are soon

llowed by chilliness, and oftentimes by pulmonary affections. It has en used in mania with advantage: it reduces the frequency of the ilse and of respiration, and occasions a tendency to repose; but the 'ects are much more temporary than those produced by the warm bath.

γ. *Washing or sponging.*—Cold, cool, or tepid washing or sponging, ay be used in febrile diseases, with great advantage, in many cases here affusion is not admissible, or where timidity on the part of e patient or practitioner prevents the employment of the latter. Dr. urrie remarks, that in all cases of fever where the burning heat of the ılms of the hands and soles of the feet is present, this method of cool-g them should be resorted to. A little vinegar is frequently mixed ith the water, to make the effect more refreshing. Washing or spong-g must be effected under precisely the same regulations as those already id down for affusion.

δ. *Shower bath.*—The shower bath is similar in its effects to affusion, ıt milder in its operation, and is mostly employed in chronic diseases, as a hygienic agent. In various affections of the nervous system, ore especially insanity, it is very useful. In many cases it is a valuable gent when we are afraid to venture on the common cold bath or cold fusion, since it is less likely to cause cramps or other symptoms indica-ve of a disordered state of the nervous system.

ε. *The Douche.*—The French word *douche*, or the Italian *doccia*, sig-fies a continued current of fluid applied to, or made to fall on, some ırt of the body. Dr. Parr states that it is synonymous with our word *pumping*," and with the Latin word *stillicidium*. At Bath, for example, e waters are applied, say to a paralyzed part, by means of a pump, and e degree or quantity of the application is determined by the number of mes the handle is raised or depressed. The water, however, does not sue in gushes, but in a continuous stream. This is evidently what the rench would call a *douche*, but our word "pumping" is not applicable a "*douche de vapeur*." According to the direction in which the water applied we have the *douche descendante*, *douche latérale*, and *douche cendante*.

History.—It is uncertain at how early a period this remedy was in se. The following passage from Cælius Aurelianus has been supposed y some to refer to this mode of employing water. "Item *aquarum uinis* partes in passione constitutæ sunt subjiciendæ, quas Græci ιτακλυσμοὺς appellant, plurimum etenim earum *percussiones* corporum ciunt mutationem." By others, however, this passage is supposed to fer to affusion.

General operation.—The effects of the douche depend on several cir-umstances; such as the nature of the fluid employed, whether vapour r liquid, and if liquid, whether simple or some saline water: the tem-erature also must have an influence, as is very evident,—the size and irection of the jet, the force with which it is applied, and its duration. t Bath, Dr. Falconer tells us, "from 50 to 200 strokes of the pump is e number generally directed to be taken at one time, which, however, ay be increased or diminished according to the age, sex, strength, or ther circumstances of the patient." On the continent it is rarely em-loyed for a longer period than 15 or 20 minutes.

The *vapour douche* is nothing more than a jet of aqueous vapour irected on some part of the body, its action depending principally on the temperature of the fluid, since its mechanical effects are comparatively slight. In the *common vapour douche* the temperature of the aqueous vapour does not exceed that employed in the vapour bath already described; and in such cases it may be regarded as a kind of local vapour bath. Thus in some affections of the ear, as otitis, otorrhœa, and otalgia, a stream of aqueous vapour may be applied to the meatus auditorius externus with great benefit; and the most ready means of effecting this is by a funnel inverted over a vessel of hot water, the ear being placed over the orifice of the funnel.

Sometimes *steam* has been used—that is, aqueous vapour heated to 212° F.; and, of course, it acts as a caustic if sufficiently long applied, causing sometimes an extensive and deep eschar. In this respect its action is similar to that of boiling water, from which, indeed, it principally differs in the circumstance of having a much larger quantity of specific heat, and in the great facility with which we can localize its effects. It may be readily applied to any part of the body by means of a small boiler (copper or tin), furnished with a pipe and stop-cock, and heated by a spirit lamp. It has been used as a powerful counter-irritant in diseases of the hip-joint, neuralgic pains, chronic rheumatism, &c. but the objections to its use are the great pain and the danger of its employment; for it is a more painful application than many other modes of causing counter-irritation, while its effects are inconstant.

The action of the *liquid douche* depends in a great measure on the temperature of the liquid, but in part also on the mechanical action of the water. This effect of percussion is common to both the cold and hot douche, and by continuance excites pain and inflammation of the part. This local excitement is observed almost immediately when hot water is employed, but takes place more slowly when we use cold water; indeed, the long action of a stream of cold water may act as a sedative, and cause all the effects which I have already described as the primary effects of cold applications.

The effect of the douche is, however, not altogether local, since the neighbouring parts, and even the whole animal economy, soon become affected. A column of water twelve feet high, made to fall perpendicularly on the top of the head, excites such a painful sensation, that, we are told, the most furious maniacs who have once tried it may sometimes be awed merely by the threat of its application; and hence one of its uses in madness, as a means of controlling the unfortunate patient.

The *cold douche* is applicable to those cases of local disease requiring a powerful stimulus. For example, chronic affections of the joints, of long standing, whether rheumatic, gouty, or otherwise, paralytic affections of the limbs, old glandular swellings, and those forms of insanity in which there are no marks of determination of blood to the head. The *warm* douche may be employed in similar cases.

For a variety of local purposes, a syringe is employed to throw a jet of water on particular parts, as into sinuous ulcers, or into the vagina, into the ear, into the rectum, &c., constituting thus a kind of douche.

ζ. Local uses.—Hot, warm, and *cold* water, applied to particular parts of the body, may be regarded as local baths. *Cold water* is applied to produce evaporation, and thereby to generate cold, with the view of relieving local irritation and inflammation. In ophthalmia, phrenitis, and even in gout (though in the latter complaint the practice has been jected to), cold water lotions are employed with great advantage. One thod of treating burns is by the application of cold water, and, if I to judge by my own sensations, it is by far the most agreeable. By ne, however, *warm water* is employed as an emollient application in rns and scalds. This is the practice of my friend Mr. Luke, one of surgeons to the London Hospital. (*Med. Gaz.* vol. xviii. p. 7).

Warm fomentations and poultices (made of bread or linseed meal) may regarded, in reference to their effects, as a local bath.

Boiling water is employed externally as a powerful irritant and a edy vesicant; its action being in this respect analogous to steam, eady noticed, and objectionable on the same ground, namely, the great in, and the uncertainty of its effects; in addition to which may be ntioned, the difficulty of localizing its action. When applied in dis-es of internal organs, it may be regarded as a powerful counter-tant.

III. *Pharmaceutical Uses.*—Water is frequently employed in armacy for extracting the active principles of various medicinal ents. The solutions thus procured are termed, by the French re-mers of pharmaceutical nomenclature, *hydroliques* or *hydrolica* (*Pharm. menclat.* of MM. Chereau and Henry, in the *Supplement* to the *inb. New Dispens.* p. 152). Those prepared by solution or mixture called *hydrolés;* and others, procured by distillation, are denominated *drolats.*

1. *Hydrolés.*—Cottereau (*Traité Elém. de Pharmacologie*, 1835), ides these into three classes; *α. Mineral hydrolés* (*hydrolés chimico-iques*), of which Goulard-water and lime-water are examples; *β. ve-able hydrolés* (*hydrolés phytobasiques*), as almond emulsion, mucilage, getable infusions, and decoctions, &c.; *γ. animal hydrolés* (*hydrolés basiques*), as broths.

2. *Hydrolats.*—These are the *aquæ distillatæ* of the British Pharma-pœias: as *aqua menthæ piperitæ*, called, in the French codex, *hydro-um menthæ piperitæ.*

A'quæ Minera'les.—Mineral Waters.

History.—Mineral waters were known to mankind in the most remote riods of antiquity, and were employed, medicinally, both as external d internal agents. Homer (*Iliad*, xxii. 147) speaks of tepid and cold ings. The Asclepiadeæ, or followers of Æsculapius, erected their nples in the neighbourhood of mineral and thermal waters (Sprengel, *st. de Médec.* par Jourdan, t. 1er. p. 144). Hippocrates (*De aeribus, uis, locis*) speaks of mineral waters, though he does not prescribe them ien speaking of particular diseases. Pliny (*Hist. Nat.* lib. xxxi.) tices their medical properties.

Natural History.—The principal source of mineral waters is the nosphere, from which water is obtained in the form of rain, snow, il, and dew, and which after percolating a certain portion of the earth, d dissolving various substances in its passage, reappears on the sur-e at the bottom of declivities (*spring water*), or is procured by sinking s or wells (*well water*). But springs are sometimes observed under cumstances which are inconsistent with the supposition of their nospheric origin. "The boiling springs which emerge on the verge perpetual snows, at an altitude of 13,000 feet above the level of the sea, as in the Himalayahs, cannot be derived from the atmosphere, not to mention the peculiar relations of the Icelandic Geysers" (Gairdner, *Essay on Mineral and Thermal Springs*, p. 289). Other sources, therefore, have been sought for, and the writer just quoted enumerates three, viz. the focus of volcanic activity, the great mass of the ocean, or other masses of salt-water, and subterranean reservoirs.

Considered with reference to their temperature, mineral waters are divided into *cold* and *hot*. The hot or thermal waters are those which possess a temperature more or less elevated above the mean of the latitude or elevation at which they are found, and the changes of which, if any, observe no regular periods coincident with the revolutions of the seasons. Three causes have been assigned as the source of the heat of mineral waters; viz. volcanic action, now in existence; volcanic action, now extinguished, but the effects of which still remain; and, a central cause of heat, which increases as we descend from the surface to the interior of the earth (Gairdner, *op. cit.*).

Fig. 39.

New Geyser.

The *Geysers*, or boiling springs, of Iceland, are evidently connected with volcanic action. They are intermittent fountains which throw up boiling water and spray to a great height into the air. For further information concerning them, I must refer to Sir G. S. Mackenzie's "*Travels in Iceland during the Summer of* 1810," and to Barrow's "*Visit to Iceland, by way of Tronyem, &c., in the Summer of* 1834."

The origin of the saline and other constituents is another interesting topic of inquiry connected with the natural history of mineral springs. As water in its passage through the different strata of the earth must come in contact with various substances which are soluble in it, we refer certain constituents of mineral waters to solution and lixiviation merely, as chloride of sodium, carbonates of lime and magnesia, iodides and bromides of sodium and magnesium, iron, silica, &c. Chemical action must, in some cases, be the source of other constituents. Thus sulphuretted hydrogen is probably produced by the action of water on some metallic sulphuret (especially nonpyrites): sulphurous and sulphuric acid, from the oxidation and combustion of sulphur, free or combined. The carbonic acid found in the acidulous or carbonated waters is referrible to the decomposition of carbonate of lime, either by heat or by the action of sulphuric acid. Hydrochloric acid is doubtless produced by the decomposition of some chloride or muriate (probably chloride of sodium or sal ammoniac). Carbonate of soda must also be considered as the product of some chemical process; thus, that found in the natron lakes of Egypt is supposed to be formed by the action of chloride of sodium on carbonate of lime (Bertholett, *Essai de Statique Chimique*, 1^er^. part. p. 406). "The different orifices of the Karlsbad Sprudel discharge annually about 13,000 tons of carbonate of soda, and 20,000 of the sulphate in the crystallized state" (Gairdner, *op. cit.* p. 325): but "a very simple calculation is sufficient to shew, that the Donnersberg alone, the loftiest of the Bohemian Mittelgebirge, a cone of clinkstone

,500 feet in elevation, contains soda enough to supply the Karlsbad aters alone for more than 30,000 years." (*Ibid.* p. 338).

Division and Properties.—Mineral waters may be classified accord-ıg to their temperature, their chemical composition, or their medicinal roperties. But hitherto no satisfactory classification has been effected any of these methods, nor perhaps can it be formed. The most con-nient arrangement is that founded on chemical composition, and which nsists in grouping mineral waters in four classes.

Class 1. *Chalybeate, ferruginous, or martial waters.* (*lquæ minerales ferruginosæ; aquæ martiales*).—Oxide of iron is a con-ituent of most mineral waters, and when the quantity is considerable, e term *chalybeate* is applied to them. Chalybeate waters have an ky, styptic taste, and the property of becoming purplish black on the ldition of tannic or gallic acids, or of substances which contain these, the infusion of galls or of tea. If the iron be in the state of sesqui-ide, the ferrocyanide of potassium causes a blue, and sulphocyanide potassium a red colour.

Most chalybeate waters contain the carbonate of the protoxide of iron; d are termed *carbonated-chalybeates.* Such waters, when exposed to e air, evolve carbonic acid, attract oxygen, and deposit the sesquioxide iron. By boiling also, the whole of the iron may be precipitated as squioxide. When the protocarbonate of iron is associated with a nsiderable quantity of free carbonic acid, the waters are termed *dulous-carbonated-chalybeates*, or simply *acidulous-chalybeates*; as the ebrated waters of Spa in Belgium. When a carbonated-chalybeate ıtains alkaline and earthy salts, but not much free carbonic acid, it is med a *saline-carbonated-chalybeate*; as the waters of Tunbridge Wells, ıdy's saline chalybeate at Harrowgate, and the Islington Spa near ndon.

In some cases the oxide of iron is in combination with sulphuric acid: se waters might be termed, in contradistinction to the above, *sul-ıted-chalybeates.* Exposure to the air, or boiling, does not precipitate the iron, and in this they are distinguished from the carbonated-ılybeates. The sulphated-chalybeates usually contain sulphate of mina, and, in that case, are termed *aluminous-chalybeates*: of these, Sand Rock Spring, Isle of Wight, the strong Moffatt Chalybeate, l Vicar's Bridge Chalybeate, are examples: the last-mentioned is bably the strongest chalybeate in existence.

The effects of chalybeate waters are analogous to those of other uginous compounds which I shall have occasion to notice in a sequent part of this work, and to which, therefore, I must refer for ther information. I may, however, mention here that these waters are ic, stimulant, and astringent, and produce blackening of the stools. e acidulous-carbonated-chalybeates sit more easily on the stomach n other ferruginous agents, in consequence of the excess of carbonic d present. The aluminous-chalybeates are very apt to occasion car-lgia, especially if taken in the undiluted state.

The use of this class of waters is indicated in cases of debility, espe-lly when accompanied with that state of system denominated anæmia. s contra-indicated in plethoric, inflammatory, febrile, and hæmorrhagic ıditions.

Class 2. *Sulphureous or hepatic waters.* (*Aquæ minerales* *sulphureæ* seu *hepaticæ*).—These waters are impregnated with hydrosulphuric acid (sulphuretted hydrogen); in consequence of which they have the odour of rotten eggs, and cause black precipitates (metallic sulphurets) with solutions of the salts of lead, silver, copper, bismuth, &c. Those sulphureous waters which retain, after ebullition, their power of causing these precipitates, contain a sulphuret (hydrosulphuret) in solution, usually of calcium or sodium. All the British sulphureous waters are cold, but some of the continental ones are thermal. The most celebrated sulphureous waters of England are those of Harrowgate; those of Scotland are Moffatt and Rothsay; of the continent, Enghien, Baréges, Aix, and Aix-la-Chapelle.

The general operation of these waters is stimulant. They are supposed to possess a specific power over the cutaneous and uterine systems. They are employed both as external and internal agents; in chronic skin diseases (as lepra, psoriasis, scabies, pityriasis, herpes, &c.)—in derangements of the uterine functions (amenorrhœa and chlorosis)—in old syphilitic cases—in chronic rheumatism and gout, and in other diseases in which sulphur or its compounds have been found serviceable, and which will be noticed hereafter. On account of their stimulant effects, they are contra-indicated in all plethoric and inflammatory conditions of system.

CLASS 3. ACIDULOUS OR CARBONATED WATERS. (*Aquæ minerales acidulæ*).—These waters owe their remarkable qualities to carbonic acid gas, which gives them an acidulous taste, a briskness, a sparkling property and the power of reddening litmus slightly, but fugaciously, and of precipitating lime and baryta waters. When they have been exposed to the air for a short time, this gas escapes from them, and the waters lose their characteristic properties.

Most mineral and common waters contain a greater or less quantity of free carbonic acid. Ordinary spring and well waters do not usually contain more than three or four cubic inches of carbonic acid gas in 100 cubic inches of water. Dr. Henry found, in one experiment, 3·38 inches (Thomson's *System Chem.*, vol. iii. p. 193, 6th edit.). But the waters called acidulous or carbonated contain a much larger quantity. Those which have from 30 or 60 cubic inches of gas are considered rich; but the richest have from 100 to 200 or more cubic inches (Gairdner, *op. cit.* p. 30). Alibert (*Nouveaux Elémens de Thérapeutique*, tom. 3me, p. 517, 5me. ed.) states, that the waters of Saint Nectaire contain 40 cubic inches in 100 of the water. This is the richest of all the acidulous springs.

Some of the waters of this class contain carbonate or bicarbonate of soda: these are termed *acidulo-alkaline*. Frequently they contain carbonate of the protoxide of iron also.

The only acidulous or carbonated spring in Great Britain is that of Ilkeston, near Nottingham, and which has been described by Mr. A. F. Greeves (*Account of the Medicinal Water of Ilkeston*, 1833), and by Dr. T. Thomson (*Cyclopædia of Practical Medicine*, art. *Waters, Mineral*).

Those acidulous waters which owe their medicinal activity principally to the carbonic acid which they contain, act chiefly on the digestive and nervous systems, but their effects are transient. They stimulate the stomach and relieve nausea. Sometimes they occasion a sensation of fulness in the head, or even produce slight temporary intoxication. The e used in some disordered conditions of the digestive organs, especially ıen connected with hepatic derangement, in dropsical complaints, in ɔrine affections, and in various other cases, which will be more fully ticed when treating of carbonic acid. When the acidulous waters ntain the protocarbonate of iron, their effects and uses are analogous to ose of the ferruginous springs already noticed. The acidulo-alkaline ıters are useful in the lithic acid diathesis, in gout and rheumatism, &c. ıe acidulous or carbonated waters are objectionable, on account of their mulant effects, in febrile, inflammatory, and plethoric subjects.

Class 4. *Saline mineral waters* (*Aquæ minerales salinæ*).—ıese waters owe their medicinal activity to their saline ingredients; for hough they usually contain carbonic acid, and sometimes oxide of iron hydrosulphuric acid, yet these substances are found in such small antities as to contribute very slightly only to the medicinal operations the water.

Saline mineral waters may be conveniently divided into five orders, ınded on the nature of the predominating ingredient.

Order 1. *Purging saline waters.*—The leading active ingredient of waters of this order is either the sulphate of soda or the sulphate of gnesia; but the chlorides of calcium and magnesium, which are ıally present, contribute to their medicinal efficacy. Those springs, which the sulphate of magnesia predominates, are called *bitter*—as ɔse of Epsom, Scarborough, and Seidlitz. The springs of Cheltenham, amington, and Spital, contain sulphate of soda. In full doses the ters of this order are mild cathartics. In small and repeated doses y act as refrigerants and alteratives. They are useful in diseased ɜr, dropsical complaints, habitual constipation, hæmorrhoids, determi- ion of blood to the head, &c.

Order 2. *Saline* or *brine waters.*—The characteristic ingredient of se waters is chloride of sodium. Iodine or bromine has been recog- ɘd in some of them, and doubtless contributes somewhat to the medi- ıl effects. The most important brine springs of England are those of ldlewich and Nantwich, in Cheshire; Shirleywich, in Staffordshire, Droitwich, in Worcestershire. The springs of Ashby-de-la-Zouch, Leicestershire, contain, besides chloride of sodium, a considerable ntity of chloride of calcium. Taken in large quantities, saline or ıe waters are emetic and purgative. In small but continued doses act as alteratives, and are supposed to stimulate the absorbent sys- . They have been principally celebrated in glandular enlargements, ecially those which are of a scrofulous nature.

Order 3. *Calcareous waters.*—Those saline mineral springs whose dominating constituent is either sulphate or carbonate of lime, or h, are denominated calcareous waters. The Bath, Bristol, and Buxton rmal waters are of this kind. When taken internally, their usual cts are stimulant (both to the circulation and the urinary and cuta- us secretions), alterative, and constipating; and are referrible, in part, he temperature of the water, in part to the saline constituents. Em- ved as baths they are probably not much superior to common water ted to the proper temperature; but they have been much celebrated the cure of rheumatism, chronic skin diseases, &c. Bath water is erally employed both as a bath and as an internal medicine in various nic diseases admitting of, or requiring, the use of a gentle but continued stimulus; as chlorosis, hepatic affections, gout, rheumatism, lepra, &c. Buxton water, taken internally, has been found serviceable in disordered conditions of the digestive organs, consequent on high indulgence and intemperance; in calculous complaints, and in gout: employed externally, it has been principally celebrated in rheumatism. The water of Bristol Hotwell is taken in dyspeptic complaints and pulmonary consumption.

Order 4. *Alkaline waters.*—The mineral waters denominated alkaline contain carbonate or bicarbonate of soda as their characteristic ingredient. They pass insensibly into, and are, therefore, closely related to, the waters of the preceding classes. Thus springs which contain carbonate of soda with a considerable excess of carbonic acid (as those of Carlsbad and Seltzer), are denominated acidulo-alkaline, and are classed with the acidulous or carbonated waters. Those in which carbonate of soda is associated with protocarbonate of iron and excess of carbonic acid (as Spa water), are termed chalybeate waters. The only waters in this country which contain carbonate of soda are those of Malvern, in Worcestershire; and Ilkeston, in Derbyshire, near Nottingham; but the quantity in both cases is very small. The first, which is a very pure water, contains only 0·6 parts of the carbonate in 10,000 of the water, and the second 3·35 grains in an imperial gallon. For external use the alkaline waters are principally valuable on account of their detergent qualities. When taken internally they act on the urinary organs. They may be employed in calculous complaints connected with lithic acid diathesis, in gout, in dyspepsia, &c.

Order 5. *Siliceous waters.* — Most mineral waters contain traces of silica, but some contain it in such abundance that they have been denominated siliceous. Thus in the boiling springs of Geyser and Reikum, in Iceland, it amounts to nearly one-half of all the solid constituents. In these waters the silica is associated with soda (silicate of soda) sulphate of soda, and chloride of sodium (See Dr. Black's analysis, in the *Trans. Royal Soc. Edin.* vol. iii.: also Faraday's, in Barrow's *Visit to Iceland*). I am unacquainted with their action on the body. It is probably similar to that of the alkaline waters.

Ac'idum Hydrochlo'ricum.—Hydrochlo'ric Acid.

History and Synonymes.— Liquid hydrochloric acid was probably known to Geber, the Arabian chemist, in the eighth century. The present mode of obtaining it was contrived by Glauber. It has been known by the various names of *spirit of salt*, *marine acid*, and *muriatic acid*. Some modern chemists term it *chlorohydric* acid. Scheele, in 1774, may be regarded as the first person who entertained a correct notion of the composition of hydrochloric acid. To Sir H. Davy we are principally indebted for the establishment of Scheele's opinion.

Natural History.—It is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Hydrochloric acid is one of the gaseous products of volcanoes. Combined with ammonia, we find it in volcanic regions.

(*b.*) *In the organized kingdom.*—Free hydrochloric acid is an essential constituent of the gastric juice in the human subject. Hydrochlorate of ammonia (sal ammoniac) was found, by Berzelius, in the urine. Chevreul states he detected free hydrochloric acid in the juice of *Isatis tinctoria.*

1. *Gaseous Hydrochloric Acid.*

PREPARATION.—Hydrochloric acid, in the gaseous state, is procured the action of strong liquid sulphuric acid on dried chloride of sodium. ie ingredients should be introduced into a tubulated retort, and the s collected over mercury. Or they may be placed in a clean and dry flask, and the gas conveyed, by means of a glass tube curved twice at ;ht angles, into a proper receptacle, from which the gas expels the air its greater gravity.

In this process, one equivalent, or 60 parts of chloride of sodium, react one equivalent, or 49 parts of the protohydrate of sulphuric acid rong oil of vitriol), and produce one equivalent, or 37 parts of hydro-loric acid (gas), and one equivalent, or 72 parts of the sulphate of da.

NGREDIENTS USED.			PRODUCTS.
1. Chlor^{de}. Sodium . 60	1 eq. Chlorine 36		1 eq. Hydrochl^{c}. Acid 37
	1 eq. Sodium 24		
q. Liquid lph^{c}. Acid 49	1 eq. Water 9	1 Hydrog. 1	
		1 Oxygen 8	1 eq. Soda 32
	1 eq. Sulphuric Acid . . 40		1 eq. Sulp^{te}. Soda 72

PROPERTIES.—It is a colourless invisible gas, fuming in the air, in con-quence of its affinity for aqueous vapour. It is rapidly absorbed by ater. Its specific gravity is, according to Dr. Thomson, 1·2847. It s a pungent odour and acid taste. Under strong pressure (40 atmo-heres) it becomes liquid. It is neither combustible nor a supporter of mbustion. When added to a base (that is, a metallic oxide), water d a chloride are the results.

CHARACTERISTICS.—Hydrochloric acid gas is known by its fuming in air, by its odour, by its reddening moistened litmus paper, and by forming white fumes with the vapour of ammonia, and by the action nitrate of silver on an aqueous solution of the gas, as will be men-ned when describing the liquid acid.

COMPOSITION.—The composition of this gas is determined both by alysis and synthesis. Thus, one volume of chlorine gas may be made combine with one volume of hydrogen gas, by the aid of light, heat, electricity, and the resulting compound is two volumes of hydrochloric id gas. Potassium or zinc heated in this acid gas, absorbs the chlorine d leaves a volume of hydrogen.

nstituents.	Result.		Eq.	Eq.Wt.	Per Cent.		Vol.	Sp. gr.
1 eq. Chlor. = 36	1 eq. Hydro-chloric acid gas = 37	Chlorine	1	36	97·297	Chlorine gas	1	2·5
1 eq. Hydr. = 1		Hydrogen	1	1	2·702	Hydrogen gas	1	0·0694
		Hydrochl^{c}. Acid	1	37	10·000	Hydrochl^{c}. Acid gas	2	1·2847

PHYSIOLOGICAL EFFECTS.—(*a.*) *On vegetables.*—Mixed with 20,000 nes its volume of atmospheric air, this gas is said by Drs. Christison d Turner (Christison's *Treatise on Poisons*) to have proved fatal to ants, shrivelling and killing all the leaves in twenty-four hours. But, cording to Messrs. Rogerson (*Medical Gazette*, vol. x. p. 312) it not injurious to vegetables when mixed with 1500 times its volume air. Dr. Christison ascribes these different results to Messrs. Rogerson having employed glass jars of too small size. We have good evidence [of] the poisonous operation of this gas on vegetables in the neighbourhoo[d] of those chemical manufactories in which carbonate of soda is procur[ed] from common salt. The fumes of the acid which issue from these wor[ks] have proved so destructive to the surrounding vegetation, that in so[me] instances the proprietors have subjected themselves to actions at la[w] and have been compelled either to pay damages, or to purchase the la[nd] in their immediate neighbourhood.

(*b.*) *On animals* this gas acts injuriously, even when mixed with 15[00] times its volume of atmospheric air. Mice or birds introduced into t[he] pure gas struggle, gasp, and die, within two or three minutes. Dilut[ed] with atmospheric air, the effects are of course milder, and in a ratio [to] the quantity of air present. In horses it excites cough and difficulty [of] breathing. When animals are confined in the dilute gas, in addition [to] the laborious and quickened respiration, convulsions occur before deat[h]. Messrs. Rogerson state, that "in a legal suit for a general nuisan[ce] tried at the Kirkdale Sessions-house, Liverpool, it was proved that hors[es] cattle, and men, in passing an alkali-works, were made, by inhaling th[e] gas, to cough, and to have their breathing much affected. In the ca[se] of Whitehouse *v.* Stevenson, for a special nuisance, lately tried at th[e] Staffordshire assizes, it was proved that the muriatic acid gas from [a] soap manufactory destroyed vegetation, and that passengers were seiz[ed] with a violent sneezing, coughing, and occasional vomiting. One witne[ss] stated, that when he was driving a plough, and saw the fog, he w[as] obliged to let the horses loose, when they would gallop away till th[ey] got clear of it." It acts as an irritant on all the mucous membranes.

(*c.*) *On man* this gas acts as an irritant poison, causing difficult respir[a]tion, cough, and sense of suffocation. In Mr. Rogerson's case, it caus[ed] also swelling and inflammation of the throat. Both in man and anima[ls] it has appeared to produce sleep.

The action of hydrochloric acid gas on the lungs is injurious in at lea[st] two ways: by excluding atmospheric air, it prevents the decarbonizati[on] of the blood; and, secondly, by its irritant, and perhaps also by i[ts] chemical properties, it alters the physical condition of the bronchi[al] membrane. The first effect of attempting to inspire the pure gas see[ms] to be a spasmodic closure of the glottis. Applied to the conjunctiva, [it] causes irritation and opacity.

Use.—It has been employed as a *disinfectant*, but is admitted on a[ll] hands to be much inferior to chlorine. The Messrs. Rogerson deny th[at] it possesses any disinfecting property. It is perhaps equally difficult [to] prove or disprove its powers in this respect. The experiments of Guyto[n] Morveau, in purifying the cathedral of Dijon, in 1773, are usually referr[ed] to in proof of its disinfecting property. If it possess powers of th[is] kind, they are certainly inferior to chlorine, or the chlorides of lime [or] soda; but, in the absence of these, hydrochloric acid gas may be trie[d]. In neutralizing the vapour of ammonia it is certainly powerful.

Application.—In order to fumigate a room, building, or vessel, wi[th] this gas, pour some strong sulphuric acid over dried common salt, plac[ed] in a glass capsule or iron or earthen pot, heated by a charcoal fire.

Antidote.—Inhalations of the vapour of ammonia may be serviceab[le] in neutralizing hydrochloric acid gas. Symptoms of bronchial inflamm[a]tion are of course to be treated in the usual way.

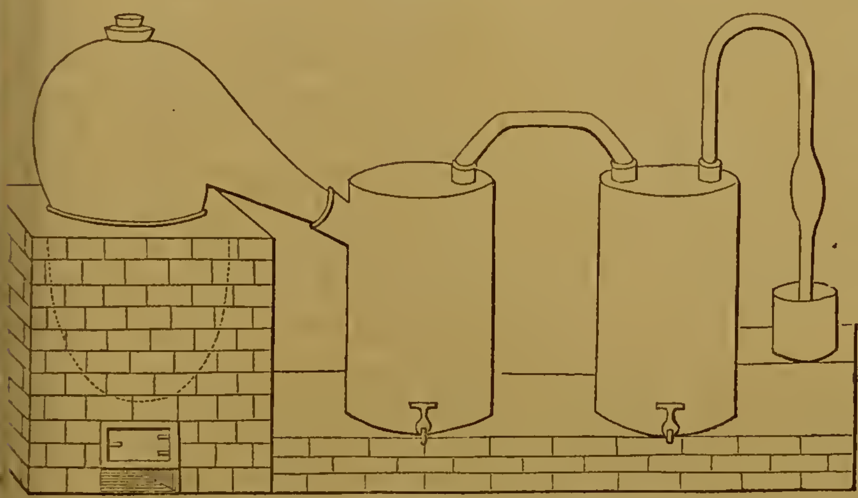
2. *Liquid Hydrochloric Acid.*

SYNONYMES.—This is an aqueous solution of hydrochloric acid, and is sually called, for brevity, *hydrochloric* or *muriatic acid.* It is the *acidum ydrochloricum* of the London Pharmacopœia.

PREPARATION.—(*a.*) *According to the Pharmacopœias.* In the London harmacopœia this acid is prepared by adding twenty ounces of sulphuric cid mixed with twelve fluid ounces of distilled water, to two pounds of ried chloride of sodium, placed in a glass retort. Twelve fluid ounces distilled water are to be put into the receiver Distil by a sand bath. 1 the Dublin Pharmacopœia a somewhat larger quantity of water is nployed. The Edinburgh Pharmacopœia orders equal weights of sulhuric acid, water, and chloride of sodium (previously heated to redness).

(*b.*) *In commerce.*—Manufacturers of hydrochloric acid generally employ an iron or stoneware pot set in brickwork over a fire-place, with a stoneware head luted to it, and connected with a row of double-necked bottles, made of the same material, and furnished with stop-cocks of earthenware. The last bottle supplied with a safety tube, dipping into a vessel of water (fig. 40).

Fig. 40.



Apparatus for making Hydrochloric Acid.

Since the manufacture of carbonate of soda from the sulphate of soda, nd the consequent necessity of obtaining the latter salt in large quanties, another mode of making hydrochloric acid has been adopted It onsists in using a semi-cylindrical vessel for the retort: the upper or flat urface of which is made of stone, while the curved portion exposed to ie fire is formed of iron. The chloride of sodium is introduced at one nd, which is then closed by an iron plate, perforated to allow the itroduction of the leg of a curved leaden funnel, through which strong ulphuric acid is poured. The funnel is then removed, and the aperture losed. Heat being applied, the hydrochloric acid gas is developed, and conveyed by a pipe into a double-necked stoneware bottle, half filled ith water, and connected with a row of similar bottles, likewise containg water. The gas dissolves in the water, which, when saturated, constitutes the *common yellow hydrochloric acid of commerce,* which is oloured by iron. By a second distillation, at a low heat, a liquid nearly olourless is obtained, which is sold as *pure* hydrochloric acid.

The *theory* of the above process is precisely that already explained n the manufacture of hydrochloric acid gas. The salt is dried, to xpel any water which may be mechanically lodged between the lates of the crystal, and to obtain uniform weights. The Edinburgh

College order the chloride to be heated to redness, to decompose any nitrate which which may be present; and, in order to insure the complete decomposition of the salt, employ a large excess of sulphuric acid, so that the residual salt is the bisulphate of soda.

PROPERTIES.—Pure liquid hydrochloric acid is colourless, evolves acid fumes in the air, and possesses the usual characteristics of a strong acid. It has the odour and taste of the gaseous acid. Its specific gravity varies with its strength. That of the London Pharmacopœia is 1·16. It is decomposed by some of the metals (as zinc and iron), hydrogen gas being evolved, while a chloride is formed in solution. It is decomposed by those oxyacids which contain five atoms of oxygen—namely, nitric, chloric, iodic, and bromic acids: the oxygen of these acids unites with the hydrogen of the hydrochloric acid to form water. It combines with ammonia, as well as with the vegetable alkalies, to form a class of salts called hydrochlorates or muriates. When it acts on a metallic oxide, water and a chloride are generated.

CHARACTERISTICS.—A solution of nitrate of silver causes, with hydrochloric acid, a precipitate of the chloride of silver. This precipitate is known to be the chloride by its whiteness, its clotty or curdy appearance, its blackening by exposure to light, its insolubility in nitric acid, its solubility in ammonia, and by its fusibility (see p. 105). When pure, hydrochloric acid neither dissolves leaf gold, nor destroys the colour of sulphate of indigo. The addition of a few drops of nitric acid readily enables it to dissolve gold. A rod dipped in a solution of caustic ammonia produces white fumes when brought near strong liquid hydrochloric acid.

COMPOSITION —At the temperature of 40° F. water absorbs 480 times its bulk of hydrochloric acid gas, and forms a solution, having a specific gravity of 1·2109 (Sir H. Davy's *Elements of Chemical Philosophy*, p. 252). Prepared according to the London Pharmacopœia, liquid hydrochloric acid has a sp. gr. of 1·16, and contains about a third of its weight of hydrochloric acid gas.

Sp. gr. of liquid acid.	Hydrochloric acid gas in 100 of liquid.	Authority.
1·16	32·32	Mr. E. DAVY.
1·162	33·945	Dr. THOMSON.
1 1620	32·621	Dr. URE.
1·1641	33·029	Dr. URE.
1·1661	33·437	Dr. URE.
1·1681	33·845	Dr. URE.

100 grains of liquid hydrochloric acid sp. gr. 1·16 should saturate 132 grains of crystallized carbonate of soda. A better substance for ascertaining the strength of the acid is pure Carrara marble (carbonate of lime): every 50 grains dissolved indicates 37 grains of real hydrochloric acid.

The *Acidum hydrochloricum dilutum* of the London Pharmacopœia is composed of four fluid ounces of the strong liquid hydrochloric acid, and twelve fluid ounces of water. One fluidrachm of it saturates very nearly 32 grains of crystallized carbonate of soda (Phillips, *Translation of the Pharmacopœia*).

IMPURITIES.—The ordinary impurities of the common liquid hydrochloric acid of the shops are perchloride of iron, sometimes a little free chlorine, and occasionally a little sulphuric acid. Dr. T. Thomson spects that bromine may be present, partly because this substance has en found in common salt, and partly because a small quantity of this bstance gives a yellow colour to pure hydrochloric acid.

The presence of *iron* is shewn by saturating the acid with carbonate soda, and then applying tincture of nutgalls, which produces a black t. Another mode is to supersaturate the liquid with ammonia or its squicarbonate, by which the red or sesquioxide of iron will be preitated.

If the liquid acid contain either *free chlorine* (or *bromine*) it will poss the power of dissolving leaf-gold, or even of decolourizing a small antity of sulphate of indigo. A solution of protochloride of tin proces a purplish colour with a solution of gold.

Sulphuric acid (free or combined) may be detected by adding to the spected acid a solution of chloride of barium: if sulphuric acid be esent, a heavy white precipitate of sulphate of baryta is procured, ich is insoluble in both acids and alkalies. In applying this test the spected acid should be previously diluted with five or six times its ume of water; otherwise a fallacy may arise from the crystallization the chloride of barium.

PHYSIOLOGICAL EFFECTS.—(*a.*) *On dead animal matter.*—Very dilute drochloric acid, mixed with dried mucous membrane, has the prorty of dissolving various animal substances (as coagulated albumen, rin of the blood, boiled meat, &c.), and of effecting a kind of artificial gestion of them, somewhat analogous to the natural digestive process— üller, *Elements of Physiology*, p. 544).

(*b.*) *On living animals.*—The effects of liquid hydrochloric acid on ng animals (horses and dogs) have been investigated by Sproegel, urton, Viborg (Wibmer, *die Wirkung der Arzneimittel und Gifte*), and Orfila (*Toxicologie Générale*). Thrown into the veins it coagulates blood, and causes speedy death. Small quantities, however, may be ected without giving rise to fatal results. Thus Viborg found that a se recovered in three hours from the effects of a drachm of the acid uted with two ounces of water, thrown into a vein. Administered the stomach to dogs, the undiluted acid acts as a powerful caustic son. Exhalations of the acid vapours take place through the mouth l nostrils, and death is generally preceded by violent convulsions.

(*c.*) *On man.*—Properly diluted, and administered *in small but repeated es*, hydrochloric acid produces the usual effects of a mineral acid ore described (pp. 80, 81, and 84): hence it is tonic, refrigerant, and retic. It usually causes a sensation of warmth in the stomach, relaxes bowels, and increases the frequency of the pulse. *Larger doses* said to have excited giddiness and a slight degree of intoxication or por. In a *concentrated form* it operates as a powerfully caustic poison. e only recorded case of poisoning by it (in the human subject) with ich I am acquainted, is that mentioned by Orfila (*Toxicolog. Générale*). e particular nature of the chemical changes effected by it in the organic sues with which it comes in contact, is not so well understood as in case of sulphuric or nitric acid. Its chemical action is less energetic in either of the acids just mentioned.

USES—(*a.*) *Internal* or *remote.*—Hydrochloric acid has been employed those diseases formerly supposed to be connected with a putrescent ndition of the fluids; as the so-called putrid and petechial fevers, malignant scarlatina, and ulcerated sore throat. It is usually administered, in these cases, in conjunction with the vegetable tonics; as cinchona or quassia. We frequently employ it to counteract phosphatic deposits in the urine. After a copious evacuation, it is, according to Dr. Paris, the most efficacious remedy for preventing the generation of worms; for which purpose the infusion of quassia, stronger than that of the Pharmacopœia, is the best vehicle. It has been employed with benefit in some forms of dyspepsia. Two facts give a remarkable interest to the employment of this acid in dyspeptic complaints; namely, that it is a constituent of the healthy gastric juice; and, secondly, when mixed with mucus, it has a solvent or digestive power in the case of various articles of food, as before mentioned. Lastly, hydrochloric acid has been used in scrofulous and venereal affections, in hepatic disorders, &c.

(*b.*) *External.*—In the concentrated form it is employed as a caustic to destroy warts, and as an application in sloughing phagedæna, though for the latter purpose it is inferior to nitric acid. Properly diluted it forms a serviceable gargle in ulceration of the mouth and throat. The objection to its use as a gargle is its powerful action on the teeth: to obviate this as much as possible, the mouth is to be carefully rinsed each time after using the gargle. It is sometimes applied to ulcers of the throat by means of a sponge. Water acidulated with this acid has been applied to frostbitten parts, to chilblains, &c. An injection composed of from 8 to 12 drops of the acid to three or four ounces of water, has been employed as an injection in gonorrhœa.

Administration.—It is given, properly diluted, in doses of from five to fifteen or twenty minims. The *diluted* acid of the Pharmacopœia may be administered in doses of from half a fluidrachm to one fluidrachm. The most agreeable mode of exhibiting it is in the infusion of roses, using the hydrochloric instead of sulphuric acid.

Antidotes.—In a case of poisoning by this acid, the antidotes are chalk, whiting, magnesia or its carbonate, and soap; and in the absence of these, oil, the bicarbonated alkalies, milk, white of egg, or demulcents of any kind. Of course the gastro-enteritis is to be combated in the usual way.

Order 6.—Nitrogen, and its Compounds with Oxygen and Hydrogen.

Nitroge'nium.—Ni'trogen.

History and Synonymes.—This gas was first recognised by Dr. Rutherford, in 1772. He termed it *mephitic air*. Priestley called it *phlogisticated air*. Lavoisier, *a'zote* (*azo'tum*). Cavendish, finding it to be a constituent of nitric acid, gave it the name it now usually bears (nitrogen).

Natural History.—It is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—It has not hitherto been found in non-fossiliferous rocks. It is a constituent of coal, of nitrates, of ammoniacal salts, and of some mineral waters. It forms 79 or 80 per cent. of the atmosphere.

(*b.*) *In the organized kingdom.*—It is a constituent of various vegetable principles, as the organic alkalies, gluten, and indigo blue; and is particularly abundant in the families *Cruciferæ* and *Fungi*. It enters into the composition of most animal substances, as albumen, fibrin, gelatin, ucus, urea, uric acid, &c. It is found in the swimming bladders of :hes.

PREPARATION.—The readiest method of procuring nitrogen is to burn piece of phosphorus in a confined portion of atmospheric air. The osphorus combines with the oxygen of the air and forms metaphospho- ; acid. The residual gas after being thoroughly washed is nearly pure trogen.

PROPERTIES.—It is a colourless, odourless, tasteless gas; neither combustible nor a supporter of combustion. It neither reddens litmus, nor whitens lime water. Its sp. gr. is 0·9722. It is very slightly absorbed by water. Its equivalent by weight is 14, by volume 1.

1 eq. Nitrog. = 14

CHARACTERISTICS.—Nitrogen is usually distinguished by its negative operties just described. The only positive test for it is combining it th oxygen to form nitric acid. This may be effected in two ways; her by electrifying a mixture of nitrogen and oxygen, or by burning stream of hydrogen in a mixture of oxygen and nitrogen. The nitric id thus produced reddens litmus, and when absorbed by potash may be cognised by the tests hereafter to be mentioned. (See *Nitric Acid.*)

PHYSIOLOGICAL EFFECTS.—The effects of nitrogen gas on vegetables d animals are analogous to those of hydrogen before mentioned 126). Thus, when inspired, it acts as an asphyxiating agent, by exiding oxygen; when injected into the blood it acts mechanically only. is an essential constituent of the air employed in respiration.

USES.—It has been mixed with atmospheric air, and inspired in cern pulmonary affections, with the view of diminishing the stimulant luence of the oxygen, and thereby of acting as a sedative. (*Dict. Mat. ed.*)

Nitroge'nii Protox'ydum.—Protox'ide of Ni'trogen.

HISTORY AND SYNONYMES.—This gas was discovered by Dr. Priestley 1776. He termed it *dephlogisticated nitrous air.* Sir H. Davy, in "*Researches*" on it, calls it *nitrous oxide.* Its common name is *ghing gas.*

NATURAL HISTORY.—This compound is always an artificial production.

PREPARATION.—It is obtained by heating nitrate of ammonia in a ss retort. Every equivalent or 71 parts of the salt are resolved into ee equivalents or 27 parts of water, and two equivalents or 44 parts of otoxide.

NGREDIENTS USED.			PRODUCTS.
Nitrate mm. 71	1 eq. Nitr^c. A^d. 54	1 eq. Nitr. 14	2 eq. Protox. Nitr. 44
		2 eq. Oxyg. 16	
		3 eq. Oxyg. 24	
	1 eq. Amm. . 17	1 eq. Nitr. 14	
		3 eq. Hydr. 3	3 eq. Water . . . 27

PROPERTIES.—At ordinary temperatures and pressure it is a colourless , with a faint not disagreeable odour, and a sweetish taste. It is not nbustible, but is a powerful supporter of combustion, almost rivalling this respect oxygen gas. Protoxide of nitrogen does not affect vegele colours. It undergoes no change of colour or of volume when xed with either oxygen or the binoxide of nitrogen.

1 eq. Prot. Nitr. =22

Its equivalent, by weight, is 22, by volume 1. Its sp. gr according to Dr. T. Thomson, is 1·5277. When subjected t a pressure of 50 atmospheres, at 45° F., it is condensed into limpid colourless liquid.

CHARACTERISTICS.—The only gas with which it is possible to confoun it, is oxygen, with which it agrees in being colourless, not combustibl but a powerful supporter of combustion re-inflaming a glowing match. It ma be readily distinguished by mixing i with an equal volume of hydrogen, an exploding it by the electric spark, b which we obtain one volume of nitrogen and an equivalent or 9 parts water.

Before combustion.		After combustion.	
1 eq. Protox. Nitr. = 22	1 eq. Hydrog. = 1	1 eq. Nitrog. = 14	and 1 eq. Water=9.

COMPOSITION.—It consists of one equivalent or 14 parts of nitroge and one equivalent or 8 parts of oxygen ; or, by measure, a volume of ni trogen and half a volume of oxygen condensed into the space of a volum

	Eq.	Eq.Wt.	Per Cent.	Davy.		Vol.	Sp. g
Nitrogen	1	14	63·6	63·3	Nitrogen gas	1	0·972
Oxygen	1	8	36·4	63·7	Oxygen gas	0·5	0·555
Protoxide Nitrogen	1	22	100·0	10·0	Protox. Nitrogen gas	1	1·527

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—Germinating seeds (peas when watered with a solution of this gas seemed unaffected by it. Plant introduced into vessels filled with the gas mostly faded in about thre days, and died shortly after. (Davy's *Researches.*) But Drs. Turner an Christison did not find that it was injurious to vegetation. (Christiso *On Poisons*, p. 756).

(*b.*) *On animals.*—The effects of this gas on insects, annelides, mol lusca, amphibials, birds, and mammals, were examined by Sir H. Davy On all it acted as a positive poison. It produced "peculiar changes in the blood and in their organs, first connected with increased living action but terminating in death." (Davy, p. 449). Slowly injected into th veins of animals, considerable quantities were found by Nysten to pro duce slight staggering only ; larger quantities produced the same disor der of the nervous system noticed when the gas is respired. (*Recherche* p. 77 and 78).

(*c.*) *On man.*—When inhaled its effects on the nervous system are mo remarkable : I have administered this gas to about one hundred person and have observed that after the respiration of it from a bladder for a fe seconds, it usually causes frequent and deep inspirations, blueness of th lips and countenance, an indisposition to part with the inhaling tub and a temporary delirium, which subsides in the course of three or fou minutes. The sensations are usually pleasing. The delirium manifes itself differently in different individuals, as in some by dancing, in other by fighting, &c. In some few cases I have seen stupor produced. Sing ing in the ears, giddiness, and tingling sensations in the hands and fee are sometimes experienced.

USES.—It has been employed in some few cases only of disease. Bed does used it in paralysis with benefit ; but found it injurious to the hyste rical and exquisitely sensible. (Davy's *Researches*, p. 542). In a remar able case of spasmodic asthma, related by Mr. Curtis (*Lancet*, vol. ii. f 1828 and 1829), it acted beneficially. In a second case it also gave relief

Ac'idum Ni'tricum.—Ni'tric Ac'id.

Hɪsᴛᴏʀʏ ᴀɴᴅ Sʏɴᴏɴʏᴍᴇs.—This acid was known in the seventh cen ry to Geber, who termed it *solutive water*, (*Of the Invention of Verity*, . xxi. and xxiii.) The nature of its constituents was shown by Caven- sh in 1785, and their proportions were subsequently determined by ivy, Gay-Lussac, and Thomson. It has been known by various names, *Glauber's spirit of nitre*, and *aquafortis*.

Nᴀᴛᴜʀᴀʟ Hɪsᴛᴏʀʏ.—It is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Combined with potash, soda, lime, magnesia, it is found on the surface of the earth in various parts of the rld. The nitrates have been found in some few mineral waters. Thus re is a district of Hungary, between the Carpathians and the Drave, iere all the springs, for the space of about 300 miles, contain a small antity of the nitrate of potash (Gairdner, *on Mineral Springs*, p. 20).

(*b.*) *In the organized kingdom.*—Nitrate of lime has been found in *rago officinalis*, *Urtica dioica*, *Helianthus annuus*, and *Parietaria offici- lis.* Nitrate of potash has been detected in the roots of *Cissampelos reira*, and *Geum urbanum*; in the juice of *Chelidonium majus*; in *Apium veolens;* and sometimes in the root of *Beta vulgaris* when advanced in e. The same salt is also found in the flowers of *Verbascum*, in the zome of *Zingiber officinale*, in the fruit of *Areca Catechu*, in the tuber- of *Cyperus esculentus*, in *Agaricus acris*, and *A. edulis* (Decandolle, *ysiol. Végét.* t. 1er. pp. 383, 387, and 403).

Pʀᴇᴘᴀʀᴀᴛɪᴏɴ. (*a.*) *In the Pharmacopœia.*—In the London Pharmaco- ia we are directed to mix in a glass retort two pounds of dried nitrate potash with an equal weight of strong liquid sulphuric acid, and to til the nitric acid in a sand bath. Mr. Phillips (*Translation of the armacopœia*) says that this process yields nitric acid of sp. gr. 1·5033 1·504.

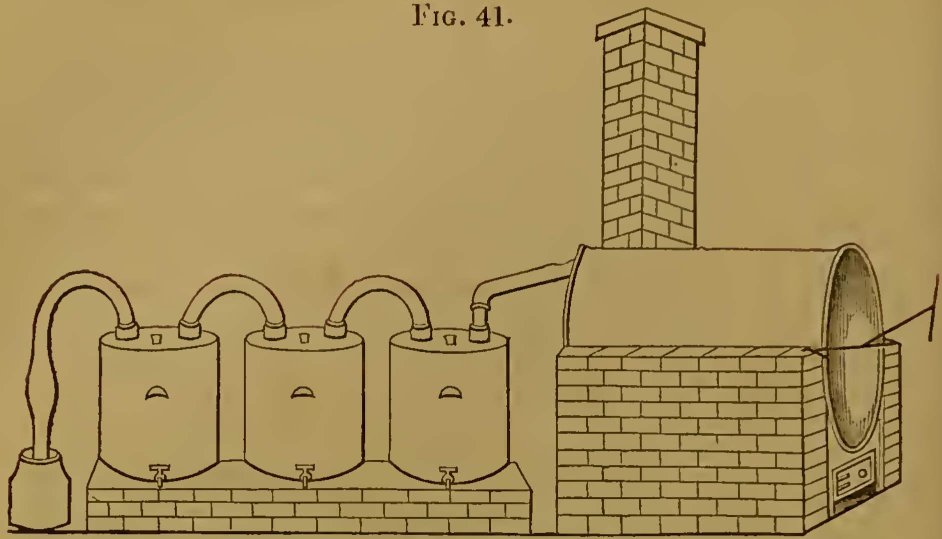
The explanation of the changes which take place is somewhat modi- l by the strength of the sulphuric acid employed. According to Mr. illips, the acid usually met with has a sp. gr. of 1·8433: I have found generally somewhat below this. The acid alluded to by Mr. Phillips composed, according to the same authority, very nearly of four equi- ents or 160 parts of dry sulphuric acid, and five equivalents or 45 rts of water. These quantities re-act on two equivalents or 204 parts nitrate of potash, and produce two equivalents or 135 parts of strong uid nitric acid (sesquihydrate), and one equivalent or 274 parts of the drated bisulphate of potash.

NGREDIENTS USED.			PRODUCTS.
. Nitrte. Poth. . 204	2 eq. Nitric Acid .	108	2 Sesquihydrate Nitric Acid 135
	2 eq. Potash . . .	96	
Liqd. Sulpc. Acid 205 (Sp. gr. 1·8433)	3 eq. Water . . .	27	
	2 eq. Water . . .	18	
	4 eq. Sulphc. Acid	160	2 Hydrated Sulphate Potash 274

stead of the glass retort directed in the Pharmacopœia, manufacturers erally employ an iron or stone-ware pot, with a stone-ware head, ich is connected with a row of double-necked stone-ware bottles. (See fig. 41, p. 158).

(*b.*) *For commercial purposes.*—The ordinary nitrous and nitric acids commerce are prepared in an iron cylinder set in brickwork over a fire-place (fig. 41). 168lbs. of nitrate of potash are introduced at o

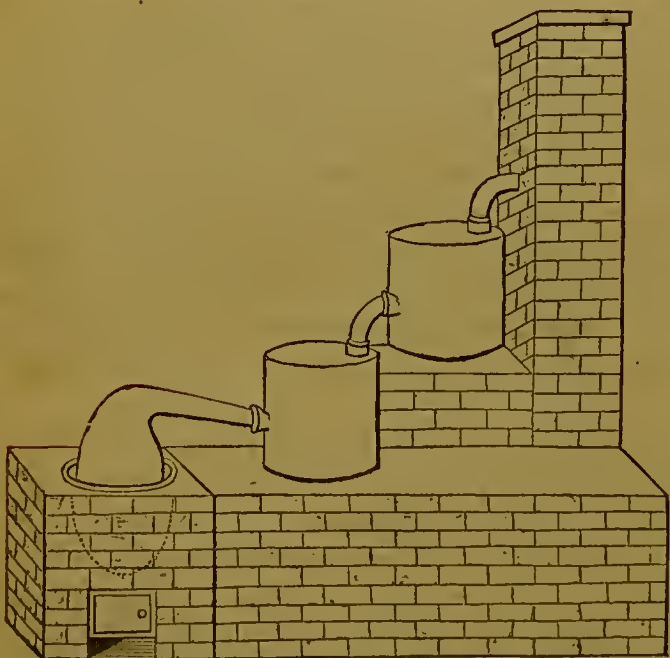
FIG. 41.



Nitric Acid Apparatus.

end of the cylinder, which is afterwards closed by a circular disk of ir perforated to allow of the introduction of a leaden funnel, through whi are poured 93lbs. of strong sulphuric acid (sp. gr. 1·845). The funnel then removed, the aperture closed, and heat applied. The vapours conveyed into a row of five or six bottles of stone-ware filled to abo one-sixth of their capacity with water. The acid obtained by this pr cess is brown and fuming, and has a sp. gr. of 1·45. It is called in co merce *nitrous acid*, or *fuming nitric acid.* To render it colourless it heated in a glass retort, placed in a sand bath: the vapour whi escapes is passed through two stone-ware bottles to save any acid th may be expelled, and is subsequently conveyed into a chimn (fig. 42). The colourless acid remaining in the retort has a s gr. of about 1·44, and co stitutes the *nitric acid* commerce. The residue the iron cylinder is a mi ture of sulphate with a li tle bisulphate of potash, a is sold as *sal enixum.* It employed as a flux, and the alum-makers*.

FIG. 42.



Apparatus for the purification of coloured nitric acid.

The quantity of the i gredients employed in t above process is ne ly in the proportion eight equivalents or 3 parts of strong sulphu acid, and seven equivale or 714 parts of nitrate potash. Some manuf turers employ two parts weight of nitrate of pota

* For the above information I am indebted to Messrs. White, nitric acid manuf turers, Castle Street, Saffron Hill, London, who have kindly permitted me to ma the above sketches of their apparatus.

one of strong sulphuric acid, or about an equivalent of each of the ·edients. As the water of the sulphuric acid is not sufficient in quan- to form liquid nitric acid with all the acid set free from the nitrate, ırt of the nitric acid is decomposed into nitrous acid and oxygen. It ıe presence of nitrous acid which communicates the red colour to the ımercial or fuming nitric acid.

'he generation of nitrous acid is greatest at the commencement and ırds the close of the operation: for at the commencement the excess ıncombined sulphuric acid attracts water from the small quantity of ic acid then set free, in consequence of which the latter is resolved nitrous acid and oxygen: about the middle of the process, when the ıntity of free nitric acid has increased while that of sulphuric acid has inished, the former passes over with water, unchanged: but towards end of the process, owing to the volatilization of the nitric acid, the ›huric acid becomes again predominant, and the red vapours of nitrous l then make their appearance.

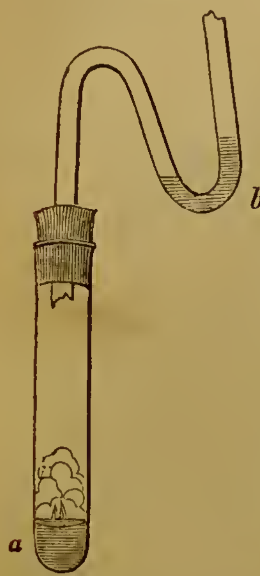
'ROPERTIES.—Strong liquid nitric acid is colourless, and has a uliar odour, and an acrid, intensely sour taste. In the air it evolves te fumes, formed by the union of the acid vapour with the aqueous our of the atmosphere; these fumes redden litmus, and become much ter when mixed with the vapour of ammonia, owing to the formation he nitrate of ammonia. The sp. gr. of the acid prepared according to Pharmacopœia is 1·5033 to 1·504, and Mr. Phillips believes this to the strongest procurable; but Proust obtained it as high as 1·62, wan 1·554, Davy 1·55, Gay-Lussac 1·510, Thenard 1·513. The acid l in the shops as *double aquafortis* has a sp. gr. of 1·36. *Single afortis* is of sp. gr. 1·22. It has a powerful affinity for water, and, ən mixed with it, heat is evolved.

'itric acid is easily deprived of part of its oxygen. Thus exposure to ır light causes the evolution of oxygen and the production of nitrous l, which gives the liquid a yellow, orange, or reddish brown colour. ə acid thus coloured may be rendered colourless by the appli- on of a gentle heat, to drive off the nitrous acid. Several of the -metallic combustibles rapidly decompose nitric acid, as charcoal, ›sphorus, sugar, alcohol, volatile oils, resins, &c. The acid is unacted by leaf gold, platinum, &c. Some of the metals also act powerfully it, as copper (in the form of turnings) and tin (in the state of foil). A le water added to the acid facilitates, in some cases, the action of me- on it. For an account of the anomalous relations of this acid and ı, I must refer the reader to Becquerel's *Traité de l'Electricité*, tom. v. 3. The hydracids (as hydrochloric acid) decompose and are decom- ›ed by nitric acid.

'HARACTERISTICS.—Nitric acid is known by the following characters: stains the cuticle yellow or orange: mixed with copper filings, effer- cence takes place, owing to the escape of binoxide of nitrogen, and a enish blue solution of nitrate of copper is obtained: the binoxide ms ruddy vapours in the air, by uniting with oxygen to form nitrous d gas; and passed into a solution of the protosulphate of iron, forms ark olive-brown coloured liquid, which has a strong affinity for oxygen, l has in consequence been employed for analysing atmospheric air: t the results obtained by it are uncertain. Morphia, brucia, or com- rcial strychnia, communicates a red colour to nitric acid, which is heightened by supersaturating with ammonia: powdered nux vomi renders this acid yellow or orange-coloured. If hydrochloric acid added to nitric acid, the mixture acquires the power of dissolving l gold: the presence of gold in solution may be recognized by the pro chloride of iron, which strikes a purple or dark colour. Lastly, saturat with pure carbonate (or bicarbonate) of potash, a nitrate of potash procured.

The *nitrates* are known by the following characters:—they evol oxygen when heated, and deflagrate when thrown on a red-h cinder or charcoal; when heated with sulphur acid they disengage nitric acid, which may recognized by its action on morphia, brucia, commercial strychnia; lastly, when mixed with su phuric acid and copper turnings, they genera binoxide of nitrogen, which is readily recogniz by its blackening a solution of protoxide of iro This last-mentioned property enables us to recogni very minute portions of the nitrates. The mixture the nitrate, copper filings, and sulphuric acid is be put into the test-tube (fig. 43 *a.*): adapt, b means of a cork, a small curved glass tube, co taining at the bend (*b*) a drop or two of the solu tion of the protosulphate of iron; apply heat the mixture in the test-tube, and in a few mi nutes the ferruginous solution becomes brown o blackish.

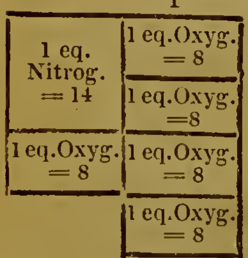
FIG. 43.



COMPOSITION.—*Anhydrous* or *dry nitric acid*, such as we find it i some nitrates, has the following composition by weight:

	Eq.	Eq. Wt.	Per Cent.	Lavoisier.	Cavendish.	Berzelius.	Da
Nitrogen	1	14	25·9	20	25	26	29
Oxygen	5	40	74·1	80	75	74	70
Nitric Acid	6	54	100	100	100	100	10

Its composition by volume is, one volume of nitrogen gas and tw and a half volumes of oxygen gas. The degree o condensation, however, is not known, as uncombine anhydrous nitric acid has not yet been procured.



Liquid nitric acid is composed of nitric acid an water. According to Mr. Phillips, when the specifi gravity of the liquid is 1·5033 to 1·504, the compo sition is as follows:

	Eq.	Eq. Wt.	Per Cen
Dry or Anhydrous Nitric Acid	1	54	8
Water	$1\frac{1}{2}$	13·5	2
Sesquihydrate of NitricAcid	1	67·5	10

100 grains of this acid will saturate about 217 grains of carbonat of soda.

The *dilute nitric acid* of the London Pharmacopœia is prepared b mixing a fluid ounce of the strong liquid nitric acid with nine flui ounces of distilled water. Its sp. gr. is 1·080. 100 grains saturat out 31 grains of crystallized carbonate of soda. The following is its mposition :—

or Anhydrous Nitric Acid	11·44	Strong Liquid Nitric Acid (sesquihydrate) .	14·3
ter	88·56	Water	85·7
ute Nitric Acid	100·00	. . . .	100·0

IMPURITIES.—The presence of nitrous acid is known by the colour. detect chlorine or the chlorides, dilute with distilled water, and apply rate of silver; a white chloride of silver is precipitated. To recognise phuric acid, add a solution of chloride of barium to the diluted acid; eavy insoluble white sulphate is thrown down. Any fixed impurities y be obtained by evaporating the acid by heat.

PHYSIOLOGICAL EFFECTS.—(*a.*) *On vegetables.*—Nitric acid decomposes different vegetable tissues to which it may be applied, and gives m a yellow colour.

(*b.*) *On animals.*—Orfila found that 26 grains of commercial nitric acid ected into the jugular vein, coagulated the blood, and caused death in o minutes (*Toxicolog. Générale*). Viborg threw a drachm of the acid, uted with three drachms of water, into the jugular vein of two horses; two hours they were well: the blood, when drawn, was slightly gulated (Wibmer, *die Wirkung*, &c.) Introduced into the stomach of gs it disorganizes this viscus, and causes death in a few hours.

(*c.*) *On man.*—On the *dead body*, M. Tartra has made various experints to determine the appearances produced by the action of nitric d. Of course this caustic decomposes the organic textures; but the enomena presented vary according to different circumstances,—as the antity employed, the presence of other substances, &c.

On the *living body*, its action of course varies, with the degree of centration or dilution of the acid. In the concentrated form the acid s as a powerfully corrosive poison, which property it derives in part m its affinity for water, but more especially from the facility with ich it gives out oxygen; so that the appearances caused by its action some of the tissues are different from those produced by sulphuric id. Thus the permanent yellow stain which it communicates to the ticle is peculiar to it. Iodine, indeed, stains the skin yellow or brown, t a little caustic potash readily removes the stain when recent; whereas yellowish stain produced by nitric acid becomes orange on the addin of an alkali or soap. Bromine also stains the skin yellow, but when ently produced, the colour may also be removed by potash. The yellow citron stain communicated to the lining membrane of the tongue, arynx, &c. by nitric acid is well shewn in Dr. Roupell's *Illustrations of e Effects of Poisons*. A preparation, presenting similar appearances, is eserved in the anatomical museum of the London Hospital. The llow substance produced by the action of nitric acid on fibrine, was med by MM. Fourcroy and Vauquelin the *yellow acid:* the same subnce is probably produced by the application of nitric acid to other imal principles. This yellow substance is bitter, and is said by rzelius to consist of yellow, altered fibrin, combined with nitric acid d with malic acid, formed by the action of some nitric acid on the rin. Nitric, like sulphuric acid, also chars the animal tissues, and us, after the ingestion of it, the stomach is sometimes found blackened, as if sulphuric acid had been swallowed. The symptoms are analogo to those produced by sulphuric acid (see *Sulphuric Acid*). The yello citron, or orange spots, sometimes observed on the lips, chin, or hea will, when present, at once indicate the kind of acid swallowed. Som times the binoxide of nitrogen is evolved by the mouth.

Properly diluted, nitric acid produces effects similar to those of t other dilute acids (see pp. 81 and 84: also *Hydrochloric* and *Sulphu Acids*). It is said, however, to act less evidently as a tonic, and to more apt to disagree with the stomach, so that it cannot be employed f so long a period. In some cases it has excited ptyalism, and from th circumstance, as well as from the occasional benefit derived from its use the venereal disease, it has by some writers been compared, in its operati to mercury; a comparison founded rather on theoretical than practic considerations.

Uses.—(*a*.) *Internal.*—As nitric acid produces certain effects, common with other mineral acids, it may be used as a substitute for t latter in various diseases. Thus, it is administered in conjunction wi the bitter infusions, in those conditions admitting of, or requiring, the u of tonics. Properly diluted, it is employed as a refrigerant in febr disorders. In lithiasis, attended with phosphatic deposits in the urin it may be used instead of the sulphuric or hydrochloric acid. In so obstinate cutaneous diseases, as impetigo, it is given to the extent of h a drachm daily in barley water (Rayer, *Treatise on the Diseases of t Skin*, p. 502). It may be employed also to relieve heartburn.

In 1793 this acid was used by Mr. Scott, a surgeon at Bombay, as substitute for mercurial preparations, which Girtanner erroneously fanci owed their efficacy to the quantity of oxygen which they containe Mr. Scott first tried it in chronic hepatitis, and with considerable su cess. He then extended its use to venereal diseases, and obtained t happiest results from it.

Subsequently, it has been most extensively employed in the la mentioned diseases; but the success attending its use has been ve variable. That it has been, and is frequently serviceable, no one c doubt who reads the immense body of evidence offered in its favour Scott, Kellie, Albers, Prioleau, Rollo, Cruickshank, Beddoes, Ferri and others. But on the other hand it is equally certain that on ve many occasions it has been useless. The same remark, indeed, may made of mercury, or of any other remedy: but as an antivenereal med cine it does not admit of comparison with this metal. However, frequently meet with syphilitic cases in which the employment mercury is either useless or hurtful. Thus it can rarely be employ with advantage in scrofulous subjects; or in persons whose idiosy crasies render them peculiarly susceptible to the influence of this meta and in sloughing sores it is inadmissible. Now these are the cases which nitric acid may be employed with benefit; and I believe the be mode of administering it is in conjunction with the compound decocti of sarsaparilla.

For further information respecting its employment, I must refer to t works of Holst (*De Acidi Nitrici usu Medico Dissertatio*, Christia 1818) and Mr. Samuel Cooper (*Dict. of Practical Surgery*).

(*b*.) *External.*—In the *concentrated* state, nitric acid has been em ployed as a powerful caustic to destroy warts, and as an application rts bitten by rabid animals or venomous serpents, to phagedenic :ers, &c. In order to confine the acid to the spot intended to be acted , the neighbouring parts may be previously smeared with some resinous ıtment. In sloughing phagedæna the application of strong nitric acid, recommended by Mr. Welbank (*Medico-Chirurg. Trans.* vol. xi.) is ended with the most successful results, as I have on several occasions nessed. The best mode of applying it is by a piece of lint tied round mall stick or skewer. When the slough is very thick, it is sometimes cessary to remove part of it with a pair of scissors, in order to enable acid to come in contact with the living surface.

Largely *diluted* (as 50 or 60 drops of the strong acid to a pint or quart water) it is recommended by Sir Astley Cooper as a wash for slough- and other ill-conditioned sores.

In the form of *ointment* (*Unguentum acidi nitrici*, Ph. Dub.) it is used various skin diseases, especially porrigo and scabies, and as an plication to syphilitic sores.

Nitric acid vapour has been employed to destroy contagion, but it is bably inferior to chlorine. It was first introduced for this purpose by . Carmichael Smyth (to whom Parliament granted a reward of £5000): ıce these fumigations have been termed *Fumigationes nitricæ Smythianæ.* e vapour is readily developed by pouring one part of oil of vitriol over parts of nitrate of potash in a saucer placed on heated sand.

Administration.—*Strong nitric acid* may be administered, in some mild ıent, in doses of from five to ten minims, three or four times daily. The *ıte nitric acid* may be given to the extent of thirty or forty minims.

The *Unguentum acidi nitrici*, Ph. Dub., also called *pommade d'Alyon*, or *genized fat*, is prepared by adding $5\frac{1}{2}$ fluidrachms of nitric acid to a ture of one pound of olive oil, and four ounces of prepared hog's-lard. oxide of nitrogen is evolved, showing that the nitric acid is de- nposed. Part of the fatty matter is oxidized, and a portion is verted into *elaïdine* (see *Unguentum hydrargyri nitratis*). This ment has a firm consistence and a yellow colour. It is more effica- ıs when recently prepared.

Antidotes.—Poisoning by nitric acid requires precisely the same tment as that by sulphuric acid. (See *Sulphuric Acid*).

Ac'idum Ni'tro-hydrochlor'icum.—Ni'tro-hydrochlor'ic Ac'id.

History and Synonymes.—This liquid was known to Geber (*Invention Verity*, ch. xxiii.). It was formerly called *aqua regia*, or *nitro-muriatic l.* Its nature was first explained by Davy.

Preparation.—It is readily prepared, according to the Dublin ırmacopœia, by mixing 2 parts, by measure, of hydrochloric acid with ırt, by measure, of nitric acid. In the arts, however, hydrochlorate of nonia, or common salt, is often substituted for hydrochloric acid; or ate of potash for the nitric acid. By the re-action of one equivalent 54 parts of nitric acid on one equivalent or 37 parts of hydrochloric l, we obtain one equivalent or 46 parts of nitrous acid, one equivalent 36 parts of chlorine, and an equivalent or 9 parts of water.

Ingredients used.		Results.
Hydrochlic. Acid 37	1 eq. Chlorine . 36	1 eq. Chlorine . . 36
	1 eq. Hydrogen 1	1 eq. Water . . . 9
Nitric Acid . . 54	1 eq. Oxygen . 8	
	1 eq. Nitrs. Acid 46	1 eq. Nitrous Acid 46

PROPERTIES.—It has a yellow colour. Its most remarkable property i that of dissolving gold and platinum, metals that are insoluble in eithe nitric or hydrochloric acid separately. It should be kept in a coo dark place; for heat rapidly expels the chlorine, while light enables it t decompose the water and to form hydrochloric acid.

CHARACTERISTICS.—It is recognised by its colour, by its power o dissolving gold, by its precipitating a solution of nitrate of silver; th precipitate being insoluble in nitric acid, but soluble in ammonia; b the production of two salts, a chloride and a nitrate, when an alkali i added to it; and by the evolution of binoxide of nitrogen on the additio of copper turnings (see *Nitric Acid*).

PHYSIOLOGICAL EFFECTS.—It is a powerfully corrosive poison, actin in a similar manner to nitric acid.

USES.—It has been employed *internally* in the same cases as nitri acid, more especially syphilis, diseases of the liver, and some of th exanthemata. *Externally* it has been used as a bath, either local o general, in syphilis and hepatic affections. In India the whole body (th head excepted) is immersed, but in this country pediluvia only a usually employed, or the body is merely sponged with it. The *nitr muriatic bath* is prepared in wooden tubs, by adding this acid to wate until the latter becomes as acid to the taste as vinegar (from $4\frac{1}{2}$ to 6 fluid ounces of the acid to about 3 gallons of water in a deep narrow tub). Th patient should remain in the bath from 10 to 30 or 40 minutes. I excites tingling and prickling of the skin, and is said to affect the gu and salivary glands, causing plentiful ptyalism; indeed, we are told th without the latter effect, every trial is to be regarded as inconclusiv In the passage of biliary calculi this bath is said to be remarkab effective.

ADMINISTRATION.—When taken internally the dose is three or fo drops properly diluted and carefully increased.

ANTIDOTE.—Poisoning by this acid is to be treated in the same way a that by sulphuric acid.

Ammo'nia.—Ammo'nia or *Ammoni'acal Gas.*

HISTORY AND SYNONYMES.—Dr. Black, in 1756, first pointed out th distinction between ammonia and its carbonate; and Dr. Prestley (*O Air*, vol. ii. p. 369, 1790) first procured ammonia in a gaseous form. H called it *alkaline air*. It is sometimes termed *volatile alkali*, and occ sionally *azoturetted hydrogen*.

NATURAL HISTORY.—Ammonia, free or combined, exists in both kin doms of nature.

(*a*.) *In the inorganized kingdom.*—Hydrochlorate and sulphate ammonia are met with native usually in the neighbourhood of volcano Aluminous sulphate of ammonia (or ammonia-alum) occurs in Bohemi Dr. Marcet detected the hydrochlorate in sea water. This salt has al been recognized in mineral waters (Gairdner, *On Mineral Springs*, p. 1 Ammonia exists in many of the native oxides of iron, and in some chal beate waters (*Dict. des Drogues*, t. i. p. 293).

(*b*.) *In the organized kingdom.*—Ammonia is found in vegetables, small quantities only. In the free state, it is said to exist in sever plants, as *Chenopodium vulvaria, Sorbus aucuparia* (*Dict. des Dro

293), in the juice of the leaves of *Isatis tinctoria*, in the bark of *nthoxylum Clava Herculis*, and in *Fucus vesiculosus*. Combined with rbonic acid, it is found in *Justicia purpurea;* with nitric acid, in the tract of hyoscyamus, distilled water of the lettuce, &c. In combination th different substances, it is found in the root of *Helleborus niger*, and *Nymphæa;* in the leaves of *Aconitum Napellus;* in the barks of *Cusparia brifuga* and *Simaruba;* and in the fruit of *Areca Catechu* (Decandolle, *hysiol. Végét.* p. 339). Lastly, it is developed during the decomposi-n (spontaneous or artificial) of most vegetable substances which ntain nitrogen, as gluten.

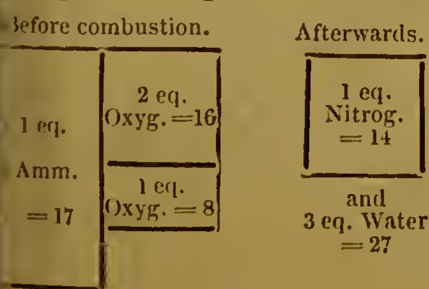
Ammonia is one of the bases found in the urine of man, where it exists combination with phosphoric, hydrochloric, and uric acids. United the last-mentioned acid, it exists in the excrement of the boa constrictor, d of some birds. The hydrochlorate is found in the dung of the camel. nmonia is one of the products of the putrefaction of animal matters.

PREPARATION.—Ammoniacal gas is obtained by heating a mixture of drochlorate of ammonia and quicklime in a glass retort, and collecting er mercury. In the absence of a mercurial apparatus, the gas may be nerated in a Florence flask, to the mouth of which a straight glass tube connected by means of a cork. The bottles which are to be filled ith gas are to be inverted over the tube.

In this process, one equivalent or 54 parts of hydrochlorate of am-onia are decomposed by one equivalent or 28 parts of lime; and the sults of the decomposition are one equivalent or 17 parts of ammonia; e equivalent or 56 parts of chloride of calcium, and one equivalent or parts of water.

INGREDIENTS USED.			RESULTS.
q. Hydrochl^{te}. Amm. 54	1 eq. Ammonia . . 17		1 eq. Ammonia . . 17
	1eq. Hydrochl^{ic}. A^{d}. 37	1 eq. Chlor. 36	
		1 eq. Hydr. 1	1 eq. Water . . . 9
q. Lime . . 28	1 eq. Oxygen . . . 8		
	1 eq. Calcium . . . 20		1 eq. Chl^{de}. Calcium 56

PROPERTIES.—It is a colourless invisible gas, having a strong and ell-known odour. It reddens turmeric paper, and changes the colour violet juice to green; but by exposure to the air, or by the applica-on of heat, both the turmeric paper and violet juice are restored to their iginal colour. The sp. gr. of this gas is 0·59. By a pressure of 6·5 mospheres, at the temperature of 50°, it is condensed into a colourless, ansparent liquid. Ammoniacal gas is not a supporter of combustion,



but is slightly combustible in the atmosphere, and when mixed with air or oxygen it forms an explosive mixture. Every two volumes of ammoniacal gas require one and a half volumes of oxygen for their complete combustion. The results of the explosion are, a volume of nitrogen and some water.

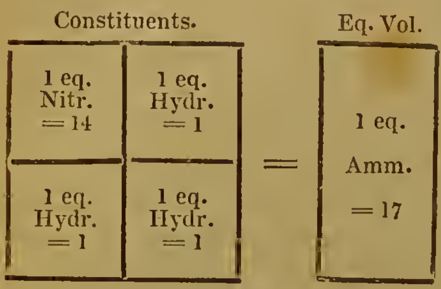
CHARACTERISTICS.—It is readily recognised by its peculiar odour, its ction on turmeric paper, and by its forming white fumes with hydro-hloric acid or chlorine. Dissolved in water, it communicates a deep lue colour to the salts of copper, and throws down a yellow precipitate *platino-bichloride of ammonia*) with the chloride of platinum.

Conia agrees with ammonia in evolving a vapour which redde turmeric paper, and forms white fumes (hydrochlorate of conia) wi hydrochloric acid gas.

Composition.—Ammonia is composed of hydrogen and nitrogen, the following proportions :—

	Eq.	Eq. Wt.	Per Cent.	A. Berthollet.
Nitrogen	1	14	82·35	81·13
Hydrogen	3	3	17·65	18·87
Ammonia	1	17	100·00	100·00

	Vol.	Sp. G
Nitrogen gas	1	0·97
Hydrogen gas	3	0·20
Ammoniacal gas	2	0·59



The annexed diagram illustrates the v lumes of the constituents of the gas, an their degree of condensation when in co bination to form ammoniacal gas.

Physiological Effects.—(*a.*) *On veg tables.*—Ammoniacal gas is destructive plants, and changes their green colour brown (Decandolle, *Physiol. Vég.*, p. 1344

(*b.*) *On animals.*—If an animal be immersed in this gas, spasm of t glottis is immediately brought on, and death results from asphyxi Nysten (*Recherches*, p. 140) injected some of this gas into the veins of dog : the animal cried out, respiration became difficult, and death so took place. Neither gas nor visible lesion was observed in the hea the two ventricles of which contained liquid blood. In another expe ment he threw ammoniacal gas into the pleura of a dog : cries, evacuati of urine, and vomiting, immediately followed ; soon afterwards conv sions came on, and continued for several hours ; ultimately they ceas and recovery took place.

In almost all cases of poisoning in animals, by ammonia, or its ca bonate, convulsions are observed, apparently shewing that these su stances act on the spinal marrow.

(*c.*) *On man.*—Ammonia is a powerful local irritant. This is prove by its pungent odour, and its acrid and hot taste; by its irritating th eyes ; and, when applied for a sufficient length of time to the skin, by i causing vesication. If an attempt be made to inhale it in the pure for spasm of the glottis comes on : when diluted with atmospheric air, irritates the bronchial tubes and larynx, and, unless the quantity be ve small, brings on inflammation of the lining membrane. Its power action on the nervous system is best seen in cases of syncope (see *Aqu Ammoniæ.*)

Uses.—Ammoniacal gas is rarely employed in medicine. M. Bourgu de Béziers used it with success in the case of a child affected with crou to provoke the expulsion of the false membrane.

Antidote.—In case of the accidental inhalation of strong ammoniac vapour, the patient should immediately inspire the vapour of acetic hydrochloric acid. If bronchial inflammation supervene, of course it to be treated in the usual way.

A'qua Ammo'niæ. — *Water of Ammo'nia.*

History and Synonymes.—The *Liquor ammoniæ* of the London Pha macopœia is, more properly as I conceive, denominated *aqua ammoni* the United States and Edinburgh Pharmacopœias. In the Dublin ıarmacopœia it is called *aqua ammoniæ causticæ.* It has also been ·med *spiritus salis ammoniaci causticus, cum calce viva paratus.*

PREPARATION.—(*a.*) In the London Pharmacopœia it is prepared from ı ounces of hydrochlorate of ammonia, eight ounces of lime, and two ıts of water. The lime, slacked with water, is to be first put into a :ort, and then the hydrochlorate of ammonia broken into small pieces: e remainder of the water is then to be added, and fifteen fluid ounces the solution of ammonia distilled.

The theory of the process is the same as that for making ammoniacal gas ·t described. The equivalent proportions of hydrochlorate of ammonia d lime are 54 of the first and 28 of the latter. Now it is obvious that ›re lime is employed in the process of the London Pharmacopœia than is eoretically necessary, if the ingredients were pure. Yet in some other ıarmacopœias the quantity is considerably greater. Thus in that of ıblin the proportions are three parts of hydrochlorate, two parts of lime, d ten parts of water. In the Edinburgh and United States Pharmacopœias e quantities are, a pound of hydrochlorate, a pound and a half of lime, pint (or pound) of distilled water, and nine ounces of distilled water. ıe distilled water is placed in the receiver to absorb the gas. The advan-ɡe contended for by using this great excess of lime is the facility with ıich the ammonia is disengaged: but this is more than compensated in e Edinburgh and United States processes by the inconvenient bulk of the ɡredients. Some excess is of course necessary to allow for impurities.

(*b.*) *In commerce,* the impure sulphate of ammonia is frequently substi-ted for the hydrochlorate. The apparatus employed is an iron cylinder nnected with the ordinary worm refrigerator, and this with a row of uble-necked stone-ware bottles containing water, analogous to those scribed under the head of nitric acid (see *Nitric Acid*).

PROPERTIES.—Solution of ammonia is a colourless liquid, having a ry pungent odour, and a caustic alkaline taste. Its action on turmeric per and violet juice is like that of ammoniacal gas before described. is lighter than water, but its sp. gr. varies with its strength. In the ops a very strong solution (called *Liquor ammoniæ fortior*) is kept, having sp. gr. 0·880: it is employed for smelling-bottles. Prepared according the London Pharmacopœia, the sp. gr. of the water of ammonia is 0·960; cording to the Dublin, 0·905; according to the United States, 0·944; ıd according to the Edinburgh, 0·939. The quantity of ammoniacal ıs which water can dissolve varies with the pressure of the atmosphere ıd the temperature of the water.

Davy (*Elements of Chem. Phil.* p. 268) ascertained that at the tempe-ture of 50°, under a pressure equal to 29·8 inches, water absorbs about '0 times its volume of gas, and becomes of sp. gr. 0·875. He drew up e following table, shewing the quantity of ammonia in solutions of dif-rent specific gravities:—

0 parts of Sp. Gr.	Of Ammonia.	100 parts of Sp. Gr.	Of Ammonia.
0·8750	contain 32·50	0·9435	contain 14·53
0·8875	29·25	0·9476	13·46
0·9000	26·00	0·9513	12·40
0·9054	25·37	0·9545	11·56
0·9166	22·07	0·9573	10·82
0·9255	19·54	0·9597	10·17
0·9326	17·52	0·9619	9·60
0·9385	15·88	0·9692	9·50

It appears from the observations of Davy and Dalton that the speci gravity of mixtures of liquid ammonia and water is exactly the mean that of the two ingredients.

Composition.—From the above observations the composition of offic nal solutions of ammonia is nearly as follows:—

	Lond. Ph. (sp. gr. 0·960)	Dub. Ph. (sp. gr. 0·950)	U. S. Ph. (sp. gr. 0·944)	Ed. Ph. (sp. gr. 0·939)	Liq. am. fo (sp.gr.0·88
Ammoniacal gas	10	12·5	14·5	15·8	30
Water	90	87·5	85·5	84·2	69
Liquor Ammoniæ	100	100·0	100·0	100·0	100

Characteristics.—(See *Ammoniacal Gas*).

Impurities.—Liquor ammoniæ frequently contains traces of the ca bonate of ammonia which may be detected by lime-water, or by a sol tion of the chloride of calcium, either of which occasions a white prec pitate of the carbonate of lime. When a portion of the liquid has be neutralized by pure nitric acid, it ought not to cause a precipitate by tl addition of the nitrate of silver, of oxalic acid, or of sesquicarbonate ammonia: for the first would indicate the presence of hydrochloric aci or chlorine; the second, of lime; the third of lime, or other earthy matt

Incompatibles.—It is hardly necessary to say that all acids a incompatible with ammonia. With the exception of the salts potash, soda, lithia, lime, baryta, and strontia, ammonia decompos most of the metallic salts.

Physiological Effects.—(*a*.) *On vegetables.*—The effects of amm nia on plants have been before noticed.

(*b*.) *On animals.*—Orfila injected sixty grains of liquor ammoniæ int the jugular vein of a strong dog: tetanic stiffness immediately came o the urine passed involuntarily, and the animal became agitated b convulsions: death took place in ten minutes. The body was imme diately opened, when the contractile power of the muscles was foun extinct. In another experiment, thirty-six grains of concentrated solu tion of ammonia were introduced into the stomach, and the œsophagu tied: in five minutes the animal appeared insensible, but in a few mo ments after was able to walk when placed on his feet; the inspiration were deep, and his posterior extremities trembled. In twenty hours h was insensible, and in twenty-three hours died. On dissection th mucous membrane of the stomach was found red in some places. Thes experiments show the effects of large doses of this solution on the ne vous system. The first experiment agrees in its results (that is, i causing tetanic convulsions) with that made by Nysten, and which ha been before mentioned, of throwing ammoniacal gas into the cavity of th pleura. From the convulsions it may be inferred that in these instanc the (grey matter of the) spinal marrow was specifically affected.

(*c*.) *On man. a. Local effects.*—In the concentrated form the loc action of liquor ammoniæ is exceedingly energetic. Applied to the ski it causes pain, redness, vesication, and destruction of the part; thu acting first as a rubefacient, then as a vesicant, and lastly as a caustic o corrosive. Its emanations are also irritant: when they come in contac with the conjunctival membrane, a flow of tears is the result; whe inhaled, their powerful action on the air-passages is well known. Per sons in syncope are observed to be almost immediately raised from

·ath-like state, merely by inhaling the vapour of this solution. In cases ' insensibility it must be employed with great caution; for, if used judiciously, serious or even fatal consequences may result. Nysten *'hristison's Treatise*) tells us that a physician, for some years sub-:t to epilepsy, was found by his servant in a fit. In order to rouse his aster, the latter applied a handkerchief moistened with this solution to s nose, so assiduously, that he brought on bronchitis, of which the ıysician died on the third day. In the *Edinburgh Medical and Surgi-·l Journal*, there is the report of the case of a lad whose death as produced, or at least hastened, by an attendant applying, "with such ıwearied but destructive benevolence," ammonia to the nose, that suffo-.tion had almost resulted. Dyspnœa, with severe pain in the throat, ımediately succeeded, and death took place forty-eight hours after-ards. A French physician also suffered ulceration of the mouth, and olent pulmonary catarrh, in consequence of the excessive use of ammo-a, given as an antidote for hydrocyanic acid.

When the solution of ammonia is swallowed in large doses, it acts as powerfully corrosive poison; but modern well-marked cases in the human bject are wanting. However, it is very evident that violent inflamma-ɔn of all that part of the alimentary canal with which the poison may be contact, would be the result, and that if much be taken, decomposition the part might be expected. When swallowed in a very dilute form, ıd in small quantity, the local phenomena are not very marked, and the fect of the substance is then seen in the affection of the general system. The chemical action of ammonia on the tissues is analogous to that of ›tash, hereafter to be described.

β. Remote effects.—The remote effects may be investigated under two ads, according as they are produced by small or large doses. *In small therapeutic doses*, such as we are accustomed to employ in the treat-ənt of diseases, ammonia acts as a stimulant, excitant, or calefacient. produces a sensation of warmth in the mouth, throat, and epigastrium, ·quently attended with eructations. The pulse is soon rendered quicker ıd fuller; the heat of the skin is sometimes increased, and there is a ten-ncy to sweating, which, if promoted by the use of warm diluents and ɔthing, frequently terminates in copious perspiration. But the skin is ›t the only secreting organ stimulated to increased exertion; we observe ə kidneys produce more urine, and frequently the quantity of bronchial ucus is increased. The nervous system is also affected. Wibmer *ie Wirkung*, &c. p. 123) has made several experiments on himself, and ›m them it appears that ammonia affects the head, sometimes causing ·pression, or a sense of fulness, but no pain. The increased capa-lity of muscular exertion, the excitement of the mental functions, and e greater facility with which all the functions are executed, are further dications of the action of ammonia on the nervous system. *The effects ' large or poisonous doses* on the human subject have not been de-ribed: but that the nervous system is affected, seems probable from a se mentioned by Plenck, which terminated fatally in four minutes; ough the symptoms are not related.

The *modus operandi* of ammonia deserves to be noticed. Does this sub-ınce become absorbed? I am not acquainted with any facts which able us to decide this question. Even admitting that absorption does ke place, it is more likely that the remote effects are of a sympathetic kind, than the result of the absorption. In calculous complaints, ammonia and its carbonate may be used with considerable advantage in those cases where potash and soda are serviceable; from which I think it probable that, like the fixed alkalies, ammonia taken into the stomach is evolved by the kidneys.

Uses.—We resort to a solution of ammonia, properly diluted, on a variety of occasions, some only of which can be here noticed.

1. *To neutralize acid.*—In dyspeptic complaints, accompanied with preternatural acidity of stomach and flatulence, but without inflammation, a properly diluted solution of ammonia may be employed with a two-fold object—that of neutralizing the free acid, and of stimulating the stomach. It must be remembered that the healthy secretions of the stomach are of an acid nature, and that the continued use of ammonia, or any other alkali, must ultimately be attended with injurious results, more especially to the digestive functions. While, therefore, the occasional employment of alkalies may be serviceable, their constant or long-continued use must ultimately be deleterious.

Ammonia may, under some circumstances, be employed to neutralize acids introduced into the stomach from without, as in poisoning by the mineral acids, though chalk and magnesia would be more appropriate being less irritant. It is a valuable antidote in poisoning by hydrocyanic acid. Its beneficial operation has been ascribed to the union of the alkali with the acid, thereby forming the hydrocyanate of ammonia but since it has been found that this salt is highly poisonous, it is evident that this explanation is not satisfactory. Some have ascribed the activity of the hydrocyanate to its decomposition by the free acids of the stomach, and the consequent evolution of free hydrocyanic acid, but the explanation is unsatisfactory. I believe the efficiency of ammonia as an antidote to poisoning by hydrocyanic acid, arises from its exerting an influence of an opposite nature to that of the poison. In poisoning by the oil of bitter almonds, or other agents supposed to contain this acid, ammonia is equally serviceable. The remedy should be given by the stomach, if the patient can swallow, and the vapour should be cautiously inhaled.

2. *To produce local irritation, rubefaction, vesication, or destruction of the part.*—As a *local agent*, ammonia has been employed in a variety of diseases, sometimes as a rubefacient or irritant, sometimes as a vesicant and occasionally as a caustic. Thus it is employed as a rubefacient in rheumatic and neuralgic pains, and as a counter-irritant to relieve internal inflammations. As a local irritant, a weak solution has been injected into the vagina and uterus, to excite the catamenial discharge; but there are some objections to its use. Thus, it is a most unpleasant kind of remedy, especially to young females; moreover, the stoppage of this discharge is in many cases dependent on constitutional or remote causes and, therefore, a topical remedy is not likely to be beneficial. Lavagna employed ten or fifteen drops of the solution diluted with milk. The following is Nisato's formula:—

℞ Ammon. liquid. gtt. xl.; Decoct. Hordei, unc. viii.; Mucilag. arab. unc. dimid. Misce, et fiant quatuor intra diem injectiones.

Sometimes ammonia is employed as a vesicatory; and it has two advantages over cantharides—a more speedy operation, and non-affection of the urinary organs. It may be employed in the form of ointment or lution. As a caustic, the strong solution of ammonia may be some-nes employed with advantage in the bites of rabid animals.

3. *The vapour of the solution of ammonia may be inhaled* when we ish to make a powerful impression on the nervous system, as in syn-pe, or to prevent an attack of epilepsy. To guard against or relieve nting, ammoniacal inhalations are very powerful and useful; their stantaneous operation is frequently astonishing. Pinel says he once w an attack of epilepsy prevented by this means. The patient (a atchmaker) had intimations of the approaching paroxysm from certain elings, but he found by inhaling the vapour of ammonia it was fre-uently prevented. In the case of a confirmed epilepsy, which I was in e habit of watching for some years, I think I have also seen analogous neficial effects. I speak doubtfully, because it is so difficult to deter-ine, in most cases, the actual approach of the fit. It is deserving of pecial notice that ammonia is useful in three conditions of system, hich, though produced by very different causes, present analogous mptoms; viz., idiopathic epilepsy—the insensibility and convulsions epilepsy) produced by loss of blood—and the insensibility and convul-ons (? epilepsy) which poisonous doses of hydrocyanic acid give rise to.

In asphyxia, ammoniacal inhalations have been strongly recommended Sage, who says that he produced the apparent death of rabbits by mersion in water, and recovered them subsequently by the use of umonia. A case is told us of a man who had been submerged in the ine for twenty minutes, and who, when taken out of the water, appeared eless, yet by the use of ammonia recovered; and a M. Routier, a sur-on of Amiens, is said to have restored a patient in the same way. at it may sometimes be of service I can readily believe, but it must be ployed with great caution.

4. *Ammonia is given internally as a stimulant and sudorific* in a variety cases with manifest advantage. In recapitulating these, I must be ry brief.

(*a*.) In continued fevers which have existed for some time, and where violent action has subsided, and the brain does not appear much dis-lered, ammonia is occasionally of great service. Its diaphoretic action ould be promoted by diluents and warm clothing. It has an advan-ge over opium—that if it does no good, it is less likely to do harm.

(*b*.) In intermittent fevers, ammonia is sometimes of advantage given ring the cold stage to hasten its subsidence.

(*c*.) In the exanthemata, when the eruption has receded from the skin, d the extremities are cold, ammonia is sometimes of great benefit on count of its stimulant and diaphoretic properties. But in many of se cases the recession arises from, or is connected with, an inflamma-y condition of the bronchial membrane, for which the usual treatment to be adopted.

(*d*.) In some inflammatory diseases (especially pneumonia and rheu-tism) where the violence of the vascular action has been reduced by per evacuations, and where the habit of the patient is unfavourable to loss of blood, ammonia has been serviceable.

5. *In certain affections of the nervous system*, ammonia is frequently ployed with the greatest benefit. Thus it has been used to relieve cerebral disorder of intoxication. In poisoning by those cerebro-inants commonly termed sedatives, such as foxglove, tobacco, and

hydrocyanic acid, ammonia is a most valuable agent. This remedy ha been supposed to possess a specific influence in relieving those disorde of the nervous system accompanied with spasmodic or convulsiv symptoms; and hence it is classed among the remedies denominate *antispasmodic:* but whenever it gives relief it is by its stimulant opera tion. Velsen, of Cleves, has used it with advantage in delirium tremen It was a remedy frequently tried in the malignant or Indian cholera, an occasionally procured relief, but this effect was not sufficiently comm to lead practitioners to place much reliance on it.

6. *Against the bites of poisonous animals,* as serpents and insect ammonia is frequently employed with the best effects. There does n appear, however, any ground for the assertion of Sage, that it is a spec fic: in fact, Fontana declares it to be sometimes hurtful in viper bites.

ADMINISTRATION.—It is given in doses of from five to twenty or thir drops properly diluted.

ANTIDOTES.—The dilute acids, as vinegar, lemon or orange juice, &

Car'bonas Ammo'niæ.—Car'bonate of Ammo'nia.

HISTORY AND SYNONYMES.—Raymond Lully, in the thirteenth centur was acquainted with carbonate of ammonia as obtained from urine; an it is probable that the Arabians had known it long before. Bas Valentine procured it by decomposing muriate of ammonia by potash (carbonate of potash).

Carbonate of ammonia has been known by the various appellations *sal alkali volatile siccum* seu *urinosum; sal volatile salis ammoniaci; su carbonas ammoniæ; sal volatile cornu cervi,* &c.

NATURAL HISTORY.—(See *Ammonia.*) Carbonate of ammonia is forme during the putrefaction or destructive distillation of those organic su stances which contain nitrogen.

PREPARATION, PROPERTIES, EFFECTS, AND USES.—In the pharmaco pœia this salt is extracted from hydrochlorate of ammonia by carbona of potash. The proportions employed in making the *spiritus ammoni spiritus ammoniæ aromaticus,* and *spiritus ammoniæ fœtidus,* are t ounces of the hydrochlorate and sixteen ounces of the carbonate. On equivalent or 54 parts of the hydrochlorate of ammonia react on o equivalent or 70 parts of carbonate of potash, and produce one equivale or 39 parts of the carbonate of ammonia, one equivalent or 76 parts chloride of potassium, and one equivalent or 9 parts of water.

INGREDIENTS USED.			PRODUCTS.
1 eq. Hydrochl^{te}. Ammonia . . 54	1 eq. Ammonia 17		1 eq. Carb^{te}. Amm.
	1 eq. Hydrochl^{ic} Acid 37	1 eq. Hydr. 1 1 eq. Chlor. 36	1 eq. Water . . . .
1 eq. Carbonate Potash 70	1 eq. Carbonic Acid 22		
	1 eq. Potash 48	1 eq. Oxyg. 8 1 eq. Potas^{m}. 40	1 eq. Chl^{de}. Potas^{m}.

1. *Spiritus Ammoniæ* (Ph. L.)—This compound is prepared from t ounces of hydrochlorate of ammonia, sixteen ounces of carbonate of potas three pints of rectified spirit, and three pints of water. This mixture to be placed in a retort, and three pints distilled. The above-describ decomposition takes place, and the carbonate of ammonia, which is pr duced, distils over with the spirit in which the greater part of it dissolv the remainder being deposited in an imperfectly crystalline state.

e Dublin Pharmacopœia, a similar compound is prepared by mixing ree ounces and a half of coarsely-powdered sesquicarbonate of ammo- a with three pints of heated rectified spirit; by the disengagement of me carbonic acid, carbonate of ammonia is produced, which dissolves the spirit, every fluid ounce of which is capable of taking up thirty ains of the carbonate.

The *spiritus ammoniæ* of either of the above pharmacopœias is a trans- rent, colourless liquid, having a pungent smell and acrid taste. It ddens turmeric paper, and dissolves camphor and the volatile oils. Its edicinal effects and uses are analogous to caustic ammonia and the ses- uicarbonate. It is less pungent than the solution of caustic ammonia, it more so than the liquor ammoniæ sesquicarbonatis. It is employed hysteria, flatulent colic, and nervous debility, in doses of from half a achm to a drachm, properly diluted with water. Saturated with cam- ior it forms a highly stimulating liniment.

2. *Spiritus ammoniæ aromaticus* (Ph. L.).—This compound, usually rmed *spirit of sal volatile*, is very analogous to the last, from which it ffers in the somewhat different proportions of the ingredients, and the ldition of some aromatics. It is prepared from five ounces of hydro- ılorate of ammonia, eight ounces of carbonate of potash, two drachms bruised cinnamon, two drachms of bruised cloves, four ounces of mon-peel, four pints of rectified spirit, and four pints of water. Mix, ıd let six pints distil. In this process, double decomposition takes place, already noticed, and the carbonate of ammonia distils over with the irit and part of the water, flavoured by the aromatics. This prepara- on is weaker than the preceding, but is more agreeable both to the ste and smell. Its effects, uses, and doses, are analogous to those of e last-mentioned compound. It is an ingredient in the *ammoniated ıcture of guaiacum* and the *compound tincture of valerian.*

3. *Spiritus ammoniæ fœtidus* (Ph. L.).—This is prepared in the same ay as the spiritus ammoniæ, except that five ounces of asafœtida are ıt into the retort with the other ingredients. It is prepared in the ublin Pharmacopœia by digesting one ounce and a quarter of asafœtida two pints of spirit of ammonia, and distilling one pint and a half. his fœtid spirit of ammonia has been very correctly declared to be useless. is merely a solution of the volatile oil of asafœtida in spirit of ammonia, r which a mixture of the tincture of asafœtida and spirit of ammonia ay be conveniently substituted. It is colourless, pungent, and fœtid, ıd by age becomes brownish. It is employed in hysteria in doses of alf a drachm to a drachm in water.

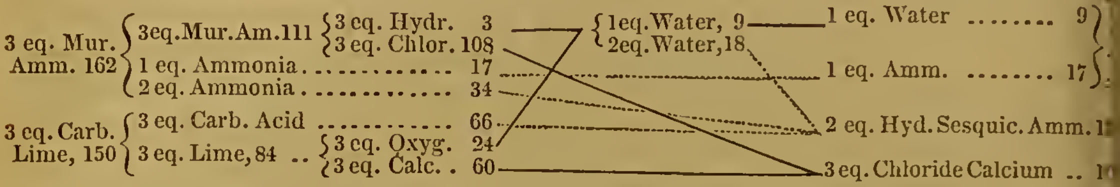
Ammo'niæ Sesquicar'bonas.—Sesquicar'bonate of Ammo'nia.

History and Synonymes.—Though this salt must have been long nown, yet, until a few years since, it was confounded with the carbonate f ammonia. It is even now frequently called *carbonate* or *subcarbonate f ammonia* in the shops. It is sometimes termed *volatile* or *smelling ılts;* and occasionally *bakers' salt*, on account of its use by bakers in ıe manufacture of some of the finer kinds of bread.

Natural History.—(See *Ammonia* and *Ammoniæ Carbonas.*)

Preparation.—In the London Pharmacopœia we are ordered to mix pound of powdered hydrochlorate of ammonia with a pound and a half of powdered chalk, and sublime with a gradually increased heat. In this process three equivalents or 162 parts of hydrochlorate of ammonia react on three equivalents or 150 parts of carbonate of lime, and produce two equivalents or 118 parts of the hydrated sesquicarbonate of ammonia, three equivalents or 168 parts of chloride of calcium, one equivalent or 17 parts of ammonia, and one equivalent or 9 parts of water. The chloride of calcium is left in the subliming pot, the hydrated sesquicarbonate is sublimed, while the ammonia and water are dissipated.

INGREDIENTS USED. RESULTS.



Sesquicarbonate of ammonia is generally procured on the large scale by subliming the ingredients in an iron pot, to which an earthen or leaden head is adapted as a receiver. As a substitute for hydrochlorate of ammonia, manufacturers frequently employ impure sulphate of ammonia; but the resulting sesquicarbonate is sometimes contaminated with a little tar or oil, and deposits a dark carbonaceous matter when dissolved in acids.

Properties.—Sesquicarbonate of ammonia is met with in the form of fibrous, white, translucent cakes, about two inches thick. When exposed to the air it evolves carbonate of ammonia, and is converted into bicarbonate of ammonia; so that its vapour has a pungent odour, and strongly reddens turmeric paper. The resulting hydrated bicarbonate is opaque, pulverent, and much less pungent, from which it has been termed *mild carbonate of ammonia*. The sesquicarbonate is soluble in four times its weight of cold water; but boiling water or alcohol decomposes it, dissolving the carbonate of ammonia, and evolving carbonic acid.

The *liquor ammoniæ sesquicarbonatis* (Ph. L.) is prepared by dissolving four ounces of this salt in a pint of water.

Characteristics.—This is recognized as an ammoniacal salt by its odour, its fugacious action on turmeric paper, and by the action of its solution on the salts of copper and on the chloride of platinum (see *Ammonia*). From a solution of caustic ammonia it may be distinguished by the white precipitate which it produces with the calcareous salts. From the monocarbonate this salt is distinguished by the effervescence caused when it is put into boiling water or alcohol. From the bicarbonate it may be known by its greater pungency and solubility.

Composition.—This salt consists, according to Mr. Phillips (*Quarterly Journal of Science*, vol. vii. p. 294) and Dr. Thomson, of carbonic acid, ammonia, and water, in the following proportions:—

	Eq.	Eq. Wt.	Per centage.	R. Phillips.
Carbonic Acid	3	66	55·93	54·2
Ammonia	2	34	28·81	29·3
Water	2	18	15·26	16·5
Hydrated Sesquicarbonate of Ammonia	2	118	100·00	100·0

Impurities.—This salt is met with in the shops of various degrees of purity. If pure, it should dissolve acids without depositing any blackish matter; it should leave no residuum when heated on platinum or glass;

should be translucent, and not opaque and pulverent; and, lastly, its lution, saturated with pure nitric acid, should give no precipitate with loride of barium or nitrate of silver, for the first would indicate suluric acid or a sulphate, the second hydrochloric acid or a chloride.

Physiological Effects (*a.*) *On vegetables.*—[See *Ammonia.*]

(*b.*) *On animals.*—The principal experimenters with this salt are ybert, Orfila, and Gaspard, on dogs, and Wibmer on man. Seybert uoted by Wibmer, *die Wirkung*, &c.) injected in one experiment teen grains, in a second twenty-five grains, and in a third experiment rty-five grains of this salt, dissolved in a little water, into the crural in of a dog: the animal appeared to suffer great pain; the frequency the heart's action was increased, the respiration became difficult, and olent convulsions came on; but in all these cases perfect recovery ok place. The blood drawn after the injection had the natural colour, our, and consistence. Orfila (*Toxicol. Génér.*) found that two drachms d a half of the salt, given to a dog, caused gastric inflammation, with anic convulsions; the body ultimately becoming curved, with the ad forcibly bent backwards. Gaspard (quoted by Wibmer) killed a ung pig, of three weeks old, by injecting twenty-four drops of (a solun of) carbonate of ammonia in an ounce of water into the veins. eath occurred in nine hours.

(*c.*) *On man.*—The principal experimenter here is Wibmer (*op. cit.*), no made his trials on himself. He found that a grain and a half of this lt produced no remarkable effect; three grains increased the frequency the pulse from 68 to 72 beats per minute, with throbbing headache. other experiments, in which he took from six to twelve grains (in me repeating the dose at short intervals), the effects were usually, but t constantly, increased frequency of pulse, with disorder of brain, nifested by the pain, heaviness, throbbing, &c. In one instance, he says, sposition to cough, and increased secretion of bronchial mucus, were markable.

From these and other experiments we infer, that the *local* action of is salt is that of an irritant and corrosive; but it is much less powerful an the caustic solution of ammonia, in consequence of the presence of rbonic acid, which in some degree neutralizes the alkaline properties of e ammonia. Swallowed in *moderate doses* (of about 30 grains) it casions vomiting: in *large doses* it excites pain, inflammation, and all e consequences of an irritant poison; while the immoderate halation of its vapour is capable of giving rise to bronchial flammation. The remote action of this salt is similar to that of caustic nmonia. Thus, in small doses it has the same exciting action on the art, brain, &c. and the same diaphoretic effect. We denominate it, erefore, stimulant, sudorific, antispasmodic, antacid, and rubefacient.

Uses.—Sesquicarbonate of ammonia is used in the same cases and nder the same circumstances as the solution of ammonia, to which, erefore, I must refer the reader. In some cases it is also employed in e production of effervescing draughts. The following are the relative oportions of acid and base to be used:—

20 grains of sesquicarbonate of ammonia will saturate about	6	fluidrachms of lemon juice.
	24	grains of crystallized citric acid.
	$25\frac{1}{2}$	grains of crystallized tartaric acid.

The *citrate* and *tartrate* of ammonia, obtained as above, are useful in allaying nausea and vomiting; they are also feebly diaphoretic, and some cases diuretic.

Sesquicarbonate of ammonia has been employed as an emetic in par lysis. An ointment made of the finely pulverized salt and lard is a ve useful rubefacient in rheumatic pains, sprains, &c. Mixed with so aromatic oil (as oil of lavender or bergamot) it is employed as a smelli salt against syncope, hysteria, &c.

Administration.—As a stimulant and diaphoretic this salt is used doses of from five to ten grains, exhibited either in the form of pill or solution. As an emetic the dose is 30 grains, properly diluted, a repeated if necessary.

Antidotes.—(See *Ammonia.*)

Ammoniacal Soaps.—When caustic ammonia is mixed with fat bodies (such as olive oil, lard, or mutton suet), it forms a kind soap, composed of the fatty acids, generated by the oil and of ammon combined with them. Two of these compounds require to be noticed:

1. *Liniment of ammonia.*—This is prepared, according to the Lond Pharmacopœia, by mixing a fluid ounce of solution of ammonia wi two fluid ounces of olive oil. This compound, sometimes termed *volat liniment*, is an *oleo-margarate of ammonia;* that is, a compound of ol and margaric acids with ammonia. It is employed as an external s mulant and rubefacient, to relieve rheumatic and neuralgic pains, so throat, and various other complaints in which cutaneous stimulants a likely to be useful. It is the

2. *Ointment of ammonia.*—In France an ointment is employed, call *liparolé d'ammoniaque*, or *pommade ammoniacale de Grondret*, and whi is composed of eight parts of solution of ammonia, seven parts lard, a one part mutton suet. This compound, rubbed on the skin, and cover by a compress, speedily produces vesication: without the compress causes rubefaction, merely owing to the volatilization of the ammon It is a very useful counter-irritant and vesicant.

Liniment of sesquicarbonate of ammoniæ.—This is prepared by mixi a fluid ounce of the solution of the sesquicarbonate of ammonia wi three fluid ounces of olive oil. It forms an imperfect kind of so owing to the presence of carbonic acid. Its uses are analogous to th of the liniment of ammonia before mentioned.

Ammo'niæ Bicar'bonas.—Bicar'bonate of Ammo'nia.

History and Synonymes.—This salt was formed by Berthollet, a hence it is sometimes termed *Berthollet's neutral carbonate of ammoni*

Preparation.—In the Dublin Pharmacopœia it is ordered to be pr pared by passing a stream of carbonic acid through a solution of fo parts of sesquicarbonate in fifteen parts of water, until the sesquic bonate be saturated. It is then allowed to remain at rest, and cryst are deposited, which are to be dried without heat, and preserved in close vessel.

Properties.—This salt crystallizes in irregular six-sided prisms. has little or no smell, and less taste than the sesquicarbonate. It is l soluble than the last-mentioned salt, and its solution does not precipit the magnesian salts, by which circumstance it may be distinguished fr the carbonate of ammonia.

Composition.—The composition of this salt is the following:—

	Eq.	Eq. wt.	Per cent.	Schrader.	Berthollet.	Phillips.		Vol.
nmonia	1	17	21·5	19	20	21·16	Ammoniacal gas	2
rbonic Acid	2	44	55·7	56	55	55·50	Carbonic Acid gas	2
ater	2	18	22·8	25	25	23·34	Aqueous Vapour	2
ystallized Sicarbon[te]. ammonia	1	79	100·0	100	100	100·00		

Physiological Effects and Uses.—The operation and uses of this lt are analogous to those of the preceding compounds of ammonia. It termed diaphoretic, antispasmodic, and antacid. Being less caustic, is more palatable than the other carbonates (Barker and Montgomery's *bservations on the Dublin Pharmacopœia*).

Administration.—The dose of it is from six to twenty-four grains, ssolved in *cold* water.

Ammo'niæ Hydrochlo'ras.—Hydrochlo'rate of Ammo'nia.

History and Synonymes.—The early history of this salt is involved considerable obscurity; for though the term *sal ammoniacus* (ἅλς ἀμμω-ικος), is met with in several old writers, it is believed, by the erudite ckmann (*Hist. of Inventions*, vol. iv. p. 370), as well as by others, to er to rock-salt. The first distinct notice of hydrochlorate of ammo-ı is to be met with in Geber, who was acquainted with the mode of rifying it by sublimation. But, as my friend Dr. Royle observes, in *Essay on the Antiquity of Hindoo Medicine* (p. 41), this salt "must ve been familiar to the Hindoos ever since they have burnt bricks, as y now do, with the manure of animals; as some may usually be found stallized at the unburnt extremity of the kiln."

The substance, whatever its nature may be, which the ancients termed l ammoniac, derived its name from *Ammonia*, the name of a district of bya where the oracle of Jupiter Ammon was situated. This district k its name from *ἄμμος, sand*, on account of the nature of its soil. rodotus (lib. iv., cap. 181 et 2) mentions the salt found in this trict.

Few substances have had so many synonymes as the hydrochlorate of nmonia; but of those I shall only mention such as are now in use, mely, *muriate of ammonia, sal ammoniac*, and *chloride of ammonium*. r others I must refer to Dr. T. Thomson's *Hist. of Chem.* vol. i. p. 125, d *Parr's Med. Dict.*, art. *Ammoniacus*.

Natural History.—(See *Ammonia*).

Preparation. (*a.*) *By the destructive distillation of bones.*—Bones are st boiled to remove the fatty matter, which is used in soap making. e larger and finer pieces are then picked out for the manufacture of ttons, handles of tooth-brushes, of knives, &c.; while the smaller and use portions are sold as manure. The remaining pieces are distilled. The still or retort is made of cast iron or of Welch bricks. In a large manufactory (fig. 44) in this metropolis, the retort (which is mad of Welch bricks) is placed perpendicularly in the furnace. Its shap

Fig. 44.

Manufacture of bone spirit (Carbonate of Ammonia) and animal charcoal.

is a right rectangular prism, the height being twenty feet; the lengt about three feet, the breadth two feet: it is closed at both top an bottom by a moveable iron plate, and the fire is made around it. Th bones are introduced at the upper end of the retort. The volatile pr ducts are conveyed (by an iron pipe, which opens into the upper part o the retort) first into water, and then into an iron receiver (in some places a old steam boiler is employed as a receiver) where the brown ammoniac liquor (*bone spirit*) and the empyreumatic oil (*animal oil*) are deposite The non-condensable portion is a fœtid inflammable gas: this, after pas ing through water contained in a second receiver (a cask or vat), is co veyed into a chimney, or is burned. The solid residue in the retort i removed, while red hot, through the lower and underground end of th retort into wrought-iron canisters, which are instantly closed by iro covers, luted to make them air tight, and then raised to the surface by crane. When cold, it is powdered and sold as *ivory black*. A coar powder is employed by sugar refiners for decolorizing saccharine liquid

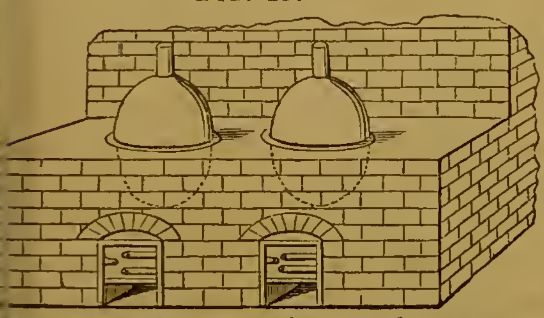
The products of this operation are easily accounted for. When bon are heated, their cartilaginous or gelatinous portion undergoes decomp sition, and its elements (carbon, hydrogen, nitrogen, and oxygen) ent into new combinations. Some of the oxygen and hydrogen unite t form water. Carbon and oxygen, combining in different proportion furnish carbonic oxide and acid. Carbon with hydrogen forms carb hydrogen; while nitrogen uniting with hydrogen produces ammoni which, with some carbonic acid, forms carbonate of ammonia. Th empyreumatic oil consists of carbon, hydrogen, and oxygen, with pr bably some nitrogen.

The carbonate of ammonia contained in the bone spirit is converte to sulphate, either by the addition of sulphuric acid, or by digestion ı ground plaster of Paris (sulphate of lime). In the first case carbonic id is evolved, in the latter we get carbonate of lime formed, from ıich the solution of sulphate of ammonia is separated by filtering. By aporation, the solution yields brown crystals of sulphate of ammonia. ıis is sublimed with common salt, by which we obtain sulphate of soda d hydrochlorate of ammonia. Every equivalent or 57 parts of sulphate ammonia re-act on one equivalent or 60 parts of chloride of sodium, d with one equivalent or 9 parts of water produce one equivalent or 54 rts of hydrochlorate of ammonia, and one equivalent or 72 parts of lphate of soda.

NGREDIENTS USED.		RESULTS.
ı. Sulph^{te}. Amm. 57	1 eq. Ammonia 17 1 eq. Sulph^{ic}. A^{d}. 40	1 eq. Hydrochl^{te}. Ammonia . 54
ı. Water . . . 9	1 eq. Hydrogen . 1 1 eq. Oxygen . 8	
ı. Chl^{de}. Sodium 60	1 eq. Chlorine . 36 1 eq. Sodium . 24	1 eq. Sulphate Soda 72

(*b.*) *From coals.*—In the distillation of coal as practised at the gasrks, the volatile matters are conveyed to a condensing vessel or refriatory, in which are deposited tar and an ammoniacal liquor which ıtains several salts of ammonia—as the sulphate, carbonate, hydrocyanate, and hydrosulphate. On the addition of sulphuric acid the carbonate, hydrocyanate, and hydrosulphate are decomposed, and by evaporation brown crystals of sulphate of ammonia are obtained. This salt is mixed with chloride of sodium, and heated in an iron pot lined with clay, to which a leaden head having an open cylindrical tube dapted (fig. 45). The hydrochlorate of ammonia is sublimed into the d of the apparatus. In the clay removed from the pots after the operaı, small but perfect and beautiful crystals of the bisulphuret of iron are ıetimes found. They are formed during the process. In some cases gas liquor is saturated with hydrochloric acid, and the brown crystals hydrochlorate obtained by evaporation are purified by sublimation. e above is a sketch of the process which I saw in operation a few rs since at the Westminster Gas Works. At the present time the gas ıor is sold to sal ammoniac manufacturers, who reside in the outskirts he metropolis.

FIG. 45.



limation of Hydrochlorate of Ammonia.

ROPERTIES.—Hydrochlorate of ammonia usually occurs in commerce he form of large hemispherical cakes, which are translucent, and by osure to the atmosphere become slightly moist. By solution or sunation it may be obtained in regular octahedral, or cubic, or plumose stals. Its sp. gr. is 1·450. Its taste is saline and acrid; it has no ur. When heated, it sublimes without undergoing fusion or decomition. It is soluble in about 3 parts of cold and 1 of boiling water: l being produced during the solution. It dissolves in alcohol.

HARACTERISTICS.—It may be recognized by the following characters: s white and volatile; and if heated on the point of a knife by the ne of a candle, it readily sublimes. Mixed with caustic potash, or ckline, it evolves ammoniacal gas, which is known by its odour, its acid. Dissolved in water the hydrochlorate of ammonia produces wit a solution of nitrate of silver a white precipitate of chloride of silve recognized by the properties before described (see p. 105): and wit chloride of platinum a yellow precipitate (*the platino-chloride of ammo nia*) which when collected, dried, and ignited, yields spongy platinum.

COMPOSITION.—The following is the composition of this salt:—

	Eq.	Eq.wt.	Per cent.	Kirwan.	Bucholz.	Berzel.		Vol.	Sp.
Ammonia	1	17	31·48	25	31	31·95	Ammoniacal gas	2	0·5
Hydrochl^ic. Acid	1	37	68·51	75	69	68·05	Hydrochl^ic. Acid gas	2	1·2
Hydrochl^te. Amm.	1	54	100·00	100	100	100·00			

1 eq. Ammonia = 17	1 eq. Hydrochl. Acid = 37

If one equivalent or two volumes of hydrochloric ac gas be mixed with one equivalent or two volumes ammoniacal gas, combination is effected; the gases di appear, heat is evolved, and the white hydrochlorate deposited.

Analogy would lead us to regard this salt as a chlori of some metallic base. If such a base exist, it mu consist of one equivalent nitrogen and four equivalents hydrogen. Berz lius assumes the existence of this hypothetical metallic base, and calls *ammonium*, while sal ammoniac is termed by him chloride of ammoniu The protoxide of this suppositious metal will be equal to an equival of ammonia and one of water. The advantages of this hypothesis a that it obviates certain difficulties respecting the compounds formed ammonia with the hydracids, and readily explains the formation of t ammoniacal amalgams: its disadvantages are, that it constrains us admit the existence of two bodies (ammonium and its protoxide) hithe not known to exist.

IMPURITIES.—The hydrochlorate of ammonia is sometimes render impure by the presence of chloride of iron. I have met with cakes this salt which when broken presented thin, yellow, concentric lami of what I believe to be a double salt of chloride of iron and hydrochlor of ammonia. That the chloride of iron performs, in this yellow co pound, the function of an acid, is shown by its not striking a bl colour on the addition of the ferrocyanuret of potassium.

PHYSIOLOGICAL EFFECTS. (*a.*) *On Vegetables.*—According to Sir Davy (*Agricult. Chemistry*), water holding in solution 1-300 of its weig of hydrochlorate of ammonia promotes vegetation. Solutions which co tained 1-30 of their weight of this salt he found to be injurious.

(*b.*) *On Animals.*—Courten (*Phil. Trans.* for 1712), Sprögel, Vibo and Gaspard (quoted by Wibmer, *die Wirkung*, &c.), injected soluti of sal ammoniac into the veins of animals (dogs and horses): large do generally caused convulsions, sometimes paralysis, and death. From t observations of Orfila, Smith, Arnold (Wibmer, *op. cit.*), and Moir (*Pharmacol. Vétérinaire*), this salt appears to be a local irritant, a when introduced into the stomach in large quantities causes vomiti purging, and gastro-enteritis. It exercises a specific influence o distant organs, for the three first of the above-mentioned experiment observed that inflammation of the stomach ensued, to whatever part the body the salt might have been applied, and the convulsions a paralysis before referred to, attest its action on the nervous syst Arnold says it diminishes the plasticity of the blood.

(*c.*) *On Man.*—Wibmer tried this salt on himself. He took from twenty grains for a dose, which he repeated at the end of an hour. ıe effects were a sensation of warmth and oppression in the stomach, adache, and increased desire of passing the urine.

In this country it is so rarely employed internally that we have very ght experience either of its physiological or of its therapeutical effects. Germany, where it is more frequently administered, it is in high ute as a powerful alterative or resolvent. "Like most salts," says ndelin (*Handbuch der speciellen Heilmittellehre*, 1er. Bd. p. 150, 3te. fl.), "sal ammoniac operates on the alimentary canal as an excito-itant." After its absorption it appears to reduce moderately the action the heart and large arteries, and, in this respect, belongs to debilitat-; or temperant agents. But it acts as excitant and irritant to the ıous and arterial capillary systems, to the lymphatic vessels and nds, to the skin, to the kidneys, and especially to the mucous mem-nes; not only increasing secretion but also improving nutrition and imilation, and counteracting organic abnormal conditions, (as tumors, ckenings, and relaxations), so frequently met with in those structures. promotes not only the mucous secretions but also cutaneous exhala-n, and even menstruation. Its diuretic effects are less obvious. It ends its stimulating influence to the serous and fibrous tissues, whose rition it improves.

'From these statements it follows that sal ammoniac operates like the re-profoundly-acting alterative agents, and even approaches, in many pects, mercury, but is especially distinguished from the latter in this, t it by no means acts to such a degree as a defluxing, nay even melt-, agent on solidified organic substance and its crasis, and by its not so verfully stimulating the lymphatic system. Its long-continued use may, eed, injure the digestive powers, but never gives rise to general cachexia. ave administered large doses of it against thickening of the mucous nbrane, for months, without remarking any injurious effects beyond se just mentioned. In large doses it purges like other salts, but in ll ones rather constipates." Kraus (*Heilmittellehre*, p. 309) says, that ight miliary eruption and very painful aphthæ have been produced by ge doses of it.

Uses.—In this country it is rarely employed internally. In Germany, ere it is frequently used, it is administered in the following cases:—

. *In mild inflammatory fevers*, especially these complicated with ctions of the mucous or fibrous membranes, as in the diseases called ous, gastric, catarrhal, or rheumatic fevers, it is employed for promot-secretion and hastening critical discharges.

. *In inflammation of the mucous or serous membranes*, as catarrh, entery, urethritis, peritonitis, pleuritis, &c. when the first violence of disease has been subdued, but when the secretions and exhalations not yet established. In these cases it is used as a substitute for cury.

. *In chronic diseases* of various kinds, as chronic inflammation of the gs, liver, and spleen—enlargement of the mesenteric glands—indura-of the prostate, uterus, and ovaries—catarrhus vesicæ—chronic ration of the uterus—mucous discharges from the urethra and vagina, s administered as an alterative, as a stimulant to the absorbent em, and as a promoter of healthy secretion.

. *In amenorrhœa* it is strongly recommended by Sundelin (*op. cit.*), as

an emmenagogue, in those cases in which the disease depends on, or i
connected with inactivity of the uterus.

Externally it is sometimes employed, on account of the cold produce during its solution, in headache, mania, apoplexy, &c. When used fo this purpose it must be applied as soon as the salt is dissolved. M Walker (*Phil. Trans.* 1801, p. 120) found that two parts of this sal with five parts of nitrate of potash and sixteen parts of water, lowere the thermometer from 50° F. to 10° F. A mixture of this kind placed i a bladder has been recommended by Sir A. Cooper as an applicatio to hernial tumors. It may be applied to the head instead of ice.

Sal ammoniac has been employed externally as a stimulant, or resolve or discutient. Dr. Paris (*Pharmacologia*) strongly recommends th following stimulant and rubefacient plaster in pulmonary complaints an in rheumatic affections of the muscles of the chest: soap ℥i. lead plast ʒij., liquified together, to which, when nearly cold, is added of hydr chlorate of ammonia finely powdered, ℥ss. The efficacy of this plast depends on the evolution of ammoniacal gas in consequence of the actio of the alkali of the soap on the hydrochloric acid of the hydrochlorate hence it should be renewed every twenty-four hours. A strong solutio of sal ammoniac (as one or two ounces of the salt to twelve ounces o water) is employed in the cure of contusions and ecchymosis, unaccom panied by any wound of the skin; in chronic tumors, as of the breast in local dropsies, as hydrocele and dropsy of the thyroid gland; i chilblains; in sphacelus after the requisite scarifications, &c. Weak solutions (as from one to four drachms of the salt to a pint of water) a employed as washes in scabies and ulcers, as gargles in cynanche, an as injections in gonorrhœa and leucorrhœa. This salt in powder sometimes used as a tooth-powder.

Administration.—For internal use the dose of it is from five to thirt grains every two or three hours, either in a pulverent form, combin with sugar or gum, or in solution with some saccharine or mucilagino solution, to which an aromatic should be added.

Antidote.—In the event of poisoning by this salt, warm water an mucilaginous and demulcent liquids should be given to promote vomi ing. No chemical antidote or counterpoison is known. Gastro-enterit is of course to be combated by the usual means.

Li'quor Ammo'niæ Aceta'tis.—Solution of Ace'tate of Ammo'nia.

History and Synonymes.—This solution appears to have been fir described in 1732, by Boerhaave, who introduced it into the Mater Medica. It was subsequently employed by Minderer or Mindereru and hence obtained one of its names, *spiritus* seu *liquor Mindereri*.

Natural History.—Acetate of ammonia is, I believe, always an art ficial compound.

Preparation.—In the London Pharmacopœia this compound is o dered to be prepared by dissolving, in four pints of distilled vinegar, fo ounces and a half (or as much as may be sufficient to saturate the acet acid) of sesquicarbonate of ammonia. Every equivalent, or 51 parts cetic acid, unite with one equivalent, or 17 parts of ammonia; while ne and a half equivalents, or 33 parts of carbonic acid, are evolved.

INGREDIENTS USED.		RESULTS.
q. Sesquicarb. Amm. . . . 50	$1\frac{1}{2}$ eq. Carb^ic. Acid 33	$1\frac{1}{2}$ eq. Carbonic Acid 33
	1 eq. Ammonia. . 17	
eq. Acetic Acid 51		1 eq. Acetate Ammonia . . 68

In the above diagram no notice has been taken of the water in the ydrated sesquicarbonate of ammonia, nor of that in the vinegar.

PROPERTIES.—When pure, this liquid is colourless. Any tint, therere, which the solution of the shops may have, is referrible to impurities either the vinegar or the sesquicarbonate. Filtering it through powered animal charcoal will usually remove any yellow or brown colour hich it may have. If quite neutral, it will affect neither turmeric nor mus paper. It is better, however, to have a slight excess of acid prent than of sesquicarbonate; for if the latter predominate, the solution much more irritant; and if employed as a collyrium, might produce convenient results.

CHARACTERISTICS.—It is totally dissipated by heat. When concenated it evolves vapours of acetic acid on the addition of strong sulnuric acid, and gives out ammonia if potash or lime be mixed with it.

COMPOSITION.—By evaporating a saturated solution of acetate of umonia under the exhausted receiver of the air-pump, and over sulnuric acid, crystals of the acetate are obtained. They are transparent lique rhomboidal prisms, and consist, according to Dr. Thomson, of

	Eq.	Eq. wt.	Per cent.
Acetic Acid	1	51	38·931
Ammonia	1	17	12·977
Water	7	63	48·091
Crystallized Acetate Ammonia	1	131	99·999

ne quantity of dry or anhydrous acetate of ammonia contained in the lution kept in the shops, varies with the strength of the distilled negar. Now, according to Mr. Phillips, 100 grains of distilled vinegar ould saturate 13 grains of crystallized carbonate of soda. This would dicate the presence of 4·6 per cent. of acetic acid; and, consequently, 0 grains of liquor ammoniæ acetatis, prepared from such vinegar, ould consist of

Acetate of Ammonia	6·040
Water	93·959
Liquor Ammoniæ Acetatis (Ph. L.)	99·999

IMPURITIES.—This solution ought neither to be discoloured by the action of hydrosulphuric acid, nor to throw down any precipitate by nitrate silver or chloride of barium. These substances, therefore, may be nployed to detect, respectively, metallic matter, hydrochloric acid or chloride, and sulphuric acid. Pure acetate of ammonia occasions no ecipitate with diacetate or acetate of lead; but the liquor ammoniæ etatis of the shops usually does, owing to the presence of some free rbonic acid or sesquicarbonate of ammonia.

PHYSIOLOGICAL EFFECTS.—In small doses this solution is regarded as mperant and refrigerant: in large doses, diaphoretic and diuretic. hese effects, however, are not very obvious. Wibmer (*die Wirkung*, &c.) ok it in moderate doses, yet did not observe any diaphoretic, diuretic, or purgative effects from it; but he experienced headache and disturbed digestion. Dr. Cullen (*Mat. Med.*) says, "I have known four ounces of it taken at once, and soon after four ounces more, without any sensible effect." The local operation of this solution is that of a mild stimulant.

Uses—(*a.*) *Internal.*—It is employed in febrile and inflammatory diseases, and forms a constituent of the ordinary saline draught. It is given in conjunction with nitrate of potash, or tartar emetic, and sometimes with camphor and opium. When administered as a diaphoretic its operation is to be promoted by the use of tepid diluents and external warmth. Its diuretic effect is assisted by keeping the skin cool, and conjoining the spirit of nitric ether.

(*b.*) *External.*—Diluted with water it is sometimes applied as a discutient wash to inflamed and bruised parts. Mixed with six or seven times its volume of rose-water, to which a drachm or two of tincture of opium may sometimes be added, it is employed as a collyrium in chronic ophthalmia.

Administration.—It is given in doses of half a fluid ounce to two or three ounces every five or six hours.

Order 7.—Carbon, and its Compounds with Oxygen, Hydrogen, and Nitrogen.

Carbo'nium.—Car'bon.

History.—The term *carbon* (from *carbo, ōnis,* coal) was first employed by Morveau, Lavoisier, and Berthollet, to designate the pure matter of charcoal. To the second of these chemists, we are indebted for demonstrating, that by combustion in oxygen gas the diamond and charcoal yield the same product; namely, carbonic acid gas.

Natural History.—Carbon is found in both kingdoms of nature:

(*a.*) *In the inorganized kingdom.*—When pure and crystallized it constitutes the diamond, which Sir D. Brewster (*Edinb. Phil. Journ.* vol. iii. p. 98, and *Philosoph. Mag.* vol. i. p. 147, 1827) suspects to be of vegetable origin; but a specimen described by Mr. Heuland (*Geol. Trans.*, 2nd series, i. 419), was found in a primary rock. Plumbago and anthracite consist principally of carbon. The bituminous substances (as coal, petroleum, naphtha, &c.) also contain it. These are admitted by geologists to be of vegetable origin. Carburetted hydrogen is evolved from coal strata, marshy places, stagnant waters, &c. Carbonic acid is found either in the free state, as in the atmosphere, in mineral waters evolved from the earth in old volcanic countries, &c., or combined with metallic oxides, in the form of the carbonate of lime, iron, &c. It is remarkable that carbon is rare among the older rocks (De la Beche, *Researches in Theoretical Geology*, p. 32).

(*b.*) *In the organized kingdom.*—Carbon is an essential constituent of all organized beings, vegetable or animal.

Properties.—Carbon is a solid, odourless, tasteless substance, neither fusible (?) nor volatile; combustible in oxygen gas, yielding carbonic acid gas. Its equivalent by weight is 6. Some years since Dobereiner asserted that he had discovered a metallic basis in it, but his statement has not been confirmed.

The other properties of carbon are so varied, that chemists are obliged admit distinct varieties of this substance: the principal are the *mond, plumbago*, and *charcoal* (animal and vegetable). Of these the latter only require consideration in this work.

1. *Plumba'go.—Graph'ite* or *Black Lead.*

History.—This substance was probably known to the ancients; but was first accurately distinguished from other bodies with which it had n previously confounded, especially with molybdena (*bisulphide of lybdenum*), by Scheele (*Essays*, p. 246), in 1779. The terms *plumbago, mbum nigrum*, and *molybdena*, met with in Pliny (*Hist. Nat.*), do not ly to graphite.

Natural History.—It is found in various parts of the world; efly in primitive rocks and the coal formations. The finest occurs at rrowdale, in Cumberland. It is brought to London, and sold by tion, at a public-house in Essex-street, Strand, on the first Monday every month. The best quality usually sells for two guineas or more pound, and is employed for making pencils. The ordinary kinds d in this country are imported from Ceylon and Hamburgh.

Properties.—It occurs either crystallized in regular six-sided prisms, n kidney-shaped masses, or disseminated in rocks. Its colour is iron steel-grey, with a metallic lustre. It has a greasy feel, and writes ily on paper. Its specific gravity is 2·08 to 2.45.

Characteristics.—It is known to be a variety of carbon by its yield- carbonic acid when burned in oxygen gas. Its physical properties inguish it from most other varieties of this element. Some kinds of l-gas charcoal closely resemble it. Of non-carbonaceous substances, ybdena (bisulphide of molybdenum) is the only substance that can confounded with it in external appearance.

Composition.—It consists essentially of carbon, but is mixed with iable properties of iron and other substances. The following are lyses of three varieties by Vanuxen (Silliman's *Journal*, vol. x. 05):

	Borrowdale. (pure.)	Borrowdale. (impure.)	Bustletown. (pure.)
Carbon	88·37	61·27	95·4
Water	1·23	5·33	0·6
Silica	5·10	10·10	2·6
Alumina	1·00	3·20	0·0
Oxides of Iron, Manganese, &c.	3·60	20·00	1·4
	99·30	99·90	100·0

uspect, however, that the finest varieties of the Borrowdale graphite tain a less quantity of foreign matter than is here stated. On the position that the carbon was chemically combined with iron, graphite formerly called *carburet* or *percarburet of iron*. From some ob- ations of Schrader's, however, it would appear that the iron is in bination with titanic acid.

Physiological Effects.—Various properties have been assigned to but farther evidence is wanting to establish its action on the body. hter (*ausführliche Arzneimittellehre*, 3er. Bd. p. 486) says it alters in e way the lymphatic secretion and the condition of the skin, and r some days' use, causes increased secretion of urine, with difficulty passing it.

Uses.—It has been employed both externally and internally in chro diseases of the skin (as herpes). When used externally, it is mixed wi lard in the proportion of one or two drachms to an ounce of the lat Internally the dose is ten or twelve grains to a drachm.

2. *Car'bo Lig'ni.—Wood Char'coal.*

History.—Wood charcoal must have been familiar to man from t most remote period of antiquity, and was probably known to the fi inhabitants of the globe. For an account of the ancient method of p curing it, I must refer the reader to the works of Theophrastus (cap. and Pliny (*Hist. Nat.* lib. xvi., cap. vii).

Natural History.—Wood charcoal is always an artificial produ Some samples of Bovey coal have very much the appearance of wo charcoal, but are readily distinguished by their containing hydrogen, consequence of which they burn with a yellow flame. Moreov they are not good conductors of galvanic electricity (Kidd's *Outlines Mineralogy*, vol. ii. p. 47.)

Preparation.—Ordinary wood charcoal is prepared, on the la scale, for the purposes of fuel, by burning billet-wood piled in a coni heap, covered by turf and sand, to prevent the access of atmosphe air, a few holes being left near the bottom and one at the top, to occ sion a draught. The heap is then set fire to, and when the flame has p vaded the whole mass, the holes are closed. When cooled, the bill are found converted into charcoal. For an account of the mode arranging the wood in heaps, consult Dumas, *Traité de Chimie, appliq aux Arts*, t. i., p. 561.

The wood charcoal used in the manufacture of gunpowder is obtain by heating wood in cast iron cylinders, the gaseous products bei allowed to escape. The woods used for this purpose are Dogwo (*Cornus sanguinea*), the common alder (*Alnus glutinosa*), and the will (*Salix*).

Properties.—Wood charcoal is black, odourless, and insipid. It h the texture of the wood from which it has been obtained. It is britt and may be easily pulverized, especially when hot. Though a very b conductor of heat, it is an excellent conductor of electricity. It insoluble, infusible, and incapable of volatilization. Its specific grav varies, according to the substance from which it has been obtained. remarkable property possessed by it is that of abstracting certain su stances (such as hydrosulphuric acid, organic colouring principl various odorous matters, &c.) from liquids in which they are dissolv or through which they are diffused. Another curious quality is that condensing, within its pores, a certain quantity of any gas with whi it may be placed in contact. One volume of box-wood charcoal abso 1·75 volumes only of hydrogen gas, but 90 volumes of ammoniacal g Some of the properties now mentioned (as that of decolorizing) a possessed in a more eminent degree by animal charcoal.

Characteristics.—By burning in oxygen gas, charcoal yields c bonic acid gas; a property by which it is shown to consist of carb Its texture and appearance will distinguish it from other forms carbon.

Physiological Effects.—Wood charcoal I believe to be an in bstance both with respect to animals and vegetables. Burdin (quoted the *Dict. de Mat. Méd.* of MM. Merat and de Lens) gave a pound of daily without producing any other effect than that of blackening the ols. A variety of properties and virtues have, however, been ascribed it, as I believe, without foundation: thus it has been termed anodyne, menagogue, tonic, purgative, &c. In Hahnemann's *Traité de Matière édicale* (traduit par A. J. L. Jourdan), no less than thirty-five pages are cupied with the enumeration of the symptoms produced by less than e-millionth of a grain of this substance!!

Uses.—In this country, charcoal is used as a therapeutic agent, prin-ally as a disinfectant and antiseptic, to absorb the fœtid odour evolved gangrenous and phagedenic ulcers. For this purpose it may be used the form of powder or of poultice. Its disinfecting and antiseptic wers, however, are much inferior to those of chlorine, or of the chlo-ies of lime and soda. As a *tooth-powder* it is a valuable agent, freeing teeth from the foreign matters which cover them, and at the same ne counteracting the unpleasant smell of the breath arising from cayed teeth or disordered stomach. Brachet (*Considerations sur Jsage du Carbon en Médecine*, Paris, 1803) states, that it checks caries the teeth. Areca nut charcoal is a favourite variety for tooth-pow-rs. Internally, charcoal has been exhibited in various affections of alimentary canal, such as dyspepsia, cardialgia, diarrhœa, and dysen-y. The beneficial effects said to have been produced in these cases n only be referred to the action of charcoal on the secretions of the wels; an explanation apparently supported by Dr. Chapman's state-nt, that in dysentery, where the stools are highly acrid and offensive, arcoal entirely divests them of their bad smell and acrimony. In nsequence of the advantage said to have been obtained by Dr. Cal-gno, of Sicily, by the use of charcoal in intermittents, it was tried by . Calvert, physician to the British forces at Palermo, and with suc-ss. (*Edinb. Med. and Surg. Jour.* vol. x., p. 15). In this country, how er, it is, I believe, never resorted to in ague by medical practitioners. . Daniel, of Savannah, has recommended it in obstinate constipation, d in the nausea and confinement of bowels which frequently attend egnancy. It has also been used in various other diseases, but expe-nce has not confirmed its efficacy.

Administration.—The dose of charcoal, as ordered by different iters, varies from ten grains to a table-spoonful or more.

In the Dublin Pharmacopœia there is a formula for a *wood charcoal taplasm* (*cataplasma carbonis ligni*). It may be prepared by mixing ely powdered charcoal with a common linseed poultice; it is applied foul ulcers to destroy their offensive odour.

3. *Car'bo Anima'lis.—An'imal Char'coal.*

History and Synonymes.—This substance must have been known m the most ancient times. The kind usually met with in the shops prepared from bones, and is termed *bone black*, or, more commonly, *ry black*, (*ebur ustum nigrum*).

Natural History.—It is always an artificial product.

Preparation.—The mode of preparing animal charcoal from bones s been already described. (See *Ammoniæ Hydrochloras*).

PROPERTIES.—In its general properties animal charcoal agrees with charcoal procured from wood. The decolorizing powers of the former are, however, much superior to those of the latter.

COMPOSITION AND PURIFICATION.—Animal charcoal, prepared by calcining the bones of the ox, sheep, and horse, consists of the following ingredients, (Dumas, *Traité de Chimie*, t. i., p. 450):

Phosphate of Lime } Carbonate of Lime }	88·0
Charcoal	10·0
Carburet or Silicet of Iron	2·0
Sulphuret of Calcium or Iron	traces
Common Bone Black	100·0

For the ordinary purposes of the arts, as sugar refining, this impure animal charcoal answers very well, because the earthy salts in no way affect the process. But in various pharmaceutical operations the presence of phosphate and carbonate of lime would preclude the use of animal charcoal, on account of the free acid in the liquids to be decolorized. Hence the necessity of the purification of animal charcoal.

In the London Pharmacopœia purified animal charcoal (*carbo animalis purificatus*) is ordered to be prepared by digesting for two days with a gentle heat, a pound of animal charcoal in a mixture of twelve fluid ounces of hydrochloric acid and the like measure of water, frequently shaking them. After pouring off the supernatant liquor the charcoal is to be washed with water until no acid is perceptible, and then dried.

In the above process the hydrochloric acid dissolves the phosphate of lime and decomposes the carbonate of lime and sulphuret of calcium, evolving carbonic and hydrosulphuric acid gases, and forming chloride of calcium, which remains in solution.

Purified animal charcoal causes no effervescence when mixed with hydrochloric acid, nor is any precipitate produced by the addition of ammonia or its sesquicarbonate to the acid. For effervescence would indicate the presence of carbonate of lime, while a precipitate with sesquicarbonate of ammonia would shew either phosphate or carbonate of lime: if phosphate, caustic ammonia would also occasion a precipitate.

Animal charcoal, when deprived of its saline matters, usually contains traces of nitrogen. Döbereiner, indeed, supposed it to be a kind of subnitruret of carbon composed of one equivalent or 14 parts of nitrogen and six equivalents or 36 parts of carbon. Bussy, however, has shown that though animal charcoal retains its nitrogen with considerable obstinacy, yet that the latter may be separated by heat.

PHYSIOLOGICAL EFFECTS.—The remarks already made in reference to the physiological effects of wood charcoal, apply equally well to animal charcoal.

USES.—The principal use of animal charcoal is as a decolorizing agent in various pharmaceutical processes, as in the preparation of sulphate of quinia, hydrochlorate of morphia, veratria, &c. The theory of its efficacy is imperfectly understood. The superior value of animal to vegetable charcoal is usually referred to the minute separation of the carbonaceous particles effected by the presence of other matters, as of osphate of lime when bones are employed. Carbonate of potash is tter for this purpose than phosphate of lime. The property possessed minute particles of charcoal, of abstracting colouring matter from uids, depends, probably, on some chemical affinities existing between ·bon and colouring matter. It is stated, in some works, that charcoal iich has been once used cannot have its decolorizing property stored by a fresh ignition, unless it be mixed with some inorganic bstance. This, however, is an error. The animal charcoal which has en used in sugar refining, is returned to the maker to be fresh ignited, d is then employed again, and this process of re-igniting, is, I am ormed, repeated many times, without any loss of decolorizing power.

Ac'idum Carbon'icum.—Carbon'ic Ac'id.

History and Synonymes.—Although the ancients were acquainted th the poisonous properties of carbonic acid gas, Dr. Black, in 1757, s the first who explained the nature of this substance. The *spiritus halis* of the ancients is evidently this acid, as is also the *spiritus 'vestris* or *gas* of Paracelsus and Van Helmont. *Fixed air, acid vapour,* d *aërial acid,* are other synonymes for it.

Natural History.—It is a constituent of both kingdoms of nature.

(*a*). *In the inorganized kingdom.*—Carbonic acid is a constituent of the nosphere. In some parts of the world it is evolved from the earth in ge quantities, particularly in old volcanic countries. Thus in the inity of the Lake of Laach, Bischof estimates the exhalation as equal 600,000lbs. daily, or 219,000,000lbs., (equal to about 1,855,000,000 bic feet) annually! (De la Beche, *Theoret. Geology.*) Some of the d evolved in the Brohlthal, on the Rhine, is employed by him in the nufacture of chemical preparations on the large scale. Most persons familiar, by report, with the *Grotto del Cane*, near Naples. It is a ity in a rock, through the fissures of which carbonic acid is evolved. has received its name from the practice of putting dogs into it, who down suffocated. The *Valley of Poison*, in Java, which has been scribed by Loudon, is another spot where this acid escapes from the th. It is a cavity of an oval form, about three quarters of a mile in circumference, and from thirty to thirty-five feet deep; filled to the height about eighteen feet with carbonic acid gas. The bottom of it is ered with the skeletons of men and various other animals, who have len victims to its destructive operation. If a traveller should be so fortunate as to enter it, he cannot be sensible of his danger until too e to return. Mr. Loudon thrust a dog in; he fell in fourteen seconds. fowl thrown in appeared to be dead before it reached the ground!!

Carbonic acid gas is frequently met with in mines and wells; and is med by miners *choke damp* (from the German *dampf*, vapour).

Few mineral waters are without this acid, and in some it exists in h quantity as to give them a sparkling or effervescent quality e p. 146).

Lastly, carbonic acid is found (native) in combination with various ses; as with soda, baryta, strontian, lime, magnesia, and the oxides of nganese, zinc, lead, iron, and copper. According to Mr. De la Beche *. cit.*) the average amount of carbonic acid locked up in every cubic rd of limestone, is about 16,000 cubic feet.

It is produced in the burning of limestone (carbonate of lime) at lim kilns, and by the combustion of charcoal, coal, wood, coal gas, the fir damp of coal mines, and other combustibles containing carbon.

(*b.*) *In the organized kingdom.*—Carbonic acid gas is exhaled b plants in dark or shady places, and hence is met with in green-hous especially during the night. Animals develope it in the process respiration, and, therefore, in crowded rooms, with imperfect ventilatio accidents have sometimes happened from the accumulated carbonic aci It is produced by the decomposition of organic matters, as during fe mentation of saccharine fluids, and in the destructive distillation animal substances: hence the danger of descending into brewers' vat Free or combined carbonic acid is found in the blood, urine, bones, &c

PREPARATION.—Carbonic acid gas may be procured in various way but for ordinary purposes is usually obtained by the action of some ac (usually hydrochloric) on carbonate of lime (as white marble). It most readily prepared in a tubulated glass retort, and may be collect over water. The ordinary hydrochloric acid of the shops should diluted with four or five times its volume of water. By the reaction one equivalent, or 37 parts of hydrochloric acid, on one equivalent, or 5 parts of carbonate of lime, we obtain one equivalent, or 56 parts chloride of calcium, one equivalent, or 9 parts of water, and one equ valent, or 22 parts of carbonic acid.

INGREDIENTS USED.			RESULTS.
1 eq. Carb. Lime . 50	1 eq. Carbon. Acid . . . 22		1 eq. Carbon. Acid
	1 eq. Lime 28	1 eq. Oxyg. 8	1 eq. Water . . .
		1 eq. Calc. 20	
1 eq. Hydrochl[ic]. Ad. 37	1 eq. Hydrogen 1		
	1 eq. Chlorine 36		1 eq. Chlor. Calc[m].

PROPERTIES.—At ordinary temperatures and pressures carbonic ac is gaseous. In this form it is invisible, irrespirable, has a faint odo and a sharp taste. Its specific gravity is 1·5277. It is neither com bustible nor a supporter of combustion, except in the case of potassiu which, when heated in this gas, takes fire, the products of the combu tion being carbon and carbonate of potash. It extinguishes most bur ing bodies when introduced into it in the ignited condition. It redde litmus feebly.

Under a pressure of 36 atmospheres at 32°, carbonic acid is a limpi colourless liquid, which is insoluble in water and in the fat oils, but soluble in all proportions in alcohol, ether, oil of turpentine, and carbur of sulphur. Its refractive power is much less than that of water. I expansibility by heat is greater than that of gases; for when heat from 32° F. to 86° F., its bulk increases from 20 to 29 volumes, while t pressure of its vapour augments from 36 to 73 atmospheres.

By an intense degree of cold, liquid carbonic acid may be solidifie Thus, when the pressure is removed from this liquid by opening a sto cock in the condensing vessel, the cold produced by the expansion is great, that a quantity of solid carbonic acid is formed. In this state is so intensely cold, that mercury, liquid chlorine, liquid cyanogen, & may be readily frozen by it. Being a very bad conductor of heat, may be handled with impunity.

CHARACTERISTICS.—Carbonic acid gas is recognised by its feebly re dening litmus, by being incombustible and a non-supporter of combusti

:cept in the case above mentioned), and by its forming, with a solution lime or of baryta, a white precipitate, soluble in acetic acid.

The carbonates effervesce on the addition of acetic or hydrochloric d. The evolved gas is known to be carbonic acid by the characters ore stated. The soluble carbonates form white precipitates in solu- ns of lime or baryta

›re combustion.		After.
: eq. ‹ygen = 16	and 1 eq Carbon. = 6	1 eq. Carb. Acid gas = 22

Composition.—By burning charcoal in one volume or 16 parts, by weight, of oxygen gas, we procure one volume or 22 parts, by weight, of carbonic acid gas.

	Eq.	Eq. wt.	Per ct.	Saussure.		Vol.	Sp. gr. or		Vol.	Sp. gr.
›on	1	6	27·27	27·04 to 27·38	Carb. vapour	0·5 or 1	0·416$\dot{6}$	Carb. Oxide gas	1	0·972$\dot{2}$
‹gen	2	16	72·73	72·96 to 72·62	Oxygen gas	1	1·111$\dot{1}$	Oxygen gas	0·5	0·555$\dot{5}$
›onic Acid	1	22	100·00	100·00 . 100·00	Carb. Acid gas	1	1.527$\dot{7}$	Carb. Acid gas.	1	1·527$\dot{7}$

Carbonic Acid Water (*Aqua Acidi Carbonici*).—At the ordinary nperature and pressure of the atmosphere, one volume of water absorbs : volume of carbonic acid gas, and acquires a sp. gr. of 1·0018. By ıbling the pressure the quantity of gas absorbed is doubled, and so on other degrees of pressure; for Dr. Henry has shewn that the quantity gas forced into water is directly as the pressure. In the United ıtes Pharmacopœia five volumes of gas are ordered to be condensed one of water. This solution is called *Artificial Seltzer Water*. The *tled soda water*, and *soda water from the fountain* or *pump*, are, in ıeral, merely aqueous solutions of carbonic acid. Carbonic acid ıer is a sparkling liquid, reddening litmus, having a pungent, acidulous ‹e, and causing a white precipitate with lime water, which precipitate e-dissolved by an excess of carbonic acid water.

Physiological Effects. (*a*.) *On Vegetables*.—Carbonic acid gas is ırious to seeds, and diminishes or stops their germination according to quantity of acid present. An aqueous solution of carbonic acid ›lied to the roots of plants promotes vegetation. An atmosphere con- ıing not more than $\frac{1}{8}$ of its volume of carbonic acid promotes the etation of plants exposed to the solar rays, but is injurious to those ıch grow in the shade (Saussure, *Recherches*, p. 25, et seq.)

b.) *On dead animal matter*.—Carbonic acid gas retards the putrefac- ı of animal substances.

c.) *On animals*.—The *respiration* of carbonic acid gas is deleterious fatal to all classes of animals. That it operates in these cases as a itive poison, and not merely by excluding oxygen, as some have sup- ed, seems to be proved by two facts:—firstly, that an atmosphere ıposed of 79 parts of carbonic acid and 21 of oxygen acts as a son, although there is as much oxygen present as there is in atmos- ric air; and, secondly, that one bronchial tube of the land-tortoise be tied, without any serious injury to the animal; but if, instead of ıg it, the animal be made to inhale carbonic acid gas by it, death es place in a few hours (Christison, *Treatise on Poisons*, p. 745, 3rd ·) The impression produced on the pulmonary extremities of the vagum, by the carbonic acid in the lungs, is supposed by some phy- ogists to be the ordinary stimulus to inspiration. According to the eriments of Nysten (*Recherches*, p. 88), this gas may be *injected into venous system* in large quantity, without stopping the circulation, and without acting primitively on the brain; but when more is injec than the blood can dissolve, it produces death by distending the heart, when air is injected into the veins (see p. 23). *Applied to the skin animals*, free access of common air to the lungs being preserved, it p duces, if the experiment be continued long enough, death.

(*d.*) *On man.*—If an attempt be made to *inhale* pure carbonic acid g the glottis spasmodically closes, so as to prevent the smallest porti from entering the lungs (Davy, *Researches*, p. 472). When mixed w more than twice its volume of air, this gas ceases to provoke spasm the glottis, and may be taken into the lungs. In this case it gives rise symptoms resembling those of apoplexy. It usually causes a sensati of tightness at the chest, uneasiness, giddiness, loss of muscular pow insensibility, and stertorous breathing, sometimes accompanied by co vulsions or delirium. These symptoms are succeeded by asphyxia a death.

Applied to the conjunctiva it acts as an irritant, and excites pain, redne and a flow of tears. *Applied to the skin* (care being taken that it is n inhaled) it produces a sensation of warmth and pricking or tingli sometimes accompanied by pain, increased frequency of the pul sweating, and excitement of the nervous system. M. Collard de M tigny (quoted by Dr. Christison) experienced weight in the head, obsc rity of sight, pain in the temples, ringing in the ears, giddiness, and undefinable feeling of terror. *Taken into the stomach*, dissolved in wat or in the form of effervescing draughts, it allays thirst, and diminish preternatural heat, thus acting like the other dilute acids. If it evolved in the stomach, it distends this viscus, excites eructations, a checks both nausea and vomiting. It appears to promote the secreti of the alimentary tube, to assist the digestive process, to allay irritati and to act as a refreshing and exhilirating substance. It is said to diuretic and diaphoretic. Wöhler and Stehberger expressly state, th the use of carbonic acid did not increase the quantity of this substan in the urine (Duncan, *Supplement to the Edinb. Disp.* p. 223). Wh drunk too quickly, and in large quantity, water impregnated with t gas has been known to excite giddiness and intoxication (Fodéré, *M Légale*); and it is probable that champagne is indebted to this substa for part of its intoxicating powers. *Applied to ulcers and suppurat surfaces*, carbonic acid gas acts as a stimulant, improves the quality the discharge in ill-conditioned and indolent ulcers, retards the putref tion of the secreted matters, diminishes the unpleasant odour of foul a gangrenous sores, and promotes the separation of the dead and mortif parts.

Uses—(*a.*) *When inhaled.*—In some diseases of the lungs, particula phthisis, it has been proposed to mix carbonic acid gas with the atm pheric air breathed by the patient, with the view of lessening the sti lant influence of the oxygen, to diminish the quantity, and improve quality of the matter expectorated, and at the same time to relieve hectic symptoms. It is not at all unlikely that temporary relief mi be gained by its employment; but difficulty is experienced in the mo of applying it. Of course, to be beneficial, it ought to be constan inspired. Temporarily it is readily inhaled, by generating it in a la bottle or jar, and breathing it by means of a tube; but for its contin use, the only method that can be employed is to evolve the acid in tient's chamber. In some parts of the continent a popular remedy for nsumption is a residence in rooms or houses inhabited by cows; and e asserted beneficial effects are supposed to be in part attributable to e carbonic acid gas contained in the chamber; but, says Vogt (*Lehrbuch r Pharmakodynamik*, Bd. ii. S. 32), "we must not overlook the humid, ld, balsamic vapour, with which the air of cow-houses is commonly pregnated."

(*b*.) *Taken into the stomach*, carbonic acid is a most valuable remedy checking vomiting, and diminishing irritable conditions of this viscus. e best mode of exhibiting it is, I believe, in the form of an effervescing ught, composed of citric acid and bicarbonate of potash. In fever, it n excellent refrigerant; especially serviceable in those cases which accompanied with gastric irritation. In that form of lithiasis ended with a white or phosphatic deposit in the urine, water impreg- ed with carbonic acid may be taken with advantage; but in this case common effervescing draught, (made of a vegetable acid, and a bonated alkali) cannot be substituted for carbonic acid water, since it nmunicates an alkaline property to the urine.

c.) *Clysters of carbonic acid gas* have been employed in certain affec- ns of the rectum and colon,—for example, ulceration of the rectum, ecially when of the kind commonly denominated cancerous.

d.) *A stream of carbonic acid gas* has been applied to the *uterus* with at benefit, in a painful condition of this viscus, as I have already ntioned (at p. 54).

e.) *Applied to the skin*, care being taken that the gas is not inhaled, it mployed either in its gaseous form, or dissolved in water. It is, of rse, adapted to those cases where it is desirable to excite the vascular em, especially of the skin, and to cause perspiration; while, on the er hand, it is objectionable in inflammatory cases. In chlorosis, norrhœa, dyspepsia, hysteria, scrofula, &c., it has also been found ul.

f.) It has been *applied to cancerous and other ulcers*, to allay pain, to rove the quality of the secretions, and to check sloughing. It is lily administered by means of a tube connected with a bottle gene- ng the gas. In this case it should be procured by the action of te sulphuric acid on marble, for if hydrochloric acid be employed, gas requires washing, to remove any of this acid which may pass with it. Or it may be used in the form of solution, in which case bottle-soda-water may be employed. Or, lastly, we may apply the t poultice.

DMINISTRATION.—Internally, carbonic acid may be administered er the form of carbonic acid water (the ordinary *bottle-soda-water*) ch may be given in quantities regulated by the moderate desires of patient.

here no objection exists to the use of the vegetable salts of potash, onic acid may be administered under the form of the *ordinary vescing draught*, composed of a vegetable acid and an alkaline onate. In febrile disorders, when the stomach is in a very irritable lition, I prefer a draught made with citric acid and the bicarbonate otash.

nother mode of employing carbonic acid is under the form of the *ulous* or *carbonated mineral waters*.

These are distinguished, according to the nature of their prepo derating constituent, into the *acidulo-alkaline* (as those of Pougues, Vich Mont d'Or, Spa, Selters, Bilin, Altwasser, &c.), the *acidulo-chalybea* (as those of Flinsberg, Giesshübel, Fachingen, and Pyrmont), and t *acidulo-saline* (as those of Wildungen, Kissingen, Schwalheim, &c.)

[For further information concerning the acidulous waters, consult Le *Account of the Watering-Places of the Continent*; and the article on mine waters, by Dr. Thomson, in the *Cyclopædia of Medicine*.]

ANTIDOTES.—In accidents arising from the inhalation of carbonic ac or carbonic oxide, proceed as follows:—remove the patient immediat into the open air, and place him on his back with his head somewh elevated. Produce artificial respiration by pressing down the ribs, a forcing up the diaphragm, and then suddenly removing the pressu Dash cold water over the body, and abstract a small quantity of blo either by venesection or cupping. Stimulants of various kinds may employed either internally by the stomach, or in the form of frictions, inhalations (as of ammonia, weak chlorine, &c.)

Al'cohol.—Al'cohol.

HISTORY.—Fermented liquors were known in the most remote ages antiquity. The sacred historian tells us (*Genesis*, ch. ix.) that after t flood (which is supposed to have occurred 2,348 years before Chri "Noah planted a vineyard: and he drank of the wine, and was drunke Homer, the most ancient of all the profane writers, and who lived m than 900 years before the Christian era, also frequently mentions wi and notices its effects on the body, mind, &c. (*Odyssey*, ix. and x Herodotus (*Euterpe*, lxxvii.), who wrote 445 years before Christ, tells that the Egyptians drank a liquor fermented from barley.

It is uncertain at what period vinous liquors were first submitted distillation. Morewood (*Essay on Inebriating Liquors*, p. 107) co ders the Chinese to have been acquainted with this process long bef the rest of Asia, Africa, and Europe. It is usually stated that Albuca who is supposed to have lived in the 12th century, taught the mod procuring spirit from wine (Gmelin, *Handbuch d. Chemie*, Bd. 2, p. 27 Raymond Lully in the 13th century was acquainted with spirit, well as with the mode of depriving it of water by means of carbonat potash.

PREPARATION.—The preparation of alcohol may be divided into th stages: the production of a fermented vinous liquid; the preparation fr this of an ardent spirit by distillation; and, lastly, rectification or pu cation.

STAGE 1. *PRODUCTION OF A VINOUS LIQUOR.*—When veg ble substances are placed in contact with air and moisture, they und that kind of decomposition which is denominated *fermentation.* T products of this process vary at different periods or stages; and on depends the distinction into kinds or varieties of fermentation. T starchy liquids, under some circumstances, become saccharine; the p cess being termed the *saccharine* fermentation. Sugar dissolved water, and mixed with glutinous matter, is converted into carbonic and alcohol; and to this process the name of *vinous* fermentatio applied. Vinous liquids are capable of generating acetic acid, and process is denominated *acetous* fermentation. Lastly, most veget bstances are slowly converted into gases and a substance called vege-ble mould (*humus*), constituting the process called the *putrefactive* :mentation.

To produce a vinous liquid it is necessary that there be present sugar · some substance capable of forming sugar, as starch), a certain quan-y of water, and a ferment (usually yeast). Moreover a certain tempera-:c (the best is between 70° and 80° F.) is necessary. The precise ıctions which each of these essentials performs are not known. As :rzelius has remarked, the changes may depend on the developement forces of no common nature. The products of this process are carbonic id, alcohol, and yeast. To account for the two first of these we take : data furnished us by Thenard.

SUBSTANCES FERMENTED AT 59°.		PRODUCTS OF FERMENTATION.	
;ar	300	Alcohol of 0·822	171·5
ıst	60	Carbonic Acid	94·6
		Nauseous residue	12·0
		Residual yeast	40·0
			318·1
		Loss	41·9
	360		360·0

Now the nauseous residue and residual yeast nearly make up the quan- of yeast employed; and supposing the loss to be proportionally ided between the alcohol and the acid, it follows that, by the vinous nentation, sugar is resolved into carbonic acid and alcohol.

The explanation of the changes which occur in the conversion of charine solutions into alcoholic liquors, depends, of course, on the view en of the composition of sugar. If we adopt, with Mr. Brande (*Manual Chemistry*), 162 as the equivalent for sugar, the following are the :nges:—One equivalent or 162 parts of sugar, with two equivalents or parts of water, are converted into four equivalents or 88 parts of bonic acid, and four equivalents or 92 parts of alcohol.

ıEDIENTS USED.				RESULTS.	
ı. Sugar	162	4 eq. Carbon	24	4 eq. Carb^c. Acid	88
		8 eq. Carbon	48		
		8 eq. Oxygen	64		
		2 eq. Oxygen	16		
		10 eq. Hydrogen	10		
ı. Water	18	2 eq. Oxygen	16		
		2 eq. Hydrogen	2	4 eq. Alcohol	92

The liquid obtained by the vinous fermentation has received different nes, according to the substance from which it is obtained. When cured from the expressed juices of fruits, as grapes, currants, goose-ries, &c., it is denominated *wine* (*vinum*); from a decoction of malt : hops, *ale* or *beer* (*cerevisia*); and from honey and water, *mead* *lromeli*). Fermented infusions of barley (raw grain and malt) pre-ed by the distillers of this country for the production of ardent spirit, technically denominated *washes*.

The liquid obtained by the vinous fermentation consists of *water*, *hol*, *colouring* and *extractive matters*, *volatile oil*, *various acids* and *s*.

TAGE 2. *Production of Ardent Spirit*.—By the distillation a vinous liquid we obtain *ardent spirit* (*spiritus ardens*). When e is employed, the spirit is called *brandy* (*spiritus vini gallici*); when the vinous liquid is obtained by the fermentation of molasses or treacl the spirit is termed *rum* (*spiritus sacchari*); when the liquid is a fer mented infusion of grain (*wash*), the spirit is denominated *corn spir* (*spiritus frumenti*); and when the vinous liquid is either a fermented in fusion of rice or toddy (*palm wine*), the spirit is named *arrack* (if fro the former, it is termed *spiritus oryzæ*). The well-known liquors calle *gin*, *hollands* or *geneva*, and *whiskey*, are corn spirits flavoured.

Ardent spirit, from whatever source obtained, consists of *water*, *alcoho volatile oil*, and, frequently, *colouring matter*. The following are, accord ing to Mr. Brande (*Phil. Trans.* for 1811 & 1813), the average quantiti of alcohol (sp. gr. 0·825 at 60° F.) in some kinds of ardent spirit:—

100 parts (by measure) of	Alcohol (by measure).	100 parts (by measure) of	Alcohol (by measure)
Brandy contain	53·39	Whiskey (Scotch) contain	54·32
Rum	53·68	Whiskey (Irish)	53·90
Gin	51·60		

When wash is distilled, the fluid that comes over is called *singlings*, *low wines*. It is concentrated or *doubled* by a second distillation, b which *raw corn spirit* is obtained. Towards the end of the distillati the distilled product acquires an unpleasant odour and taste from th presence of volatile oil, and is called *faints*. Raw corn spirit is so by the distiller to the rectifier at 11 or 25 per cent. *over proof*, in th language of Sykes' hydrometer.

Stage 3. *Rectification*.—The object of the rectifier is deprive ardent spirit of its volatile oil and water. This is effected b repeated distillations, and by the use of pearlash (carbonate of potash which, by its powerful affinity for water, checks the rise of this fluid distillation.

All kinds of ardent spirits contain a volatile oil, which is termed b the Germans *Fuselöl*. That obtained from potatoe spirit has bee described by Pelletan (*Jour. de Chimie Médicale*, tom. 1er. p. 76), und the name of *huile volatile de pomme-de-terre*: it appears to be analogo to the oil procured from corn spirit, and which has been noticed b Buchner (*Repert.* 24, 270). From Messrs. Bowerbank, rectifiers, London, I have received, under the name of *oil of grain*, a sample volatile oil obtained by them in the rectification of corn spirit. It is limpid, transparent liquid, of a pale yellow colour, having an unpleasa odour and an acrid taste. When washed with water, and then distill from chloride of calcium, it is quite colourless. Its sp. gr. is 0·833 56° F. It burns in the atmosphere with a flame like that of light carb retted hydrogen gas. It dissolves iodine, and is soluble in alcohol an ether, but is insoluble in water, in liquor ammoniæ, and in liquor potass It dissolves in strong nitric acid, but acquires a slightly yellowish re tinge, and when the mixture is heated, violent re-action takes plac nitrous fumes mixed with nitric ether are so rapidly evolved, that if th experiment be performed in a tubulated retort the stopper is sometim forced out with considerable violence. Sulphuric acid added to this o forms with it a deep, blood-red coloured, thick liquid, and evolves he and an odour analogous to that of mint. Potassium rapidly decompos it with the evolution of hydrogen. I am informed by Messrs. Bowerba that they obtain from 500 gallons of corn spirit about 1 gallon of oil grain, which they employ as a substitute for lamp oil.

In the London Pharmacopœia alcohol is directed to be procured by issolving one pound of chloride of calcium (fused) in a gallon of rectified pirit (sp. gr. 0.838): from this seven pints and five fluid ounces of lcohol (sp. gr. 0·815) are to be distilled. In this process the chloride f calcium, (which is very soluble in spirit) having a powerful affinity for ater, prevents the rise of this fluid during distillation, and thus the pirit is deprived of nearly the whole of its water.

Properties.—Alcohol is a limpid, colourless, inflammable liquid, aving a peculiar and penetrating odour, and a burning taste. Its sp. gr. 59° F., is 0·7947; at 62½° F., 0·791; at 173° F., it is only 0·73869 Dumas, *Traité de Chimie*, t. 5, 462).

No means of solidifying it are at present known. It boils at 173° F.: ery volume of the boiling liquid gives 488·3 vols. of vapour calculated 212° F. The sp. gr. of alcohol vapour by experiment is 1·6133, by lculation; according to Dr. Thomson, 1·5972.

It is very combustible. In atmospheric air it burns with a pale blue ame, giving out a very intense heat, and generating carbonic acid and ater, but depositing no soot. The colour of the flame may be variously nted—as yellow by chloride of sodium, violet by chloride of potassium, een by boracic acid or a cupreous salt, carmine red by chloride of hium, crimson by chloride of strontium, and greenish yellow by chlole of barium. One volume of alcohol vapour requires, for its complete mbustion, three volumes of oxygen gas, and yields two volumes of carnic acid gas and three volumes of aqueous vapour. If alcohol vapour ixed with atmospheric air or oxygen gas be passed through a tube ated to dull redness, the products are carbonic, acetic, and *aldehydric** ids, water, and a peculiar substance having a disagreeable, pungent our (*Liebig*). By the combustion of alcohol vapour by spongy platim the products are *aldehyd*†, acetal, acetic acid, and acetic ether iebig).

Alcohol has a strong affinity for water: hence it abstracts this fluid om the atmosphere, and precipitates from their watery solution those its (*e. g.* sulphate of potash) which are not soluble in spirit: while, on e other hand, water precipitates from their alcoholic solution those bstances (*e. g.* resin and oil) not soluble in water. By the mixture of cohol and water, heat is evolved, while air-bubbles are so copiously veloped, that for a few moments the liquid appears turbid. When cold, e resulting compound is found to possess a greater density than the ean of its constituents: but as the condensation varies with the proртions of alcohol and water employed, the sp. gr. of the resulting comund can be ascertained by experiment only. The maximum condention is obtained by mixing 54 vols. of alcohol with 49·77 vols. of ater: the resulting compound measures 100 vols., so that the condensa-

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* *Aldehydric acid* (Aldehydsäure) is a term applied by Liebig and Poggendorf *andwörterbuch der Chemie*) to the Lampic acid of Daniell. It is derived from *cohol de hydrogenatus*. Its probable formula is $C^4 H^3 O^2 + \dot{H}$.

† *Aldehyd* (Aldehyd), another term introduced by the same chemists to indicate a id composed of $C^4 H^4 O^2$.

tion is 3·77. If we regard this as a definite compound of alcohol an water, its composition may thus be stated:—

	Eq.	Eq. Wt.	Per Cent.	Rudberg. Vols.	Rudberg. Weigh
Alcohol	1	23	46	54·00	42·
Water	3	27	54	49·77	49·
Terhydrate of Alcohol	1	50	100	100·00	92·

Alcohol combines with certain salts (as the chlorides and nitrates) form definite compounds, which have been termed *alcohates*, in which th alcohol appears to act as a substitute for the water of crystallization.

Alcohol is a solvent of many organic substances, as volatile oil, fix oil, resin, extractive, most varieties of sugar, many nitrogenous organ acids, the vegetable alkalies, urea, caseum, gliadine, leucine, picrom and osmazome. It prevents the putrefaction of animal substances, an is, in consequence, extensively employed in the preservation of anatomic preparations. Its efficacy is imperfectly understood. It acts, in part least, by excluding air (oxygen) and water,—the two powerful promote of putrefaction; for when animal substances are immersed in spirit, th fluid mixes with and replaces the water with which the tissue was im pregnated; and thus prevents putrefaction by removing one of the essen tial conditions to its production, namely, the presence of water. I attraction for water, and its power of coagulating albuminous substance are properties which probably assist powerfully in rendering it an anti septic. Alcohol and rectified spirit of wine give greater firmness to, an whiten the animal tissues. The latter property is objectionable in th preservation of some morbid specimens, as gelatiniform cancer (*canc gélatiniforme* or *aréolaire* of Cruveilhier,—the *matière colloïd* of Laenne A mixture of one part rectified spirit and three parts water will, howev preserve specimens of the last-mentioned disease in a transparent conditio

Characteristics.—Alcohol and ardent spirits are recognized b their inflammability, odour, taste, and miscibility with water. In ord to detect alcohol in liquids supposed to contain it, let the suspecte liquor be submitted to distillation with a gentle heat (as from a vapo or water bath), and to the distilled liquid add dry carbonate of potas to abstract the water. The alcohol floats on the surface of the alkali solution, and may be recognized by the characters above mentioned.

Composition.—The elementary constituents of alcohol are carbo hydrogen, and oxygen.

	Eq.	Eq.Wt.	Per Cent.	Dumas & Boullay.	Saussure.
Carbon	2	12	52·18	52·37	51·98
Hydrogen	3	3	13·04	13·31	13·70
Oxygen	1	8	34·78	34·61	34·32
Alcohol	1	23	100·00	100·29	100·00

	Vol.	Sp. G
Carbon vapour	1 or 2	0·83
Hydrogen gas	3	0·20
Oxygen gas	0·5	0·55
Alcohol vapour	1	1·59

Chemists are not agreed as to the manner in which these constituents a grouped. By some these elements are regarded as forming one equiva lent of olefiant gas, and one equivalent of water: others consider alcoh to be a compound of one equivalent of a $\frac{4}{4}$ carbo-hydrogen (called b some *etherine*, by others *tetarto-carbo-hydrogen* or *quadri-hydrocarburet* and two equivalents of water; while a third class of philosophers vie s liquid as a hydrated oxide of a $\frac{4}{5}$ carbo-hydrogen (*ethereum* of Kane, *ule* of Berzelius), or as the hydrate of ether; for ether is by them garded as the oxide of ethereum. The latter opinions involve the cessity of assuming the equivalent for alcohol to be 46; that is, double amount stated above. The following table illustrates the views just ted:—

	Eq.	Eq. Wt.	Per Cent.
nt gas	1	14	60·7
·	1	9	39·3
ol	1	23	100·0

	Eq.	Eq. Wt.	Per Cent.
Etherine	1	28	60·7
Water	2	18	39·3
Alcohol	1	46	100·0

	Eq.	Eq. Wt.	Per Cent.
Ethereum	1	29	63·04
Oxygen	1	8	17·39
Water	1	9	19·56
Alcohol	1	46	99·99

	Eq.	Eq. Wt.	Per Cent.
Ether	1	37	80·43
Water	1	9	19·56
Alcohol	1	46	99·99

ALCOHOLOMETRY.—The value of ardent spirit is, of course, proportionate to the quantity of alcohol contained therein; and, therefore, a ıdy mode of estimating this is most desirable. The alcoholometrical thod usually adopted consists in determining the sp. gr. of the liquid an instrument called the hydrometer. That employed in this country, the collection of the duties on spirits, is called *Sykes's hydrometer*. irit having the sp. gr. 0·920, at 60° F. is called *proof spirit*; that ıich is heavier is said to be *under proof*, while that which is lighter is led *over proof*. The origin of these terms is as follows:—Formerly a y rude mode of ascertaining the strength of spirit was practised, led the *proof:* the spirit was poured upon gunpowder, in a dish, and lamed. If at the end of the combustion the gunpowder took fire, spirit was said to be *above* or *over proof;* but if the spirit contained ıch water, the powder was rendered so moist that it did not take : in this case the spirit was declared to be *below* or *under proof*. spirit of different strengths will or will not inflame gunpowder, ording to the quantity of spirit employed, it became necessary to fix legal value of proof spirit: this has been done, and proof spirit *iritus tenuior*, Ph. L.) is defined, by act of parliament, to be such that the temperature of 51° F. thirteen volumes of it weigh exactly as ch as twelve volumes of water. According to this definition the gr. at 60° F. is 0·920, and spirit of this strength consists of

	By Weight.	Sp. Gr.
Alcohol	49	0·791
Water	51	1·000
Proof spirit	100	0·920

oof spirit may be prepared by adding three pints of distilled water, at ', to five pints of rectified spirit, sp. gr. 0·838. Compounded spirits *g.* gin) are not allowed (6 Geo. 4, cap. 80, sect. 124) to be kept or ıt out stronger than 17 per cent. under proof; but gin, as usually d by the rectifier, is 22 per cent. under proof. Distillers are not rmitted (6 Geo. 4, cap. 80, sect. 81) to send out spirits at any other ength than 25 or 11 per cent. above, or 10 per cent. below proof. ıe legislature (6 Geo. 4, cap. 80, sects. 101 & 114) has also defined rits of wine to be of the strength of 43 per cent. over proof at least. The liquid sold as rectified spirit has usually a sp. gr. of m 54 to 60 or 64 per cent. over proof. Hatters employ that at 54 56; varnish-makers that at 58 per cent. over proof. Rum and ındy, as usually sold, are 10 per cent. under proof. The act already quoted (sect. 130) declares, that no foreign or colonial spiri (not being compounded colonial spirits) shall be kept or sent out of le strength than 17 per cent. under proof. The following table, showin the specific gravities of spirits of various strengths, indicated by Syke hydrometer at 60° F., has been drawn up from "*The Ne Plus Ult* (vol. ii.) *of Assaying, Weighing, Measuring, and Valuing of Spirituo Liquors.* By W. Gutteridge. London, 1828."

	Sykes's Hydrometer.	Sp. Gr.
Over proof.	70 per centum	0·8095
	64	0·8221
	62	0·8259
	60	0·8298
	58	0·8336
	56	0·8376
	55·9	0·8379
	55·7	0·8383
	54·1	0·8413
	50·1	0·8482
	43·1	0·8597
	25	0·8869
	11·1	0·9060

	Sykes's Hydrometer.	Sp. Gr.
	Proof	0·9200
Under proof.	5 per centum	0·9259
	10	0·9318
	11	0.9329
	17·1	0·9396
	22·3	0·9448
	23·1	0·9456
	25·1	0·9476
	50·3	0·9673
	80·4	0·9854
	100 (water)	1·0000

Another mode of judging of the strength of spirits (as brandy) is th phial test, technically called the *bead*, the *preuve d'Hollande* of th French. It consists in shaking the spirit in a phial, and observing th size, number, and bursting of the bubbles (or beads as they are termed the larger and more numerous the beads, as well as the more quickl they break, the stronger the spirit.

Hitherto chemical analysis has been of little avail in determining th strength of spirit, at least for commercial purposes. For, on the on hand, we are yet in want of an accurate method of determining the rela tive quantities of alcohol and water in mixtures of these fluids; while, o the other, the combustion of spirit by the black oxide of copper, and th estimation of the quantity of alcohol by the carbonic acid produced, i impracticable for ordinary purposes.

Purity.—Alcohol, or rectified spirit of wine, should be colourless an transparent. Its freedom from other substances than alcohol or water i to be determined by the purity of its odour, by the absence of any aci or alkaline reaction, by its easy and complete volatility. The presenc of volatile oil (*oil of grain*, or *Fuselöl* of the Germans) may be ascertaine by strong sulphuric acid, which communicates a red colour to this sub stance (Geiger, *Handb. d. Pharm.*) Vogel says, that a solution of silve is a delicate test of volatile oil: when mixed with spirit, and exposed t solar light, it becomes red if any oil be present, but undergoes no chang of colour if the spirit be pure.

Physiological Effects. (*a.*) *On vegetables.*—Alcohol acts on plant as a rapid and fatal poison. Its effects are analogous to those of hydro cyanic acid.

(*b.*) *On animals.*—Leeches immersed in spirit die in two or three mi nutes. Their bodies are shrivelled or contracted, and before death they make but few movements; the head and tail of the animal are drawn together. Fontana found, that when half the body of a leech was plunged in spirit, this part lost all motion, whilst the other half con tinued in action. The same experimentalist observed, that spirit killed frogs when administered by the stomach (in doses of 40 drops), injected

neath the skin, or when applied to the brain or spinal marrow. Plung-
; the heart of this animal in spirit caused its motion to cease in twenty
conds. Applied to the right crural nerve of a frog, it destroyed the
wer of moving, in the right foot, on the application of stimulus (Fontana,
eatise on the Venom of the Viper, translated by J. Skinner, vol. ii.
371, *et. seq.*) Monro (*Essays and Observ. Physic. and Literary*,
l. iii. p. 340) observed, that alcohol applied to the hind legs of a frog
ndered the pulsations of the heart less frequent, and diminished sensi-
ity and mobility. Fontana (*op. cit.* p. 365, *et. seq.*) states that turtles
re killed by spirit administered by the stomach or by the anus, or
ected beneath the skin: before death the animal became motionless:
plied to the heart of these animals it destroyed the contractility of this
cus. Some very interesting experiments were made with spirit on
ds by Flourens (*Recherches sur les fonctions et les propriétés du système
veux dans les animaux vertébrés*, 1824). This distinguished physiolo-
t administered six drops of alcohol to a sparrow, whose skull he had
d bare. In a few minutes the animal began to be unsteady both in
lking and flying. After some time a dark-red spot appeared on the
ll, in the region of the cerebellum, and became larger and deeper-
oured in proportion as the alcohol more powerfully affected the animal.
some other experiments, Flourens observed that alcohol produced the
ne effects on the movements of birds as the removal of the cerebellum
asioned, but that when alcohol was administered the animal lost the
of his senses and intellectual faculties; whereas when the cerebellum
s removed, no alcohol being given, he preserved them. From these
l other observations, Flourens is of opinion that alcohol, in a certain
e, acts specifically on the cerebellum, and that in larger doses it affects
er parts also. Furthermore, he thinks the physical action of alcohol
the cerebellum to be absolutely the same as a mechanical lesion.

The effect of alcohol on fishes is analogous to that on other animals.
a little spirit be added to water in which are contained some minnows
prinus phoxinus, Linn.), the little animals make a few (spasmodic ?)
ps, and become incapable of retaining their proper position in the
er, but float on their sides or back. If removed into pure water they
n recover.

The mammals on which the effects of alcohol have been tried are dogs,
s, horses, rabbits, and guinea-pigs. The principal experimentalists
Courten (*Phil. Trans.* for 1712); Fontana (*op. cit.*); Viborg (*Abhandl.
Thierärzte*, Theil II. quoted by Wibmer, *Die Wirkung*, &c.); Brodie
il. Trans. for 1811); and Orfila (*Toxicologie Générale*). The results of
ir experiments may be thus briefly expressed:—Four drachms of alco-
injected into the jugular vein of a dog coagulated the blood and
sed instant death (Orfila). Introduced into the stomach of cats, dogs,
abbits, it produces an apoplectic condition (Brodie and Orfila): this
e is preceded, according to Orfila, by a strong excitement of the
in. The same experimentalist found that alcohol acts with less
rgy when injected into the cellular texture, than when introduced into
stomach; from which he infers that its first effects are the result of
action which it exerts on the extremities of the nerves; though he
its that ultimately it becomes absorbed. On examining the bodies
nimals killed by introducing alcohol into the stomach, this viscus
been found in a state of inflammation.

(*c.*) *On man.*—The effects of alcoholic liquors on man vary with t strength of the liquid, the substances with which the alcohol is combin the quantity taken, and the constitution of the patient.

a. The local effects of alcohol and rectified spirits are those of powerfully irritant and caustic poison. To whatever part of the bo these agents are applied they cause contraction and condensation of t tissue, and give rise to pain, heat, redness, and other symptoms inflammation. These effects depend partially or wholly on the chemi influence of alcohol over the constituents of the tissues: for the affinity this liquid for water causes it to abstract the latter from soft living pa with which alcohol is placed in contact; and when these are of an alb minous or fibrinous nature, it coagulates the liquid albumen or fibrin, a increases the density and firmness of the solid albumen or fibrin. T irritation and inflammation set up in parts to which alcohol is appli depends (in part) on the resistance which the living tissue makes to t chemical influence of the poison: in other words, it is the reaction the vital powers, brought about by the chemical action of alcohol. B besides the local influence of this liquid dependent on its affinity, can hardly refuse to admit a dynamical action (*vide* pp. 7, 11), in virt of which it sets up local irritation and inflammation, independent its chemical agency. The coagulation of the blood contained in t vessels of the part to which this liquid is applied (an effect which Orf observed when he killed an animal by injecting alcohol into the cellu tissue of the thigh of a dog), depends of course on the chemical i fluence of the poison.

β. The remote effects of ardent spirits on man may be convenien considered in the order of their intensity; and for this purpose we m divide them into three degrees or stages.

1. *First or mildest degree* (*Excitement*).—This is characterized excitement of the vascular and nervous systems: the pulse is increas in frequency, the face flushed, the eyes animated and perhaps r the intellectual functions are powerfully excited, the individual is mo disposed to joy and pleasure; cares disappear; the ideas flow mo easily and are more brilliant. At this period the most violent protes tions of love and friendship are frequently made, there is a strong disp sition to talk, and various indiscretions are oftentimes committed. Th degree of effect I presume to be the condition to which all pers aspire in drinking: the unfortunate drinks to drown his cares; t coward to give him courage; the *bon-vivant* for the sake of enjoying t society of his friends; the drunkard from mere sensuality. No perhaps, would wish to go beyond this, yet many, when they have g thus far, exceed their intended limit.

2. *Second degree* (*Intoxication* or *Drunkenness*).—The essential cl racters of this stage are a disordered condition of the intellectual fu tions and of volition, manifested by delirium, varying in its charact in different individuals, and by an incapability of governing the acti of the voluntary muscles. This state is accompanied with excitement the vascular system, and frequently with nausea and vomiting: it followed by an almost irresistible desire for sleep, which usually co tinues for several hours, and is attended with copious perspirati When the patient awakes he complains of headache, loathing of fo great thirst, and lassitude: the tongue is furred and the mouth clamm

3. *Third degree* (*Coma* or *True Apoplexy*).—This condition is usually served when excessive quantities of spirit have been swallowed in a ort time. According to Dr. Ogston (quoted by Dr. Christison) the tient is sometimes capable of being roused; the pulse is generally w, the pupils are occasionally contracted, but more commonly dilated, l the breathing is for the most part slow: but exceptions exist to all se statements. Convulsions are rare: when they occur the patients usually young. In some cases actual apoplexy (with or without guineous extravasation) is brought on. The immediate cause of th appears to be either paralysis of the muscles of respiration, or sure of the glottis.—(*Vide* pp. 68 and 69).

Consequences of habitual Drunkenness.—The continued use of rituous liquors gives rise to various morbid conditions of system, a only of the most remarkable of which can be here referred to. One these is the disease known by the various names of *delirium tremens*, *potatorum*, *oinomania*, &c., and which is characterized by delirium, mor of the extremities, watchfulness, and great frequency of pulse. pathology is not understood. It is sometimes, but not constantly, nected with, or dependent on, an inflammatory condition of the brain its membranes. Opium has been found an important agent in cting the subsidence of this affection.

Insanity is another disease produced by the immoderate and habitual of spirituous liquors. The records of our pauper lunatic asylums w that, in a large proportion of cases, the exciting cause of madness he use of ardent spirits.

Disease of the liver is frequently met with in drunkards. It is gene- y of the kind termed by Baillie *common tubercle of the liver*, by Elliotson (*Med. Gaz.* vol. xii. p. 484) the *gin liver;* by others, *nulated*, *lobulated*, *mamellated*, or *scirrhous liver*. Laennec calls it *hosis* (from κιῤῥὸς, *yellowish*), in reference to its usual tawny yellow our. A beautiful representation of it is given by Cruveilhier (*Anatom. tholog.* liv. 12^e^. pl. 1.) Dr. Carswell (*Patholog. Anat.* art. *Atrophy*) described it as consisting in atrophy of the lobular structure of the r produced by the presence of a contractile fibrous tissue. It is not, refore, a disease depending on the formation of a new tissue. The ites, which so frequently accompanies it, arises from the compression which the portal vessels are subjected by the fibrous tissue; and the ndice, another frequent effect of it, doubtless depends on compression he gall ducts. Some excellent remarks on this disease have been de by my able colleague, Dr. Hope (*Principles and Illustrations of rbid Anatomy*.)

Persons addicted to the use of ardent spirits are usually dyspeptic. ronic inflammation of the stomach, or even a scirrhous state of the orus, has been said to be occasionally produced by hard drinking.

The kidneys of dram-drinkers are sometimes affected with a disease t described by Dr. Bright, and which is generally attended by albu- ious urine. They assume a granular state, which Dr. Hope regards corresponding to the granular liver just described.

Modus Operandi.—That alcohol becomes absorbed is proved by the t that it has been found in the blood. Tiedemann and Gmelin (*Uber Wege auf welchen Substanzen aus d. Magen ins Blut gelangen*) ognized the odour of it in the blood of the splenic vein, though they were unable to detect it in the chyle. A similar observation is repor by Magendie (*Element. Compend. of Physiology*, by Dr. Milligan, p. 2 1823). Moreover the recognition of the odour of alcoholic liquors in t breath of individuals who have swallowed them, as well as their detecti by their smell in the fluid contained in the ventricles of the brain, in t pericardium, &c., prove indisputably that alcohol becomes absorb Dr. Cooke (*Treatise on Nervous Diseases*, i. 222) states, on the auth rity of Sir A. Carlisle, that in one case the fluid of the ventricles of t brain had the smell, taste, and *inflammability* of gin. The correctness the last observation has been questioned by Dr. Christison, on the grou that gin of sufficient strength to take fire could not enter the blo vessels without coagulating the blood.

Morbid Appearances.—On examining the bodies of individuals w have been poisoned by ardent spirits, redness and inflammation of t stomach are sometimes, but not invariably found. In old drunkards t mucous membrane of the stomach is often injected and thickened. Co gestion of the cerebral vessels, with or without extravasation of blood effusion of serum, is not unfrequently observed. Traces of the pois may or may not be found in the stomach, according to the rapid with which death has been produced. The odour of the spirit m perhaps be recognised in various parts of the bodies, especially in t brain and the serous cavities.

Uses.—1. *Medicinal.* (*a.*) *Internal.*—Raw spirit is rarely adm nistered internally: for when ardent spirit is indicated, brandy, rum, g or whiskey, is usually employed. Each of these liquors presents so peculiarity of operation which makes it preferable in certain cas "Brandy," observes Dr. Paris (*Pharmacologia*), "is said to be simply c dial and stomachic; rum, heating and sudorific; gin and whiskey, diu tic; and arrack, heating and narcotic." *As a stomachic stimulant*, bran is employed to relieve spasmodic pains, to check vomiting, especi sea-sickness, and to give temporary relief in some cases of indigesti attended with pain after taking food. *As a stimulant and restorative* the last stage of fever, brandy is sometimes given with considera benefit. For this purpose the *mistura spiritûs vini gallici* of the Lond Pharmacopœia, better known as *egg flip*, is said to be a favourite p paration with Sir H. Halford. *To relieve mild cases of diarrhœa*, tended with griping pain, but unaccompanied by any inflammat symptoms, a small quantity of brandy and water, taken warm with n meg, is often an efficacious remedy. *As a powerful stimulant*, to supp the vital powers, and to prevent fainting during a tedions operati brandy is most serviceable. It is also used to relieve syncope, and restore patients from a state of suspended animation. *In delirium trem* it is not always advisable to leave off the employment of spirituous liqu at once, since the sudden withdrawal of the long-accustomed stimu may be attended with fatal consequences. *In poisoning by foxglo* brandy and ammonia are the remedies most to be relied on.

(*b.*) *External.*—Spirit of wine is used externally for several p poses, of which the following are the principal:—*As a styptic*, to strain hæmorrhage from weak and relaxed parts. It is efficacious in t ways: it coagulates the blood by its chemical influence on the liq albumen and fibrin, and it causes the contraction of the mouths of t bleeding vessels by its stimulant and astringent qualities. Sponge oft linen soaked in brandy, or in spirit and water, has been applied to ıe mouth of the uterus in uterine hæmorrhage (Richter, *Arzneimit-ellehre*, 3er Bd. S. 256). *Spirit is used to harden the cuticle over tender nd delicate parts.* Thus brandy is sometimes applied to the nipples everal weeks before delivery, in order to prevent production of sore ipple from suckling, in individuals predisposed to it. The efficacy of pirit, in hardening the cuticle, depends, in part, on its chemical influence. pirit gargles have been found serviceable in checking the tendency to iflammation and swelling of the tonsils. *As a stimulant application*, arm rectified spirit has been applied to burned or scalded parts, on the rinciples laid down for the treatment of these cases by Dr. Kentish. roperly diluted, spirit has been employed as a wash *in various skin iseases*, and *in ulcers of bed-ridden persons*, and as a *collyrium* in hronic ophthalmia. *Frictions with rectified spirits* have been used in ıe abdominal region, to promote labour pains; on the chest, to excite ıe action of the heart, in fainting or suspended animation; in the ypogastric region, to stimulate the bladder, when retention of urine epends on inertia, or a paralytic condition of this viscus; in various arts of the body, to relieve the pain arising from bruises, or to stimulate aralyzed parts.

The inhalation of the vapour of rectified spirit has been recommended relieve the irritation produced by the inspiration of chlorine; but I ive tried the practice on myself without benefit. The readiest mode of fecting it is to drop some spirit on a lump of sugar, and hold this in e mouth during inspiration.

Diluted spirit has been used *as an injection for the radical cure of drocele.* A mixture of wine and water, however, is commonly em-oyed in this country.

Spirit has been used to form cold lotions. — As the efficacy of it epends on its evaporation, it should be applied by means of a single yer of linen, and not by a compress. Evaporating lotions are applied the head in cephalalgia, in phrenitis, in fever, in poisoning by opium, c.; to fractures of the extremities; to parts affected with erysipelatous flammation, &c.

2. *Pharmaceutical.*—The alcohol of the Pharmacopœia (sp. gr. 815) is not employed in the preparation of any officinal substances, it it is a valuable agent in chemical analysis, and is used in determining e purity of certain medicinal substances; as iodine, iodide of potassium, e vegetable alkalies, castor oil, &c. Rectified and proof spirits are ost extensively employed in officinal pharmacy: as in the formation of ıctures (the *alcoolés* of the French pharmacologists), spirits (*alcoolats alcoolata* of the Codex), ethers, etherial oil, and resinous extracts, d in the manufacture of the vegetable alkalies. Spirit is added to rious preparations to assist in preserving them.

Antidotes. — The first object in the treatment of poisoning by irituous liquors is to evacuate the contents of the stomach, which is best fected by the stomach-pump; emetics being frequently unsuccessful. imulants are then to be employed: the most effectual are the injection cold water into the ears, cold affusion to the head and neck, warmth the extremities, when these are cold, and the internal use either of nmonia, or of the solution of the acetate of ammonia, both of which agents have been found useful in relieving stupor. The cerebral con-gestion often requires the cautious employment of local blood-lettin and the application of cold to the head. If the patient appear to b dying from paralysis of the respiratory muscles, artificial respiratio should be effected: if from closure of the larynx, tracheotomy may b performed (see pp. 68 and 69).

Æ'ther Sulphu'ricus.—Sul'phuric E'ther.

History and Synonymes.—This liquid is said to have been know to Raymond Lully, who lived in the 13th century, and to Basil Valentin in the 15th century. In 1540, Valerius Cordus described the method making it. He termed it *oleum vitrioli dulce.* The Germans call *vitriolic naphtha* (*naphtha vitrioli*).

Natural History.—It is always an artificial product.

Preparation.—The following are the directions in the London Pha macopœia for preparing it:—"Take of rectified spirit three pound sulphuric acid two pounds, carbonate of potash, previously ignited, ounce: pour two pounds of the spirit into a glass retort, add the acid it, and mix. Afterwards place it on sand, and raise the heat so that tl liquor may quickly boil, and the ether pass into a receiving vessel cool with ice or water. Let the liquor distil until some heavier portion begin to pass over. To the liquor which remains in the retort after the he has subsided, pour the remainder of the spirit, that ether may distil the same manner. Mix the distilled liquors, then pour off the supe natant portion, and add to it the carbonate of potash, shaking them fr quently during an hour. Lastly, let the ether distil from a large reto and be kept in a stoppered vessel."

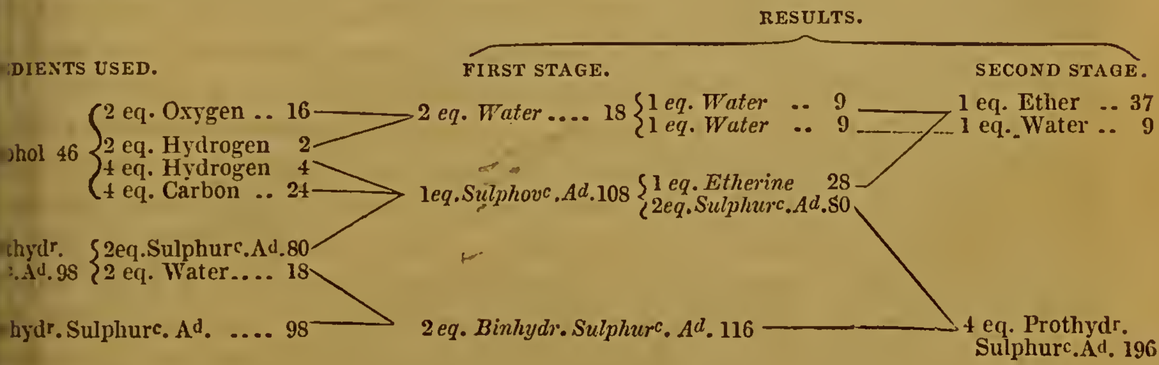
When required to be produced in small quantities, ether may be ma in a tubulated glass retort, connected by an adopter with a cooled gla receiver; but on the large scale a leaden still heated by steam is us instead of the retort. With this is connected a condensing worm, ke cool in the usual way, and delivering the distilled liquor into receiver with a glass lid.

Theory of Etherification.—In order to convert two equivale or 46 parts of alcohol into one equivalent or 37 parts of ether, we mu abstract one equivalent or nine parts of water.

	Carbon.	Hydrogen.	Oxyg
2 equivalents Alcohol are composed of	4 eq.	6 eq.	2
Abstract 1 equivalent Water composed of	0 eq.	1 eq.	1
1 equivalent Ether	4 eq.	5 eq.	1

But though the phenomena are thus far very simple, there are so accessory changes which make the theory of etherification exceedin complicated, and about the precise nature of which chemists are n quite agreed.

It appears that when strong liquid sulphuric acid and rectified spi are mixed, the acid loses part of its saturating power, and a new co pound is formed (*sulpho-vinic acid* of Hennell; *ethereo-sulphuric ac* of Liebig). The heat employed causes this to undergo decompositi which ether and sulphuric acid are obtained. Mr. Hennell explains process in the following way:—Four equivalents or 196 parts of protohydrated sulphuric acid re-act on two equivalents or 46 parts alcohol, and produce two equivalents or 18 parts of water, one ivalent, or 108 parts of sulpho-vinic acid, and two equivalents or 116 ts of the binhydrated sulphuric acid. These are the products of first stage of the process. By the heat employed the sulpho-vinic d is decomposed into one equivalent or 28 parts of a $\frac{4}{4}$ carbo-lrogen (*etherine)*, and two equivalents or 80 parts of anhydrous phuric acid. The carbo-hydrogen *(etherine)* uniting with one equiva-t or 9 parts of water forms one equivalent or 37 parts of ether, which til over; while the anhydrous sulphuric acid, with the binhydrated phuric acid, reproduces protohydrated sulphuric acid, which remains the retort with one of the two equivalents of water formed in the first ge of the process; so that ether, water, and protohydrated sulphuric d, are the products of the second stage of the process. The following gram illustrates the changes according to Mr. Hennell's views *hil. Trans.* 1826 and 1828):—



According to this theory, sulpho-vinic acid may be regarded as a *ulphate of etherine.*

. Sulphuric Acid	80	2 eq. Sulphuric Acid		80
. Carbon	24	1 eq. Etherine	4 eq. Carbon	24
. Hydrogen	4		4 eq. Hydrogen	4
. Sulpho-vinic Acid	108	1 eq. Bisulphate Etherine		108

The theory of etherification, according to Liebig *(Handwörterbuch der emie,* 1 Bd. S. 110—116, 1837), may be thus concisely stated:—ur equivalents or 196 parts of the protohydrated sulphuric acid re-act two equivalents or 46 parts of alcohol, and produce one equivalent 9 parts of water, one equivalent or 117 parts of ethereo-sulphuric acid, d two equivalents or 116 parts of binhydrated sulphuric acid. These the products of the first stage of the process. At a temperature of out 255° F. the ethereo-sulphuric acid is decomposed into an equivalent 37 parts of ether, which distil over, and two equivalents or 80 parts of hydrous sulphuric acid, which, with the binhydrated sulphuric acid, produce four equivalents or 196 parts of the protosulphuric acid: the ter remain in the retort with the equivalent of water produced in the st stage of the process.

The following diagram will perhaps serve to render this view more elligible:—

INGREDIENTS USED.		RESULTS. FIRST STAGE.		SECOND S[TAGE]
2 eq. Alcohol 46	1 eq. Oxygen .. 8	1 eq. Water 9		1 eq. Wat[er]
	1 eq. Oxygen .. 8			
	1 eq. Hydrogen. 1			
	5 eq. Hydrogen 1			
	4 eq. Carbon .. 24	1 eq. Ethereo-Sulp^r. Ad. 117	1 eq. Ether .. 37	1 eq. Eth[er]
2 eq. Prothyd^r. Sulphur^c. A^d.	2eq. Sulphur^c. A^d. 80		2eq. Sulphur^c. A^d. 80	
	2 eq. Water.... 18			
2 eq. Prothyd^r. Sulphur^c. A^d.	 98	2 eq. Binhydr. Sulp^c. A^d. 116		4 eq. Pro[thydr]. Sulphur[ic Ad].

The ethereo-sulphuric aeid of Liebig may be viewed as the *hydrate* [of] *sulpho-vinic acid* (Hennell),—as a *bisulphate of ether*,—as the *hydrat*[e of] *bisulphate of etherine*,—or, lastly, as the *bisulphate of the oxide* [of] *ethereum* (*ethule*).

1 eq. Sulpho-vinic A^d. (Hennell) 108	1 eq. Sulphuric Acid 80	1 eq. Sulphuric A^d. 80	2 eq. Sulphuric A^d.
1 eq. Water 9	1 eq. Ether 37	1 eq. Etherine 28	1 eq. Ether^m. (Ethule)
		1 eq. Water 9	1 eq. Oxygen ......
1 eq. Hyd^rd. Sulpho-vinic A^d. 117	1 eq. Bisulph^e. Ether 117	1eq. Hyd^rd. Bisulph^e. Etherine 117	1 eq. Bisulphate Ox^e. Ethereum........

The ethereo-sulphurie aeid of Liebig must not be confounded with [a] compound of a similar name deseribed by Magnus, and whieh contain[s], aeeording to Liebig (*op. cit.*), neither sulphuric acid nor ether, but consi[sts] of hyposulphuric aeid and an organic substance (protoxide of etherine), and its elementary eomposition is probably $S^2 C^4 H^4 O^6$.

During the distillation of ether, the relative proportions of the ingr[e]dients in the retort are eonstantly varying: the quantity of sulpho-vin[ic] aeid (ethereo-sulphuric acid, aecording to Liebig) is diminishing, whi[le] that of sulphurie aeid is increasing; and, consequently, during t[he] progress of the proeess the boiling point of the liquid gradually rise[s]. When it has arrived at about 340° F., and when, eonsequently, the su[l]phurie aeid is greatly in exeess, the earbo-hydrogen and aeid begin [to] react on eaeh other; the produets of this reaetion are water, sulphuro[us] aeid, and carbon: the latter blaekens the liquid in the retort, while t[he] sulphurous acid is distilled over with some water. Hence, therefor[e], as soon as " a heavier portion" (*i. e.* an aqueous solution of sulphuro[us] aeid) is perceived under the ether in the reeeiver, the process is stoppe[d], and when the liquid in the retort has become sufficiently eool, mo[re] rectified spirit is added, and distillation again performed.

The reetification of ether is intended to free it from aleohol, wat[er], sulphurous acid, and oil of wine. It is ordered to be effected by t[he] addition of carbonate of potash and re-distillation. In order to separa[te] aleohol from ether, the readiest method is to shake the ether with twi[ce] its bulk of water; then pour it off, and remove the water which t[he] washed ether has dissolved, by adding some fresh burned lime, a[nd] distilling the ether a seeond time.

Properties.—At ordinary temperatures ether is a eolourless, ve[ry] limpid liquid, having a penetrating, peculiar, though somewhat fragra[nt] odour; a hot, pungent taste, and a high refraetive power. It is a b[ad] conductor of eleetrieity. Absolutely pure ether has not been solidifi[ed] by any degree of cold hitherto produeed. The sp. gr. of pure eth[er] at 68° F. is, aceording to Dumas and Boullay, 0·713 (Brande's *Manu[al] of Chemistry*). The ether of the shops contains a little alcohol, a[nd] its sp. gr. varies from 0·733 to 0·765: in the Pharmaeopœia the sp. g[r.] at 62° F. is fixed at 0·750. Ether is extremely volatile: when of sp. g[r.]

20, its boiling point (the mercury in the barometer standing at 30 hes), is about 98° F. In a vacuum it boils at 40° F. below zero. The poration of ether causes intense cold. The sp. gr. of ether vapour s found by Gay-Lussac to be 2·586. Pure and recently prepared er possesses neither acid nor alkaline properties; but, by exposure air and light, it absorbs oxygen, by which acetic acid and water are duced. The acetic acid is not immediately observed, because it nbines with some undecomposed ether to form acetic ether (Dumas).

Ether is very combustible: it burns in atmospheric air with a yel-ish white flame, and forms carbonic acid and water. Its vapour, ced with oxygen or atmospheric air, forms a violently explosive mixture. e house of an apothecary at Bern was blown up, in consequence of a ited candle being taken into a cellar in which a bottle of ether had been ken. One volume of ether vapour consumes, in burning, six volumes oxygen gas: the products are four volumes of carbonic acid, and five umes of aqueous vapour. By the slow combustion of ether vapour, means of a coil of platinum wire, a substance is formed which . Daniell called *lampic acid*, but which he afterwards supposed to acetic acid, combined with a peculiar compound of carbon and lrogen. I have before mentioned, that it is called by Liebig, *aldehydric l*, who says it is composed of $C^4H^3O^2 + \dot{H}$ (*Handwörterbuch der Che-*, 1 Bd. S. 188, 1837).

Ether is sparingly soluble in water: nine volumes of the latter dis-e one of the former. Ether, which has been washed with water, con-s a small portion of the latter liquid. Alcohol dissolves ether in all portions.

Ether abstracts bichloride of mercury, terchloride of gold, and the quichloride of iron, from their watery solutions. It readily dissolves nine and iodine, but the solutions by keeping undergo decomposi-. It sparingly dissolves sulphur and phosphorus: the ethereal solu- of phosphorus is luminous in the dark, when poured on hot water. issolves the volatile oils, most of the fatty and resinous substances, e of the vegetable alkalies, urea, and osmazome.

CHARACTERISTICS.—Sulphuric ether may be recognized by its combus-ity, its yellowish white flame, its volatility, its peculiar odour and e, its complete solubility in alcohol, and its sparing solubility in water, onsequence of which, when mixed with water and agitated in phial, mixture speedily separates, on standing, into two layers.

COMPOSITION.—The following is the elementary composition of ether:

	Eq.	Eq.Wt.	Per Cent.	Dumas & Bouillay.
Carbon	4	24	64·87	65·05
Hydrogen	5	5	13·51	13·85
Oxygen	1	8	21·62	21·24
Ether	1	37	100·00	100·14

hemists are not agreed as to the manner in which these elements are ciated. Ether has been considered, at different times, as a *dihydrate lefiant gas*,—a *hydrate of etherine*,—or as the *protoxide of ethereum ule*).

Olefiant gas	28	1 eq. Etherine	28	1 eq. Ethereum (Ethule)	29
Water	9	1 eq. Water	9	1 eq. Oxygen	8
Dihydrate of Olefiant gas	37	1 eq. Hydrate of Etherine	37	1 eq. Protox^e. of Ether^m.	37

In this diagram olefiant gas is regarded as a $\frac{2}{2}$ carbo-hydrogen, etl rine as a $\frac{4}{4}$ carbo-hydrogen, and ethereum as $\frac{4}{5}$ carbo-hydrogen.

PURITY.—Absolutely pure ether is not necessary for medicinal pu poses. Hence in the London Pharmacopœia we are told that ether whi has a sp. gr. of 0·750 may be employed: but it would have been better to ha limited the sp. gr. to 0·740. Of course the presence of alcohol or wa increases the sp. gr. of this liquid: hence the lightest ether is to be p ferred, as being the freest from these. Ether which contains no alcol does not coagulate the serum of the blood. Pure ether does not red litmus, but the ether of the shops usually does so slightly. Ten flu ounces of water should not dissolve more than one fluidounce of eth and the solution should be quite transparent.

PHYSIOLOGICAL EFFECTS. (*a.*) *On Vegetables.*—Ether, like alcoh acts as a powerful and rapid poison to plants.

(*b.*) *On Animals.* The effects of it on dogs have been determined Orfila (*Toxicolog. Générale*), who found that half an ounce introdu into the stomach, and the œsophagus tied, caused attempts to von diminished muscular power, insensibility, and death in three hou Three drachms and a half injected into the cellular tissue of the thi caused death on the fourth day. Jäger (quoted by Wibmer, in *Die W kung*, &c.) found that half an ounce of ether acted as a fatal poison t crane: at the end of 48 hours its odour could be readily detected in body. He made similar experiments with pigeons and ducks. One the last mentioned animals took altogether an ounce of ether, yet was dead at the end of 24 hours.

(*c.*) *On man.* The operation of ether is analogous to that of alcol but is much more rapid and transient. *Swallowed in moderate do* it makes a powerful impression on the mouth, throat, and stomach, all spasm, and relieves flatulence: but, according to some observers, it a ments neither the heat of the body nor the frequency of the pu (Schwilgué, *Traité de Mat. Méd.* 1818): also, Trousseau and Pido *Traité de Thérap.* 1836). Its first effects on the cerebral functions those of an excitant, but the subsequent ones are those of a depress agent. *In somewhat larger doses* it produces intoxication like that cau by alcohol. *In excessive doses* it occasions nausea, a copious flow saliva, giddiness, and stupefaction.

The long and habitual use of ether diminishes the effect of this su stance over the system, and therefore the dose must be proportiona increased. Dr. Christison mentions the case of an old gentleman w consumed sixteen ounces every eight or ten days, and had been in habit of doing so for many years. Yet with the exception of an asth for which he took the ether, he enjoyed tolerable health. The chem Bucquet, who died of scirrhus of the colon, with inflammation of stomach and of the intestines generally, took, before his death, a pint ether daily to alleviate his excruciating pains (Merat and De Lens, *D Mat. Méd.*).

When the vapour of ether, sufficiently diluted with atmospheric air *inhaled*, it causes irritation about the epiglottis, a sensation of fulness the head, and a succession of effects analogous to those caused by protoxide of nitrogen (*vide* p. 156), and persons peculiarly susceptibl the action of the one are also powerfully affected by the other (*Journ Science*, vol. iv. p. 158). If the air be too strongly impregnated with etl pefaction ensues. In one case this state continued with occasional iods of intermission for more than 30 hours: for many days the pulse s so much lowered that considerable fears were entertained for the ety of the patient (*op. cit.*) In another case, an apoplectic condition, ich continued for some hours, was produced.

Modus Operandi.—When ether is swallowed it is rapidly absorbed, l subsequently thrown out of the system by the pulmonary surface. gendie (*Elem. Compend. Physiol.* by Milligan) says, that ether introced into the cavity of the peritoneum is discoverable in the expired by its odour. Thrown into the cavity of the pleura, it produces edy death, and its odour is very obvious when we approach the mouth he animal.—(*Lectures on the Tissues*, Lancet, Nov. 22, 1834).

Jses.—1. *Medicinal.* (*a.*) *Internal.*—Ether is principally valuable as peedy and powerful agent in spasmodic and painful affections, not endent on local vascular excitement, and which are accompanied by a e, cold skin, and a small, feeble pulse. If administered during a oxysm of spasmodic asthma, it generally gives relief, but has no tency to prevent the recurrence of the attacks. In cramp of the stomach, gultus, and flatulent colic, its happy effects are well established. It is ietimes highly advantageous in a paroxysm of angina pectoris. Dur- the passage of urinary or biliary calculi it may be used as a substitute or in combination with, opium, to overcome the spasm of the ducts or es through which the calculus is passing.

n the latter stages of continued fever, ether is sometimes admissible. s employed to relieve the subsultus tendinum and hiccup. Desbois Rochefort (*Mat. Méd.*) administered it in intermittent fevers. He gave bout half an hour before the expected paroxysm, it acted as a mild horetic, and prevented the recurrence of the attack.

Ieadache of the kind popularly called nervous, that is, unconnected ı vascular excitement, is sometimes speedily relieved by ether. I e found it beneficial principally in females of delicate habits. In such occasionally gives immediate relief, even when the throbbing of the poral vessels and suffusion of the eyes (symptoms which usually contracate the employment of ether), would seem to shew the existence xcitement of the cerebral vessels.

n flatulence of stomach it may be taken in combination with some natic water. Against sea-sickness it should be swallowed in a glass hite wine. Durande (*Observ. sur l'Efficacité du Mélange d'Ether huriq. et d'Huile volatile de Tereb. dans Coliques hépatiq. produites par Pierres Biliaires*, 1790), recommends a mixture of three parts ether two oil of turpentine as a solvent for biliary calculi Bourdier (*Mém. a Société de Méd.*) employed ether to expel tape-worm. He adminisd it by the stomach and rectum in an infusion of male fern, giving a e of castor-oil an hour after. In faintness and lowness of spirits it is pular remedy. In poisoning by hemlock and mushrooms it has been loyed (J. Frank, *Toxicologie*, s. 70,108). In asphyxia it has been l with benefit.

he vapour of ether is inhaled in spasmodic asthma, chronic catarrh, dyspnœa, hooping cough, and to relieve the effects caused by the dental inhalation of chlorine gas. It may be used by dropping some r in hot water, and inspiring the vapour mixed with steam, or it may lropped on sugar which is to be held in the mouth. The inhalation of the vapour of the etherial tincture of hemlock is occasionally useful relieving spasmodic affections of the respiratory organs, and hasbe recommended in phthisical cases.

(*b.*) *External.*—The principal external use of ether is to produce co by its speedy evaporation. Thus in strangulated hernia it may be dropp on the tumour and allowed to evaporate freely: by this means a consid able degree of cold is produced, and, in consequence, the bulk of the pa diminished, whereby the reduction of the hernia is facilitated. Dropp on the forehead, or applied by means of a piece of thin muslin, etl diminishes vascular excitement, by the cold produced from its evapo tion, and is exceedingly efficacious in headache and inflammatory con tions of the brain. In burns and scalds it may also be employed as refrigerant. If its evaporation be stopped or checked, as by covering with a compress, it acts as a local irritant, causing rubefaction, and, long-continued application, vesication. It is used with friction as a lo stimulant.

2. *Pharmaceutical.*—Ether is employed in the preparation of t compound spirit of sulphuric ether. It is also used to extract the act principles of certain drugs, as of lobelia, aloes, musk, &c. The soluti (none of which are contained in the London Pharmacopœia) are call etherial tinctures (*tincturæ æthereæ*), or by the French pharmacologi *éthérolés.* Ether is of assistance in determining the purity of some me cinal substances, as of aconitina and veratria, which are very soluble in It is also employed in toxicological researches, to remove bichloride mercury from organic mixtures.

Administration.—It may be given in doses of from half a fluidrac to two drachms:—a tea-spoonful is the ordinary quantity. This d may be repeated at short intervals. It is usually exhibited in so aromatic water, and frequently in combination with other antispasmo and stimulants, as ammonia, valerian, &c. It may be perfectly incor rated with water, or any aqueous mixture, by rubbing it with spermac employed in the proportion of two grains for each fluidrachm of et (*United States Dispensatory.*)

Antidotes.—In cases of poisoning by ether the same treatment is be adopted as before recommended in cases of poisoning by alcohol.

O'leum Æthe'reum (Ph. L.)—*Ethe'real Oil.*

History and Synonymes.—This liquid is commonly termed *heavy of wine*, or simply *oil of wine*. Dumas (*Traité de Chimie*, t. 5me. p. 54 says it was known to Paracelsus, who designated it *sweet oil of vitr* Modern writers have given it various appellations founded on its s posed composition. Thus according to Mr. Hennell it is a *sulphat hydrocarbon*,—Dumas calls it *sulphatic ether*,—others a *double sulph of ether* and *hydrocarbon*,—while Liebig terms it *ethereo-sulphate ether-oil*, the term ether-oil being applied by this writer to a fluid ¼ car hydrogen.

Preparation.—The following directions for procuring it are give the London Pharmacopœia. "Take of rectified spirit two pounds, s phuric acid four pounds, solution of potash, distilled water, of each a flu ounce, or as much as may be sufficient. Mix the acid cautiously w the spirit. Let the liquor distil until a black froth arises; then im ately remove the retort from the fire. Separate the lighter supernatant quor from the heavier one, and expose the former to the air for a day. ld to it the solution of potash first mixed with water, and shake them gether. Lastly, when sufficiently washed, separate the ethereal oil iich subsides." I am informed by Mr. Hennell that 33 lbs. (*avoird.*) rectified spirit, and 64 lbs. (*avoird.*) of oil of vitriol, yielded, in one eration, 17 ounces (*avoird.*) of ethereal oil.

Theory of the Process.—In the first part of the process the changes the same as those which occur in the process for making sulphuric ier. When the sulphuric acid and rectified spirit are mixed, sulpho-iic acid (ethereo-sulphuric acid, according to Liebig) is formed, and by tillation water and ether are obtained.

The formation of ethereal oil depends, according to Mr. Hennell, on decomposition of two equivalents or 216 parts of sulpho-vinic acid o one equivalent or 136 parts of ethereal oil, and two equivalents or 80 rts of sulphuric acid.

NGREDIENTS USED.		RESULTS.
ι. Sulphovinic Acid 216	8 eq. Hydrogen . . . 8	1 eq. Ethereal Oil . . 136
	8 eq. Carbon 48	
	2 eq. Sulphuric Acid. 80	
	2 eq. Sulphuric Acid. 80	2 eq. Sulphuric Acid . 80

This view of the subject is principally founded on the fact that sulpho-ic acid, or a sulpho-vinate, when heated, yields, among other products, ereal oil.

But Liebig states that the compound formed by the mixture of sulphu-acid and rectified spirit is ethereo-sulphuric acid, and that the heavy of wine (the ethereal oil, Ph. L.) is an ethereo-sulphate of a $\frac{4}{4}$ carbo-lrogen, which he calls ether-oil (Aetherol). Consistently with this w we may account for the formation of the heavy oil of wine by sup-ing that by the heat employed, one equivalent or 117 parts of ethereo-phuric acid are resolved into one equivalent or 28 parts of a fluid $\frac{4}{4}$ carbo-lrogen (ether-oil of Liebig), two equivalents or 80 parts of sulphuric d, and one equivalent or 9 parts of water. By the union of the $\frac{4}{4}$ carbo-lrogen (ether-oil of Liebig) with one equivalent or 117 parts of ereo-sulphuric acid, there are formed an equivalent or 145 parts of ethereal oil of the Pharmacopœia (the *ethereo-sulphate* of Liebig's *er-oil*).

GREDIENTS USED.			RESULTS.
. Ethereo-sulphuric Acid . . 117			1 eq. Etherl. Oil (Ph.L.) 145
. Ethereo-ılphuric cid. . 117	4 eq. Hydrogen 4	1 *eq.* $\frac{4}{4}$ *Carbohydr*n. (*Ether-oil* Lieb.) 28	
	4 eq. Carbon . 24		
	1 eq. Water . . 9		1 eq. Water 9
	2eq. SulphuricAd. 80		1 eq. Sulphuric Acid . . 80

During the process olefiant gas is evolved. By the mutual action of sul-iric acid and the $\frac{4}{4}$ carbo-hydrogen, water, sulphurous acid, and carbon, produced. The deposition of the last-mentioned substance is the cause the black froth alluded to in the Pharmacopœia. The lighter super-ant liquor also referred to is the ethereal oil mixed with ether. The er evaporates by exposing the mixture to the air for a day. To remove traces of sulphurous acid, the oil is to be washed with a solution of stic potash. Liebig says alkalies decompose it (*op. cit.* p. 122).

Properties.—Ethereal oil is usually a yellowish oily liquid, having a uliar aromatic odour, and a bitter aromatic taste. Its sp. gr. accord-to Mr. Hennell, is 1·05; but according to Serullas, it is 1·13. It is insoluble in water, but dissolves readily in alcohol and ether. It neith reddens litmus nor precipitates a solution of chloride of barium, so th the sulphuric acid contained in it seems to be completely neutralized.

According to Mr. Hennell ethereal oil dissolves a variable quantity a $\frac{4}{4}$ carbo-hydrogen, part of which separates in a crystalline form wh the oil is kept for some time, or when exposed to cold. This crystalli compound, the existence of which was first pointed out by Mr. Henn is called *wine-oil-camphor* (*Weinöl-Campher*) by Gmelin (*Handb. d. Ch mie*, 2^er^. Bd. s. 405),—*etherine* by Liebig (*Handwört d Chemie*, 1^er^. B s. 116).

When ethereal oil is slightly heated with water it yields ethereo-su phuric acid (sulpho-vinic acid of Hennell) and a light oily fluid (*light sweet oil of wine*) which floats on water. This substance is a mixtu of two isomeric compounds,—the one a solid (*wine-oil-camphor* or *eth rine*) the other a liquid (*ether-oil* of Liebig). Each of these compoun is a $\frac{4}{4}$ carbo-hydrogen (Liebig and Poggendorf, *Handwört. d. Chem* 1^er^. Bdes. s. 119).

Characteristics.—Ethereal oil is recognized by its oily appearan its peculiar odour and taste, its slight solubility in, but greater speci gravity than, water, and its solubility in ether and alcohol. If it heated in a test tube it yields an inflammable vapour which burns li olefiant gas, and a carbonaceous residue which contains sulphuric ac as is proved by lixiviating with water and testing by chloride of bariu Ethereal oil added to a solution of chloride barium, occasions no clou ness, but if we evaporate the mixture to dryness, the residue is found contain sulphate of baryta.

Composition.—Three chemists have analysed ethereal oil, name Hennell, Serullas, and Liebig. The results of two only of these agr namely, those of Liebig and Serullas.

	LIEBIG AND SERULLAS.					HENNELL.		
	Eq.	Eq.Wt.	Theory.	Liebig.	Serullas.	Eq.	Eq.Wt.	Per C
Sulphuric Acid	2	80	55·17	55·614	55·02	1	40	3
Carbon	8	48	33·10	33·180	33·05	9	54	5
Hydrogen	8	8	5·52	5·418	5·49	9	9	
Water	1	9	6·21	5·788	6·11	0	0	
Ether^l^.Oil(Ph.L.)	1	145	100·00	100·000	99·67	1	103	10

Mr. Hennell regards ethereal oil as a *sulphate of hydrocarbon*, where Dumas considers it to be a *sulphate of ether*. Serullas called it a *dou sulphate of ether and hydrocarbon*. Lastly, Liebig regards it as an *ether sulphate of* (a $\frac{4}{4}$ carbo-hydrogen, which he terms) *ether-oil*.

These different opinions may be thus represented:—

LIEBIG.	SERULLAS.	DUMAS.	HENNELL.
1eq.Ethereo-sulpc. Ad. 117 1 eq. Ether-oil 28	2 eq. Sulphuric Acid 80 1 eq. Ether........ 37 4 eq. Hydrocarbon .. 28	1 eq. Sulphuric Acid.. 40 1 eq. Ether 37	1 eq. Sulph^c^. Acid 9 eq. Hydrocarbon
1 eq.Ethereo-sulphate Ether-oil 145	1eq.Doub.Sulph^e^.Eth^r^. and Hydrocarbon . 145	1 eq. Sulphate Ether..117	1 eq. Sulphate Hy-drocarbon ......

Physiological Effects.—These have not been determined. I g fifteen drops to a small rabbit: death took place within an hour. T symptoms were indisposition to move, apparent tendency to sleep, f lowed by incapability of supporting the erect position, occasional conv sive movements, grating of the teeth, and insensibility. The body w ened immediately after death: the heart was still beating, and its right vities were gorged with purple blood. Ethereal oil, therefore, acts on e nervous system in a somewhat analogous way to ether.

Uses.—Ethereal oil is used in the manufacture of the *spiritus ætheris lphurici compositus* of the Pharmacopœia. This preparation is an imitan of the *liquor anodynus mineralis* of Hoffinan. It is made by mix-g eight fluidounces of sulphuric ether, sixteen fluidounces of rectified irit, and three fluidrachms of ethereal oil. In addition to the stimuting and antispasmodic qualities derived from the ether and alcohol, it supposed by some to possess anodyne properties highly useful in nerus irritation, and want of sleep arising from that cause.

"Dr. Hare," in his *Chemical Compendium*, "reports the opinion of rs. Physick and Dewees in favour of the efficacy of the officinal oil of ne, dissolved in alcohol, in certain disturbed states of the system, as a unquillizing and anodyne remedy." (*United States Dispensatory*). The mpound spirit of sulphuric ether is sometimes employed as an adjunct laudanum, to prevent the nausea which the latter excites in certain bits. Its dose is from half a fluidrachm to two fluidrachms, in any oper vehicle.

Spir'itus Æ'theris Nit'rici.—Spir'it of Ni'tric E'ther.

History and Synonymes.—Spirit of nitric ether was known to Rayond Lully in the 13th century. Basil Valentine, in the 15th century, ught an improved method of obtaining it (Geiger, *Handb. d. Pharm.*). has been known by various names,—such as *sweet spirit of nitre* (*spiritus ri dulcis*),—*spirit of nitrous ether* (*spiritus ætheris nitrosi*), and *nitre ops*. Nitric ether was first mentioned by Kunkel in 1681.

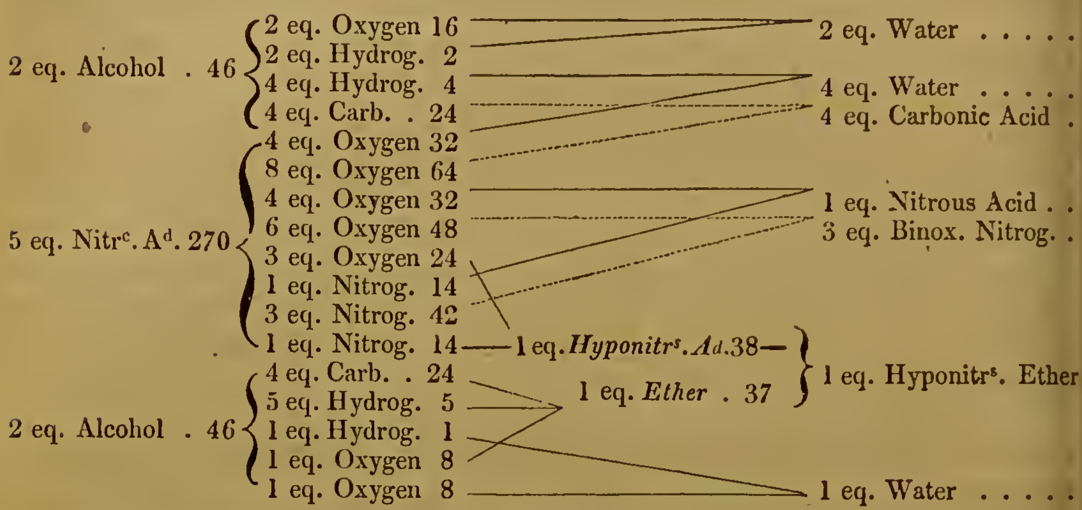
Preparation.—The following directions for its preparation are given the London Pharmacopœia:—"Take of rectified spirit three pounds, ric acid four ounces: add the acid gradually to the spirit, and mix: en let thirty-two fluid ounces distil." At Apothecaries' Hall it is prered in an earthenware still (heated by the slow application of steam to outer surface), with a condensing worm-pipe of the same material.—should be slowly distilled at a temperature of about 180° F. (Brande's *anual of Pharmacy*).

Theory of the Process.—The changes in this process are complicated, consequence of the products being very numerous. The nitric acid is prived of part of its oxygen, and thereby furnishes binoxide of nitron, and nitrous and hyponitrous acids, as well as some nitrogen and otoxide of nitrogen. The oxygen which is abstracted from the nitric id unites with some hydrogen of the alcohol to form water, and with me carbon to produce carbonic acid.

One equivalent or 38 parts of hyponitrous acid react on two equivaits or 46 parts of alcohol, and produce one equivalent or 75 parts of ponitrous ether (commonly termed nitric ether), and one equivalent or parts of water. The hyponitrous ether and some spirit distil over, and nstitute the spirit of nitric ether of the Pharmacopœia.

Besides the above, which are the more essential changes, others take ace by which additional products are obtained. Thus acetic, malic, xalhydric?) and oxalic acids, are likewise produced, but in small quanies. The production of acetic acid may be accounted for by suppos-g either that a portion of the alcohol is deprived of part of its hydrogen, or that some oxygen of the nitric acid unites with porti of hydrogen and carbon of the alcohol. The acetic acid re-acting some alcohol produces acetic ether, which distils over. The origin of malic (oxalhydric ?) acid is probably similar to that of the acetic ac The oxalic acid is produced by the union of a portion of the oxygen the nitric acid with some carbon of the alcohol.

The following diagram will explain some of the more essential chan attending the production of hyponitrous ether.



Properties.—Spirit of nitric ether, (Ph. L.,) is a colourless lim liquid, having a fragrant ethereal odour somewhat analogous to that ripe apples, and a pungent, aromatic, sweetish, acidulous taste. I sp. gr. should not exceed 0·834. It is very volatile, producing mu cold by its evaporation. It is very inflammable, and burns with whitish flame. By keeping, it becomes powerfully acid, and th strongly reddens litmus, and produces effervescence with the alkali carbonates. It dissolves in alcohol and water in all proportions.

Characteristics.—It is principally distinguished by its peculi odour, its inflammability, its lightness, and its miscibility with wat The spirit of nitric ether of the shops usually strikes a deep olive colo with the protosulphate of iron, thereby indicating the presence of b noxide of nitrogen, and produces, with tincture of guaiacum, a blue ti which passes through various shades of green: this last effect probab depends on the presence of nitrous or nitric acid. These effects are n invariably produced; as when spirit of nitric ether has been long ke though it may still possess the proper odour.

Purity.—This compound is most extensively adulterated by mixing with rectified spirit and water. The fraud is recognized by an attenti examination of the flavour of this substance, and by taking the sp. gr. the liquid. If the sp. gr. exceed 0·834, the presence of water may suspected. Nitric or nitrous acid may be suspected, if the liquid posse the power of strongly reddening litmus, and of causing effervescence wi the alkaline carbonates. Some years since, large quantities of spi of wine, flavoured with nitric ether in order to evade the payment of t duty on spirit, were brought to England from Ireland, under the name spirit of nitric ether.

Composition.—The spirit of nitric ether of the Pharmacopœia is mixture of *hyponitrous ether*, *alcohol*, and *water:* the relative proportio have not been ascertained.

The ultimate composition of hyponitrous ether is the following:—

	Eq.	Eq. Wt.	Theory.	Dumas & Boullay.
bon	4	24	32·00	32·69
drogen	5	5	6·67	6·85
ygen	4	32	42·67	41·46
rogen	1	14	18·66	19·00
ponitrs. Ether	1	75	100·00	100·00

	Vols.	Sp. Gr.
Carbon vapour	2 or 4	1·6666
Hydrogen gas	5	0·3472
Oxygen gas	2	2·2222
Nitrogen gas	1	0·9722
Vapour of Hyponitrs. Ether	2	2·6041

Chemists are not agreed as to the precise manner in which these ments are associated. We may regard hyponitrous ether as the *drated hyponitrite of etherine*, the *hyponitrite of the oxide of ethereum hule*), or the *hyponitrite of ether*. The following diagram illustrates se opinions :—

. Etherine	28	1 eq. Ethereum	29	1 eq. Ether	37
. Water	9	1 eq. Oxygen	8		
. Hyponitrous Acid	38	1 eq. Hyponitrous Acid	38	1 eq. Hyponitrous Acid	38
. Hydrd. Hyponitrite Etherе.	75	1 eq. Hyponitrite Oxide Ethereum	75	1 eq. Hyponitrite Ether	75

Physiological Effects.—Its effects on *vegetables* have not been ertained.

I am not acquainted with any experiments made to determine its ects on *animals* generally. Veterinarians employ it as a diuretic on ious occasions, and as a stimulant in the advanced stages of fever to se the exhausted powers of horses (Youatt, *The Horse*, in the Library Useful Knowledge).

On man its effects have not been satisfactorily ascertained. The inhaon of its vapour is dangerous when too long continued, as is proved the following case. A druggist's maid-servant was found one morn; dead in her bed, and death had evidently arisen from the air of her artment having been accidentally loaded with the vapour of this uid from the breaking of a three-gallon jar of it. She was found lying her side, with her arms folded across the chest, the countenance and sture composed, and the whole appearance like a person in a deep ep (Christison's *Treatise on Poisons*).

Taken internally in moderate doses it acts as a diuretic. It is believed possess diaphoretic properties. By some pharmacologists it is deibed as being refrigerant, a quality which it probably owes to the free d which it usually contains. I am unacquainted with the effects of ge doses, but they are probably analogous to, though less energetic n, those of other ethereal compounds. Kraus (*Heilmittellehre*) says, oy twelve years of age took a drachm in the morning fasting, and that aused violent colic which lasted for six hours, and was accompanied h vomiting. Probably these effects arose from the preparation conning a considerable quantity of free acid.

Uses.—It is employed as a diuretic in some disorders of children and mild dropsical complaints, as in the anasarca which follows scarlatina. is given in conjunction with squills, acetate or nitrate of potash, or foxve. As a refrigerant and diaphoretic it is used in febrile complaints combination with the acetate of ammonia and tartar emetic. As a minative it is frequently useful in relieving flatulence and allaying nausea. On account of its volatility it may be applied to produce c[illegible] by its evaporation.

Administration.—The usual dose of this liquid in febrile cases [illegible] about half a drachm. When we wish it to act as a diuretic it should [illegible] given in large doses, as two or three tea-spoonfuls.

Antidotes.—In poisoning by the inhalation of the vapour of this co[illegible] pound, the treatment will be the same as that described for poisoning [illegible] carbonic acid gas.

Ac'idum Acet'icum.—Ace'tic Ac'id.

History.—Vinegar must have been known from the most rem[illegible] periods of antiquity. It is mentioned by Moses (*Numbers*, ch. vi. v. [illegible] 1490 years before Christ. Hippocrates (*De natura muliebri*) employ[illegible] ὄξυς λευκὸν, or *white vinegar*, medicinally. Both Plutarch and Livy t[illegible] us that Hannibal, in his passage over the Alps, softened the rocks by [illegible] and vinegar. Geber (*Investigation of Perfection*, ch. iii.) was acquain[illegible] with the purification of vinegar by distillation. Stahl, in 1723, obtain[illegible] concentrated acetic acid from the acetates by the action of sulphuric ac[illegible]

Natural History.—Free or combined with potash, lime, or ammon[illegible] acetic acid is met with in the juices of many plants. Thus, Vauque[illegible] found the acetates of potash and lime in the sap of the elm; and Mo[illegible] detected acetate of ammonia in the fruit of the Areca Catechu. F[illegible] acetic acid has been recognized in the gastric juice by Tiedemann a[illegible] Gmelin. The acid found in the perspiration, the urine, milk, and blo[illegible] and which some have called acetic, is now generally believed to b[illegible] distinct substance, and is termed lactic acid. Gmelin (*Handb. d. Che[illegible]* says acetic acid has been found in some mineral waters. If the obser[illegible]tion be correct, the acid is probably to be referred to some decomposi[illegible] organic matter accidentally present in the water.

Preparation.—The acetic acid of commerce is obtained from t[illegible] sources—vinegar and pyroligneous acid: the first is procured by exciti[illegible] the acetous fermentation in certain liquors, the other by the distillati[illegible] of wood.

1. *By the Acetous Fermentation.* (*a.*) *Manufacture of Vi[illegible]gar.*—Vinegar may be procured by the fermentation of various su[illegible]stances; but that met with in English commerce, and which is employ[illegible] in this country for domestic purposes, is prepared from malt, or a mi[illegible]ture of malt and raw barley, which is mashed with hot water, as in t[illegible] ordinary operation of brewing. The cooled wort is then transferred [illegible] the fermenting tun, where it is mixed with yeast, and undergoes t[illegible] vinous fermentation. The wash is then introduced into barrels, plac[illegible] close together in a chamber, and a moderate heat (about 80° F.) is k[illegible] up until the acetous fermentation is complete. This process usua[illegible] occupies several weeks, or even months. The liquor thus procured [illegible] not yet fit for sale. It is introduced into large tuns furnished with fa[illegible] bottoms, on which is placed *rape* (the residuary fruit which has serv[illegible] for making domestic wines). These rape-tuns are worked by pairs; o[illegible] of them is quite filled with the vinegar from the barrels, and the oth[illegible] only three-quarters full, so that the fermentation is excited more easily [illegible] the latter than the former, and every day a portion of the vinegar is co[illegible]veyed from one to the other, till the whole is completely finished, and

· sale.—(For further information on this subject, consult Aikins' *Dict. Chem.*, and Donovan's *Domestic Economy*, in Lardner's *Cabinet Cyclo-dia*). Green twigs, or fresh cuttings of the vine, recommended by erhaave, are sometimes employed, instead of rape, to flavour vinegar. Formerly acetification was effected by placing the wash in barrels the ng-holes of which were loosely covered with tiles, and exposing it to ; air for several months. But the introduction of stoved chambers has arly superseded this method.

(*b.*) *Theory of acetification.*—The theory of the acetous fermentation imperfectly understood. During the process oxygen of the air is sorbed, and carbonic acid is usually evolved, while the alcohol of the ish gradually disappears, and acetic acid is produced. A remarkable dis-ction between the acetous and vinous fermentation, is, that for the mer to be perfectly established, the presence of atmospheric air (or of ygen) is essential, while for the latter this is not necessary. It is usually pposed, that during the acetous fermentation the alcohol is converted o acetic acid. Two equivalents or 46 parts of alcohol, with four equi-lents or 32 parts of atmospheric oxygen, contain the elements of one uivalent or 51 parts of acetic acid, and of three equivalents or 27 parts water.

NGREDIENTS USED.			RESULTS.
ı. Atmospheric)xygen 32	3 eq. Oxygen . .	24	3 eq. Water . . . 27
	1 eq. Oxygen . .	8	
ı. Alcohol . . . 46	3 eq. Hydrogen .	3	
	3 eq. Hydrogen .	3	
	4 eq. Carbon . .	24	
	2 eq. Oxygen . .	16	1 eq. Acetic Acid 51

Several circumstances favour this hypothesis; such as the simultaneous appearance of alcohol and production of acetic acid—the strongest nes yielding the best vinegars: in other words, the quantity of acetic id being proportional to that of alcohol; and, lastly, the formation of etic acid by the slow combustion of alcohol, as well as by allowing a xture of alcohol, water, and yeast, to trickle through beech shavings pre-usly soaked in vinegar,—a mode of generating acetic acid practised in rmany. (Mitscherlich, *Lehrbuch der Chemie.*) But, on the other hand, s to be recollected, that many vegetable substances yield acetic acid ring their spontaneous decomposition, without the production of alco-l. In alluding to these cases, Dr. Turner (*Elem. of Chem.*) observes—ll these processes, however, appear essentially different from the proper etous fermentation above described, being unattended with visible vement in the liquid, with absorption of oxygen, or disengagement of bonic acid."

The student will observe that the theory of acetification above given es not account for the appearance of carbonic acid during the process. ie evolution of this substance is generally considered to be accidental, d not essential to the formation of acetic acid.

(*c.*) *Properties of Vinegar.*—Malt vinegar is of a yellowish or reddish lour, an agreeable acid taste, and a peculiar but pleasant odour. Its gr. varies from 1·0135 to 1·0251. (Thomson, *System of Chemistry*). is very liable to undergo decomposition when exposed to the air: it comes turbid, loses its acidity, acquires an unpleasant odour, and de-sits a slippery gelatinous substance called the *mother of vinegar*, which, when collected and dried, resembles gum, and is destitute of nitrogen. During these changes we observe mouldiness (*Mucor mucedo*) on its surface. Vinegar nourishes some microscopic animals, commonly though very improperly termed *eels* (*Vibrio Aceti*). These may be destroyed by submitting the vinegar to heat. It is also infested by a small fly (*Musca Cellaris*).

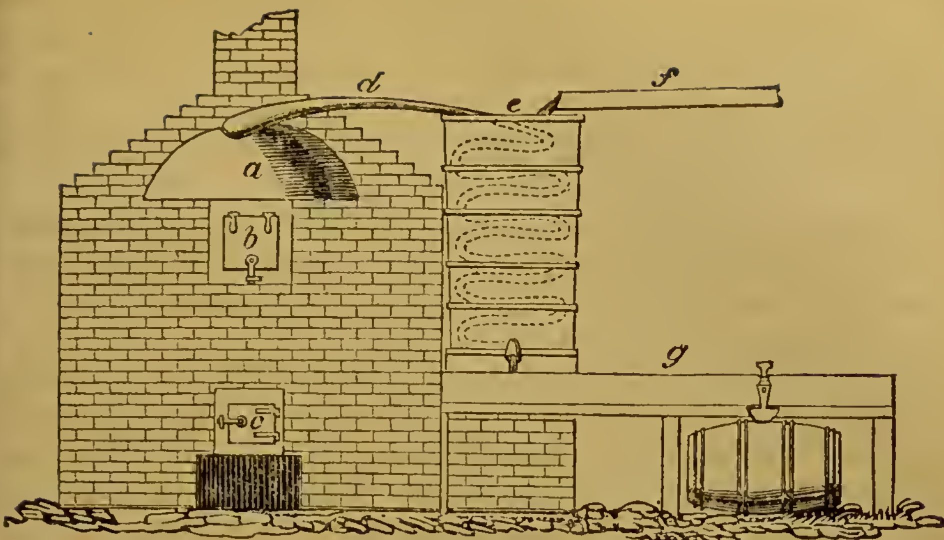
(*d.*) *Constituents of Vinegar.*—Malt vinegar consists of *water, acetic acid, colouring matter*, a *peculiar organic matter* commonly termed mucilage, a small portion of *alcohol*, and *a peculiar odorous principle.* Vinegar makers are allowed to add one one-thousand part by weight of sulphuric acid. The strongest malt vinegar, called *proof vinegar*, (or No. 24 vinegar) should contain 5 per cent. of real acetic acid; but according to Mr. Phillips, that of commerce does not usually contain more than 4·6 per cent. One fluidounce, or 446 grains of vinegar of the latter strength, should saturate very nearly 58 grains of crystallized carbonate of soda, or dissolve about 20 grains of pure white marble (carbonate of lime). In the Pharmacopœia we are told that a fluidounce of vinegar is saturated by 60 grains of crystallized carbonate of soda, two grains being allowed for saturating the sulphuric acid permitted to be added by law, and for decomposing the sulphates contained in the water employed in vinegar-making (Phillips's *Translation of the London Pharmacopœia*). The quantity of sulphate of baryta thrown down by the addition of solution of chloride of barium to a fluidounce of vinegar, should not exceed 1·14 grains (Phillips.) If the vinegar be free from copper, lead, and other metallic matter, it forms no precipitate on the addition of hydrosulphuric acid.

(*e.*) *Distillation of Vinegar.*—In the Pharmacopœia this is ordered to be effected in a glass apparatus. The seven-eighths first distilled are to be kept for use: they constitute the *acetum distillatum* of the London Pharmacopœia. If a copper still or pewter worm be employed, the distilled product has a metallic impregnation. On the large scale earthenware or silver condensing tubes are employed.

2. *By the destructive Distillation of Wood.*—This acid is procured by the distillation of wood in cast-iron cylinders. Oak, ash, birch, and beech woods, are employed: fir wood does not answer. The brushwood or spray of trees is sometimes used. The products are charcoal, which remains in the still, and various volatile substances; some condensible, others not.

The condensation of the vapours is effected by passing them through a worm, kept cool by immersion in water. The condensible products are water, acetic acid, and tar: these form crude pyroligneous acid. The incondensible products are carbonic acid and some inflammable gases: viz. carbonic oxide, light carburetted hydrogen, and olefiant gas. These are allowed to escape, or are burned in the furnace.

FIG. 46.



Distillation of Spray for Pyroligneous Acid.

The still, a cast-iron boiler.
The boiler door for the introduction of the spray.
Furnace door.
Still head.
Worm tub.
f. Waterspout for supplying the refrigeratory.
g. Gutter conveying the acid and tar from the worm to the barrels or other receiving vessels.

The receiver is usually a large cistern. In it the distilled liquor ɩarates into layers: the lower one is tar; next to this, acetic acid and ter, holding in solution some tar; and, floating on the top, is a light . By means of a pump the middle stratum is removed, and is rectified slow distillation. The first product that comes over is *pyroxilic spirit;* er this, acetic acid and water, with some essential oil of tar. This tified acid is of a brownish colour, and has an empyreumatic smell. is saturated with lime, forming an impure acetate of lime, which is composed by a concentrated solution of sulphate of soda: sulphate of e precipitates, and acetate of soda remains in solution. The latter is ified by crystallization, fusion in an iron pot, and re-crystallization.

From the crystallized acetate of soda, strong acetic acid is obtained by tillation with sulphuric acid. The proportions in the Pharmacopœia :—two pounds of the crystallized acetate, nine ounces of sulphuric d, and nine fluidounces of water. On the small scale, the acid is tilled in glass or earthenware vessels. On the large scale, silver conısors are sometimes used. The above proportions are very nearly ıal to one equivalent or 137 parts of crystallized acetate of soda, one ıivalent or 49 parts of protohydrate of sulphuric acid, and six equivats or 54 parts of water. The results of the distillation, on this culation, will be the formation of one equivalent or 72 parts of ıydrous sulphate of soda, and the disengagement of one equivalent or parts of anhydrous acetic acid, which distils over with thirteen ıivalents or 117 parts of water.

NGREDIENTS USED.			RESULTS.		
q. Water	 54		13 eq. Water	117	Acid Acet. (Ph. L.)
q. Cryst^{d}. Ac^{c}. soda	117	6 eq. Water . 54 1 eq. Acet^{c}. A^{d}. 51 1 eq. Soda . . 32	1 eq. Anhyd. Acet^{c}. A^{d}.	51	
eq. Protohyr^{d}. Sulph^{c}. Acid . .	49	1 eq. Water . 9 1 eq. Sulph^{c}. A^{d}. 40	1 eq. Sulph^{te}. Soda .	72	

Properties.—(*a*.) *Of Glacial Acetic Acid.*—This is the protohydrat acetic acid, which is crystallized solid at about 40°. F. It is th strongest acid procurable, but, as it has no uses in medicine, will n require further notice.

(*a*.) *Of the Acetic Acid of the Pharmacopœia.*—This is a limpi colourless liquid, having a pungent but agreeable odour, and an acri taste. Its sp. gr. is 1·048. It possesses the usual properties of an aci such as reddening litmus, causing effervescence with the alkaline earthy carbonates, and saturating bases. It is volatile, and by he evolves an inflammable vapour.

(*c*). *Of the Distilled Vinegar of the Pharmacopœia.*—This contain besides acetic acid and water, some alcohol and an organic substan derived from the mucilage of the vinegar. Hence when it is saturat with alkalies the solution becomes brown by heat, and deposits a darl coloured substance. Mr. Phillips states that a mixture of 15 parts b weight of the officinal acetic acid and 85 of water is equal in strength t distilled vinegar.

Characteristics.—Free acetic acid is known by its peculiar odo and by its volatility. Its vapour reddens litmus, and fumes with ammoni This acid produces no precipitate with lime water, with solutions of th barytic salts, or with a solution of nitrate of silver. It forms with pota a very deliquescent salt.

The neutral acetates are all soluble save those of molybdenu and tungsten. The acetates of silver and protoxide of mercury ar slightly soluble. The acetates are known by the acetic odour whic they emit on the addition of sulphuric acid, and by the white lamell and pearly precipitates which many of them produce with either th nitrate of silver or the protonitrate of mercury. All the acetates ar decomposed by heat, and give results which vary somewhat accor ing to the nature of the base. Some of the acetates, as those o potash, lead, and copper, evolve when heated an inflammable flui called *acetone* or *pyro-acetic spirit*, whose composition is C^3. H^3. O^1.

Composition.—Anhydrous or real acetic acid consists of carbo hydrogen, and oxygen, in the following proportions :—

	Eq.	Eq.Wt.	Per Cent.	Prout.	Berzeliu
Carbon	4	24	47·06	47·05	46·
Hydrogen	3	3	5·88	5·88	6·
Oxygen	3	24	47·06	47·07	46·
Anhydrous Acetic Acid	1	51	100·00	100·00	100·

The acetic acid of the London Pharmacopœia consists of water a pure acetic acid. As 100 grains of it saturate 87 grains of crystalliz carbonate of soda, it must contain 30·8 per cent. of pure acetic aci (Phillips, *op. cit.*). This is very nearly one equivalent of acid to thirte equivalents of water.

	Eq.	Eq.Wt.	Per Cent.	Philli
Anhydrous Acetic Acid	1	51	30·35	30
Water	13	117	69·65	69
Acetic Acid (Ph. L.)	1	168	100·00	100

Purity.—The foreign matters likely to be present in acetic acid a excess of water, sulphuric, hydrochloric, or nitric acid, copper, lead, ti other metallic matter. Acrid substances, such as capsicums, grains of adise, &c. are sometimes added to vinegar to increase its pungency. ey are discovered by carefully saturating the vinegar with potash, and n tasting the solution with attention.

The strength of the acetic acid is ascertained by determining its urating power. One hundred grains of the officinal acid should urate 87 grains of crystallized carbonate of soda, or dissolve about 30 ins of white marble (carbonate of lime). One hundred grains of tilled vinegar should saturate 13 grains of crystallized carbonate of a, or dissolve about $4\frac{1}{2}$ grains of white marble.

f sulphuric acid be present, a white precipitate is produced by the lition of acetate of lead or chloride of barium. Hydrochloric acid is ected by the white precipitate (chloride of silver) caused with nitrate ilver. The presence of nitric acid is known by immersing a piece of er in the suspected acetic acid: if nitric acid be present, nitrate of er would be formed, which might be recognized by the subsequent lition of hydrochloric acid.

Lead, copper, or tin, would be recognized by the precipitate produced hydrosulphuric acid or ammonia. If lead be present, the iodide of assium would throw down a yellow precipitate of iodide of lead.

Physiological Effects.—Before proceeding to notice the operation acetic acid on vegetables and animals, it may be useful to point out h of its effects on *dead organic matters* as have reference to the influ-e of this substance on living beings. In the first place, it is a well-own and powerful antiseptic, and is employed, partly on this account, the ordinary operation of pickling, and in the preservation of animal d, and of anatomical preparations. The impure acetic acid obtained he distillation of wood, acts more efficaciously in this respect than the e acid, on account of the creosote which it contains. Secondly, the on of acetic acid on albumen, fibrin, and the sanguineous particles, erves especial notice. Liquid albumen (as the serum of the blood, l the white of egg) is not coagulated by the ordinary acetic acid of the ps. Coagulated albumen is readily dissolved by it with the evolution nitrogen, especially with the assistance of heat. Fibrin, as muscle or crassamentum of the blood, also dissolve in it: the solution, by poration, yields a gelatiniform mass. Caseum is coagulated by it. changes the form of the red particles of frog's blood, and dissolves part the red colouring matter (Müller's *Physiology*, p. 106). It is an ellent solvent of gelatine. Diluted and mixed with mucus, it acts as igestive fluid (Müller, *op. cit.*, p. 545).

a). *On vegetables.*—Distilled vinegar is ranked, by Achard, among etable poisons (Decandolle, *Phys. Végét.*).

b). *On animals generally.*—According to Orfila (*Journ. Chim. Méd.* ii. p. 449) concentrated acetic acid acts as a caustic poison to dogs. causes blackening of the mucous lining of the stomach, analogous to t produced by sulphuric acid. The same authority tells us that four five ounces of common vinegar prove fatal to dogs in ten or fifteen urs, if vomiting be prevented by the œsophagus. Injected into the ns, vinegar does not appear to act very energetically. Viborg threw ounces and a half of wine vinegar into the jugular vein of a horse: next day the animal was well (Wibmer, *Wirkung d. Arzneim.*)

Analogous results have been obtained by Courten and Hertwich (quot by Wibmer) and by Pommer (mentioned by Dr. Christison).

The impure acetic acid obtained by the distillation of wood, has be usually regarded as possessing much more activity than pure acetic ac of the same strength, in consequence of the presence of empyreuma oil. An extensive series of experiments have been made with it amphibials, birds, and mammals, by Berres, Kerner, and Schubart From these it appears that pyroligneous acid is a caustic poison; an that it destroys some of the lower animals, viz. amphibials, merely b contact with the external skin. Large doses affect the cerebro-spin system, and cause giddiness, insensibility, paralysis, and convulsions. very constant effect was an affection of the windpipe and lungs. Th acid was detected in the blood and secretions by its odour (Wibm *Wirkung d. Arzneim*).

(*c.*) *On man.*—In the concentrated state acetic acid is an irritant an corrosive poison. Its chemical influence depends principally on i power of dissolving fibrin, albumen, and gelatine, as before mentione by which it acts as a solvent of many of the animal tissues. Applied the skin it acts as a rubefacient and vesicant. Only one case of poiso ing by its internal use is known. The patient (a girl) appeared to b intoxicated, complained of acute pain, and was violently convuls (*Journ. Chim. Méd.* t. vii).

Swallowed in a very dilute form, and in moderate doses, acetic ac acts in a very analogous manner to the diluted mineral acids (see pp. 8 81, 84, and 96). Thus it is refrigerant, tonic, diaphoretic, and diuret Its local operation is astringent. Used moderately it assists the digesti process, and is therefore taken as a condiment. It is in repute wi young ladies for diminishing obesity. It is said that the long-continu use of it, in full doses, will induce chronic diseases of the gastro-inte tinal mucous membrane; and Morgagni says, it has even given rise scirrhus of the pylorus.

Vinegar may be taken in considerable quantity at one time witho inconvenience. Dr. Christison knew a case in which eight ounces we swallowed without injury.

The vapour of strong acetic acid is very pungent and irritating. Th long-continued inhalation of acetic vapours, as by the workmen employ at vinegar-works, is said by Sundelin (*Handb. d. Heilmittellehre*) to b injurious to the lungs, and to bring on chronic inflammation of the organs.

Uses.—1. *Medicinal.*—Taken internally, common vinegar or acet acid, properly diluted, is used for various purposes; the most importa of which are, to allay febrile heat by its refrigerant qualities, to dimini inordinate vascular action, to relieve certain affections of the brain su posed to depend on, or be connected with, venous congestion, and to a by its chemical properties of an acid. Thus, in *fevers*, whether simp or eruptive, but especially in those varieties commonly denominat putrid and bilious, vinegar (more or less diluted with water) is a mo refreshing drink, allaying thirst, and diminishing excessive heat. *hæmorrhages*, as from the nose, lungs, stomach, or uterus, it is partic larly beneficial by its refrigerant, sedative, and astringent qualities. diminishes excessive vascular action, and promotes contraction of th

·eding vessels. As a local astringent, it is injected into the nose in istaxis, and is used as a wash in profuse hæmorrhoidal discharges. ıe benefit obtained by the application of vinegar and water to the domen, vulva, and thighs, in uterine hæmorrhages, arises from the d produced. In *phthisis pulmonalis*, vinegar diluted with water is netimes serviceable as a palliative, by its refrigerant qualities: it ieves the hectic symptoms, diminishes or puts a stop to the night eats, checks bronchial hæmorrhage, and prevents diarrhœa. In *mania* has been recommended as a means of allaying cerebral excitement. *poisoning by opium*, and some other narcotics, it is used to counteract effects of these substances: but as acetic acid forms soluble and werful compounds with the active principles of some of these poisons, ought not to be exhibited until the contents of the stomach have been ıcuated. In poisoning by the alkalies and their carbonates, and by ıc, vinegar is the safest and most efficacious acidulous substance that ı be employed. In diseases attended with *phosphatic deposits* in the ne, it may be advantageously used either as a medicine or condiment. *an adjunct to the acetate of lead*, acetic acid is recommended by Dr. T. Thomson, to prevent the formation of carbonate of lead, which believes to be more apt to produce lead colic than the acetate. In *rvy*, the acetic, as well as other vegetable acids, has been found serveable. *Clysters containing vinegar* have been employed for the purpose provoking alvine evacuations in obstinate constipation and strangulated nia; of expelling the small round worm (*Ascaris vermicularis*); of ecking uterine and intestinal hæmorrhage; and of relieving inflammation congestive conditions of the brain.

As a stimulant, disinfectant, and antiseptic, lotions containing acetic d are used in gangrenous and other ill-conditioned ulcers. For these poses crude pyroligneous acid is more efficacious than ordinary egar, on account of the creasote and other substances which it conns. In ulceration of the throat, in scarlatina and cynanche, gargles ıtaining acetic acid or vinegar are sometimes used with good effect. llyria, containing it, are useful as mild astringent applications in chronic ıthalmia, and for removing lime-dust adhering to any part of the globe lid of the eye.

Sponging the face, trunk, or extremities, with cold or tepid vinegar l water, is frequently most refreshing and grateful in febrile disorders. diminishes preternatural heat, promotes the cutaneous functions, and erates as a beneficial stimulant to the nervous system.

Fomentations containing vinegar are used in bruises, sprains, &c.

The concentrated acetic acid sold in the shops under the name of roligneous acid, is a valuable remedy for the cure of the different forms porrigo, popularly called ring-worm or scalled head. Its application, ıich may be effected by means of a piece of lint wrapped round a oden stick, causes acute but temporary pain, redness of the skin, and itening of the abraded spots. One or two applications are usually ficient to effect a cure. Strong acetic acid is also employed as a ıstic to destroy corns and warts. It has been proposed as a speedy ans of exciting rubefaction and vesication, and for this purpose otting-paper or cambric, moistened with this acid, has been applied to neck in cases of croup.

Under the name of *aromatic vinegar*, concentrated acetic acid, flavoured with other odorous substances, is employed in smelling-bottles and vinaigrettes. The vapour is inhaled to relieve fainting and headache; and is sometimes employed for correcting unpleasant odours, which it does not by destroying but by covering them.

2. *Pharmaceutical.*—Vinegar or acetic acid is employed for extracting the virtues of various medicinal substances, as squills, colchicum, and cantharides: the solutions are called *medicated vinegars* (*aceti*...), or, by the French pharmacologists, *oxéolés*. A small quantity of spirit is usually added to them for the purpose of preventing the decomposition of the vinegar, and, in consequence of this, a small portion of acetic ether is generated. The preparations into the composition of which acetic acid and honey enter, are called *oxymels*, or the *acid mellites*. Acetic acid is employed also in the manufacture of the salts called *acetates*. Lastly, it is a powerful solvent of the gum-resins, and is used, on this account, in the preparation of the emplastrum ammoniaci.

Administration.—Vinegar is given internally in doses of from a tea-spoonful to half an ounce: used as a clyster, the quantity is one or two fluidounces. A refrigerant drink in fevers is made by adding one or two ounces of vinegar to a quart of water.

The *aromatic vinegar* (*acetum aromaticum*) of the shops is a solution of camphor and of the oils of cloves, lavender, and rosemary, in concentrated acetic acid. On the addition of water, part of the camphor is precipitated. It is made in imitation of *Henry's aromatic vinegar*. In the Edinburgh and Dublin Pharmacopœias is an officinal substitute for the latter preparation: it is called *acidum aceticum camphoratum*. It is prepared by dissolving half an ounce of camphor (pulverized by means of a few drops of alcohol) in six fluidounces of acetic acid. These preparations are only used as errhines.

In the Edinburgh Pharmacopœia is a very useless preparation called *acidum aceticum aromaticum*, made by digesting dried rosemary tops, dried sage leaves, dried lavender flowers, and cloves, in distilled vinegar. It is an imitation of the celebrated *Thieves* or *Marseilles vinegar* (*acetum quatuor furum*), once supposed to be a prophylactic against the plague and other contagious diseases.

As the medicinal value of *oxymel* (*oxymel simplex*) depends principally on the vinegar which it contains, it is best noticed here. In the London Pharmacopœia this compound is directed to be prepared by mixing a pint and a half of acetic acid (Ph. L.) with two pounds of honey made h...

This preparation has been reputed detergent, and, in consequence, has been employed in gargles. It is commonly esteemed expectorant, and as such is used in slight colds. Diffused through barley water, it forms a refrigerant and agreeable drink in febrile and inflammatory complaints. It is frequently used as a vehicle for other medicines. The dose of it is usually two or three spoonfuls.

Antidotes.—In cases of poisoning by strong acetic acid, the treatment should be that recommended for poisoning by hydrochloric and sulphuric acids.

Creaso'ton.—Cre'asote.

History.—This substance was discovered a few years since by Reichenbach, who termed it *creasote* (from κρεας, *flesh*; and σώζω, *I preserve*), or the *flesh-preserver*, on account of its antiseptic property. Its name is sometimes written *Creosote* or *Kreosote*. In the London Pharmacopœia is described as *an oxyhydrocarburet* (*oxy-hydro-carburetum*) prepared om pyroxilic oil.

Natural History.—It is an artificial product; and is obtained by the structive distillation of organic substances. It is found in pyroligneous id, in tar, in Dippel's oil, in wood smoke, and empyreumatic waters.

Preparation.—The preparation of creasote is a very troublesome and lious process. The following concise abstract of it is taken from Tur-r's Chemistry (5th ed. p. 872). Those portions of the oil (called in e Pharmacopœia *pyroxilic oil*) distilled from wood-tar, which are avier than water, are first freed from adhering acetic acid by carbonate potash, and, after separation from the acetate, are distilled. A little osphoric acid is mixed with the product to neutralize ammonia, and other distillation resorted to. It is next mixed with a strong solution potash, which combines with creasote, allows any eupion which may present to collect on its surface, and by digestion decomposes other ganic matter: the alkaline solution is then neutralized by sulphuric d, and the oil which separates is collected and distilled. For the mplete purification of the *creasote*, this treatment with potash, followed neutralization and distillation, requires to be frequently repeated. r further details I must refer to Dumas' *Traité de Chimie*, and to the *n. de Chim. et Physiq.* t. 57, 1834).

Properties.—Pure creasote is colourless and transparent: it has a high ractive power, and an oleaginous consistence. Its odour is that of oked meat, its taste burning and caustic, its sp. gr. 1.037 at 68° F. oils at 397° F.; and is fluid at —16·6° F. It is combustible, burning h a sooty flame. It absorbs chlorine, and is resinified by it. Nitric d is decomposed by it, with the evolution of nitrous fumes. Sulphuric d in small quantity reddens, and in large quantity blackens it. Potas-n decomposes it, with the evolution of gas (hydrogen?) and the formation otash, which combines with some inspissated creasote. It is soluble lcohol, ether, sulphuret of carbon, eupion, naphtha, acetic acid, and tic ether. It dissolves resins, various colouring matters (as of cochi-l, saffron, and madder), and some salts (as the acetate of potash). It very little action on caoutchouc; and does not possess any acid or line re-action on test paper. Mixed with water, it forms two combi-ions: one is a solution of 1·25 parts of creasote in 100 of water; the r, on the contrary, is a solution of 10 parts of water in 100 of sote.

t coagulates the albumen of eggs and of the blood. Concentrated uminous liquids are immediately coagulated by it; dilute ones, lually. Fibrin is not altered by it. It is powerfully antiseptic with ect to meat and fish. Tar, smoke, and crude pyroligneous acid, owe , if not the whole, of their antiseptic properties to it. According to J. R. Cormack (*Treatise on Creosote*, 1836), the only essential part he mummifying process practised by the ancient Egyptians was the lication of such a heat as would first dry up the body, and then de-pose the tarry matters which had been previously introduced, and generate creasote.

Characteristics.—The odour of creasote is its most characteristic perty. To this must be added its combustibility, its oleaginous earance, its complete solubility in acetic acid and caustic potash, and ction on albumen before mentioned.

Purity.—Creasote, when pure, is perfectly colourless ; but that m with in commerce has frequently a more or less brownish tinge. Rectifi oil of tar, capnomor, and almond oil, are substances which have been might be associated with it (Cormack, *op. cit.*) These impurities a readily detected by mixing separate portions of the suspected liqu with acetic acid and caustic potash: pure creasote is completely solub in these fluids ; not so the adulterated.

Composition.—Ettling (*Ann. de Chimie*, liii. p. 333), analyzed creaso which was supposed to contain three per cent. of water. Making allo ance for this impurity, its composition, as determined by this chemist, nearly as follows :—

	Eq.	Eq.Wt.	Per Cent.
Carbon	14	84	77·42
Hydrogen	9	9	8·12
Oxygen	2	16	14·46
Creasote	1	109	100·00

At present, however, the equivalent of creasote must be considered uncertain, since no definite compound of this substance has been an lyzed by which the combining proportion could be ascertained.

Physiological Effects. (*a.*) *On vegetables.*—Plants moistened wi creasote water fade and die. (Miguet, *Recherches sur la Créasote*, 183 The injurious effects of smoke on vegetation are probably to be refer principally to the creasote which it contains.

(*b.*) *On animals generally.* — Insects (as flies), spiders, and sm fishes, die in two minutes after their immersion in water containing few drops of creasote suspended in it. According to Mr. Cormack, t effects of creasote on dogs are remarkably similar to those of hydrocya acid, and are much less apparent when this substance is injected into t carotid arteries than into the veins. When thrown into the latter suddenly stops the heart's action and causes hurried respiration, one two convulsive fits, shrill cries, and death. Injected into the caro artery it produces coma. Introduced into the stomach it gives rise dimness and fixation of the eyes, vertigo, and coma: when given in la quantities it also affects the heart. (Cormack, *op. cit.* p. 66, et. se Corneliani (*Jour. Chem. Méd.* t. ii. ser. 10) and Miguet have obser inflammation of the gastro-intestinal mucous membrane of dogs poiso by creasote, but which survived some time.

(*c.*) *On man.*—Creasote operates locally as an irritant and caus Applied to the skin it causes heat, redness, and the destruction of t cuticle, which comes away in the form of furfuraceous scales. On t tongue it produces a painful sensation. Dropped into the eye it oc sions acute pain. Placed in contact with a suppurating surface whitens the part as does nitrate of silver. Swallowed in large dose causes vomiting and purging. The caustic effect of creasote doubtl depends on the same property which renders it capable of preserv meat and of coagulating albumen.

Unless largely diluted, it occasions, when swallowed, heat in t tongue, pharynx, œsophagus, and stomach. Small doses, as one or t minims, produce in most individuals no other unpleasant effect than t just mentioned. Larger doses give rise to nausea, vomiting, verti eadache, and heat of head. Dr. Elliotson (*Medico-Chirur. Trans.* ol. xix.) knew a lady who increased the dose of creasote to forty drops efore it disagreed: the addition of a single drop beyond this produced ctreme giddiness, insensibility, and vomiting, followed by headache for veral days. When given in moderate doses it does not affect the owels; so that, as Dr. Elliotson has observed, "aperients are as quisite as if it was not taken." When, however, the dose has been onsiderably augmented, diarrhœa or even dysentery has been produced. 'ormack, *op. cit.* p. 93). The influence of creasote on the urinary gans is sometimes very marked. Dr. Macleod (*Med. Gaz.* vol. xvi. 599, and vol. xvii. p. 653), was I believe the first who noticed that the ine acquired a blackish colour by the use of it. A similar effect is ferred to by Dr. Elliotson. In some cases creasote is recognized, by odour, in the urine, showing that it has been absorbed. Occasionally increases the quantity of this secretion, but in diabetes it sometimes has opposite effect. In some instances it has caused micturition and angury, so that in its influence over the urinary organs it bears some semblance to turpentine. Some other effects which have been ascribed it require further evidence to establish them.

Uses.—Various substances, some known to contain creasote, others pposed to do so, have long been used in medicine, in the same diseases which creasote itself is now employed: and, in consequence, it has en imagined that they owe part of whatever efficacy they really possess this substance. These remarks apply to tar, soot, crude pyroligneous id, *aqua Binelli**, the empyreumatic water of Runge and Hanke, rothonide†, and animal or Dippel's oil. To this list should be added, cording to Mr. Cormack (*op. cit.*), mummy.

As an *internal* remedy, creasote has been principally celebrated, in this untry, as a remedy possessing extraordinary powers of arresting miting. It has, however, been greatly overrated. It is decidedly jurious in inflammatory conditions and structural disease of the omach, and frequently fails in allaying the sickness dependent on ganic diseases, as of the heart and kidneys. It is most successful in sterical cases, and sometimes succeeds in pregnancy. Creasote was st employed to relieve vomiting by Dr. Elliotson (*Medico-Chirurg. Tr.* l. xix.), to whose paper, as well as to that of Mr. Taylor, apothecary of e North London Hospital (*Lancet*, August 15, 1835), I must refer for ses illustrative of extraordinary success with it. It is regarded by r. Macleod (*Med. Gaz.* vol. xvi. p. 598, and vol. xvii. p. 653) as of ubtful efficacy; and has completely failed in the hands of Dr. Paris *ppendix* to the 8th edit. of the *Pharmacologia*, 1838).

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* *Aqua Binelli*, or *Aqua arterialis balsamica Doctoris Binelli*, a once celebrated ptic, discovered by a physician (Dr. Binelli) of Turin, in 1797 (Dierbach, *Neuesten tdeck. in d. Mat. Med.* 2te. Ausg. 1837. See also Dr. J. Davy, *Edinb. Med. and rg Journ.* July 1833).

† *Pyrothonide* (from πῦρ, *fire*; and ὀθόνη, *linen*), or *liquor pyro-oleosus e linteo ratus*, is a very popular remedy for tooth-ache and skin diseases. It is sometimes pared by distilling rags, and is then called *rag oil;* but the common mode of pro-ring it is to burn a cone of paper on a plate or other cold body; it is then termed *per oil.* It has been analyzed by Herberger (Buchner, *Repertorium*, Bd. 32, 347). For further particulars concerning it, consult Merat and De Lens, *Dict. Mat. éd.*; Dierbach, *op. cit.*; Schwartze, *Pharm. Tabell.* 2te. Aus.; L. Richter, *Ausführl. zneim.* Supplem. Bd.

It sometimes relieves gastrodynia or flatulence, but is admissible i those cases only in which local stimulants are usually found beneficia Where both hydrocyanic and creasote have been separately tried withou success, Dr. Elliotson advises their union.

Creasote has been tried in a few cases of diabetes. In some i diminished both the quantity and saccharine quality of the urine (Di Elliotson, *Med.-Chir. Trans.* and Professor Berndt, *Lancet*, July 18, 1835 In no case does it appear to have effected a permanent cure.

In neuralgia, hysteria, and pulmonary diseases, it has also been use with occasional advantage: but a more extended experience is require to establish its efficacy in these cases.

As an *external* agent creasote may frequently be employed with grea advantage. It has been successfully applied to relieve toothache. Afte carefully cleaning out the cavity of the tooth, a drop of creasote may b introduced by means of a camel's hair pencil, and the cavity filled wit cotton soaked in this liquid. As a local application to chronic ski diseases (particularly the different forms of porrigo and impetigo) it is considerable value. Where a caustic application is required, it may b applied undiluted; but for other purposes it is used either in the form ointment, or dissolved in water as a wash. Creasote may be beneficiall used as an application to foul and indolent ulcers. It serves the doubl purpose of stimulating the living surface (and thereby of changing th quality of actions going on in the part), and also of preventing th putrefaction of the secreted matters. It is sometimes applied pure, bu more commonly diluted with water. In hæmorrhages it acts as a mo efficient styptic, partly in consequence of its power of coagulatin albuminous liquids, and thereby of causing the formation of a clot, an partly by causing contraction of the bleeding vessels. Creasote wat may be applied either to bleeding wounds and leech-bites, or introduce into the vagina in uterine hæmorrhage, by means of pledgets of lin soaked in it. There are many other purposes for which creasote ha been applied as a local agent, but which I think it sufficient merely t name, referring the reader to the various papers and works before quote for further information. It has been employed to check caries, to restrai excessive suppuration, and to repress fungous granulations in burns an scalds; to act as a counter-irritant in chronic ophthalmia, in whic disease it is sometimes dropped into the eye on the same principle tha nitrate of silver and other local stimulants are used; and to remov condylomatous and other excrescences. The inhalation of creasot vapour is occasionally useful in relieving excessive bronchial secretio Dr. Elliotson cured two cases of chronic glanders in the human subjec by injecting an aqueous solution of creasote up the affected nostril.

Administration.—Creasote may be given, at the commencement o its use, in doses of one or two drops diffused through an ounce of wate by the aid of mucilage: the dose should be gradually increased. A before mentioned, in one case forty drops were given with impunity: i another instance, ninety drops were administered in less than half a da without any bad symptom (Mr. Taylor, *Lancet*, August 15, 1835).

As a caustic, undiluted creasote is sometimes applied by means of camel's hair pencil.

The *unguentum creasoti* of the London Pharmacopœia is composed o a fluidrachm of creasote and an ounce of lard. It is used principally i in diseases, as ringworm. The quantity of creasote in it may be creased or diminished according to circumstances. When used by ay of friction, eight or ten drops of creasote to the above quantity of rd may be sufficient.

Lotions, gargles, or injections of creasote, are prepared by dissolving om two to six drops (according to the circumstances of each case) in an unce of water. A solution of this kind is sometimes mixed with ultices.

The inhalation of creasote vapour may be effected by diffusing a few ops of creasote through water or a mucilaginous liquid, and breathing rough this, by means of the ordinary inhaling bottle (see p. 51).

ANTIDOTES.—In a case of poisoning by creasote, the depression of the al powers is to be counteracted by ammonia and other stimulants. r. Cormack suggests the use of chlorine, but the value of this agent s not been determined by actual experiment. Oleaginous and mucilanous drinks are recommended by Corneliani, for the purpose of prenting the local action of creasote on the mucous lining of the stomach d intestines. Vinegar does not diminish, but, according to Corneliani, creases its activity. Mr. Cormack says albumen augments its poisons operation. Bleeding is suggested by this writer, in order to lieve the distension of the heart, and thereby to excite the contracons of this viscus. Artificial respiration should on no account be nitted. Any inflammatory symptoms which may subsequently appear e of course to be treated by the usual antiphlogistic measures.

Petro'leum.—Petro'leum.

HISTORY.—Herodotus (*Melpomene*, excv.) mentions the petroleum rings of Zacynthus (now called Zante) more than 400 years before hrist. The substance known to mineralogists as petroleum is the *black phtha* (μέλαν) of Dioscorides (lib. i.), the *bitumen liquidum* of Pliny b. xxxv.)

NATURAL HISTORY.—There are two varieties of liquid bitumen or ineral oil: one is transparent and nearly colourless, or only slightly llow, and when burnt leaves no residuum; the other is thick, of a ddish brown colour or blackish, and leaves, after combustion, a black al. The first is called *naphtha* (a Chaldæan word); the second *troleum* (from *petra*, a rock; and *oleum*, oil) or *rock oil*, because it is equently found exuding in the form of an oily liquid from rocks. Both nds are supposed to be produced by the decomposition of organic egetable) matter, for they are always found in Neptunian rocks, and ey appear sometimes to be one of the products of the decomposition of al (Berzelius, *Traité de Chim.* t. 6me.) From the investigation of rs. Christison and Gregory (*Tr. Roy. Soc. Edinb.* vol. xiii. p. 1), it appears obable that some varieties of petroleum, as that of Rangoon, are products of destructive distillation, since they contain paraffine and eupion, bstances obtained from organic bodies by heat.

Petroleum is found in this country at Ormskirk in Lancashire, at olebrook Dale in Derbyshire, and at St. Catherine's Well near Edinurgh. In France it is produced at the village of Gabian in Languedoc, id hence it was termed *Oleum Gabianum.* It is also found in various her parts of Europe, especially in Italy. In the United States of

America it is met with in various places: that from the shore of Senec Lake in New York is called *Seneka oil.* Several of the West Ind Islands, especially Barbadoes and Trinidad, yield it. The Barbado petroleum (*Petroleum Barbadense,* Ph. Lond. et Dubl.: *Pisselæum Indicu* Dale) is commonly termed *Barbadoes Tar,* or *B. Naphtha.* That import by Mr. Clarke professes to be the produce of the springs on Mount H estate, in Barbadoes. In various localities of Asia, petroleum is m with in great abundance.

Properties.—Barbadoes petroleum, at ordinary temperatures, has t consistence of treacle: its colour is reddish brown or blackish; its odo and taste are bituminous. It floats on water: is combustible, yielding thick black smoke, and leaving a carbonaceous residuum. It is insolub in water.

Composition.—The ultimate constituents of Barbadoes petroleum a carbon and hydrogen, with small quantities of oxygen and nitrogen. I distillation, five parts by measure yield rather more than four parts of yellow oily fluid, somewhat similar in appearance to the liquid carb hydrogen obtained in the manufacture of oil-gas. The residuum the retort is a substance analogous to asphaltum. It yields b destructive distillation traces of ammonia. Some kinds of petroleu contain paraffine and eupion.

Physiological Effects.—Petroleum possesses stimulating properti which are principally observed in its effects on the organs of secreti (the skin, the kidneys, and the mucous membranes), the activity of whi it promotes: hence it has been called sudorific, diuretic, expectorant, & It is said to be an excitant to the lymphatic vessels and glands.

Uses.—As an internal remedy it is employed in chronic pulmona affections (as winter coughs, old asthmas, &c.), in obstinate skin diseas (as lepra, psoriasis, and impetigo), and against tape-worm.

As an external agent it is applied to obstinate ulcers, as lupus, and cut neous diseases, and is employed as a stimulating liniment in chron rheumatism, paralysis, and chilblains.

Administration.—The dose of Barbadoes petroleum is a small te spoonful given in any convenient vehicle (as some aromatic water, tea, spirit). The quantity should be gradually increased. It is said that ounce has been taken in the day without inconvenience.

Suc'cinum.—Am'ber.

History.—Amber was known to Thales of Miletus, 600 years bef Christ. He was the first who noticed that when rubbed it acquired t power of attracting light bodies. Hence arose the term electricity, fr *ηλεκτρον, amber.* Theophrastus (*De lapidibus*) also mentions this proper

Natural History.—Amber is found in different parts of the worl The principal portion of that met with in commerce, comes from t southern coasts of the Baltic, in Prussia, and is cast on the shore betwe Königsberg and Memel. It is supposed to be disengaged, by the acti of the sea, from beds of lignite.

The vegetable origin of amber is shewn by various facts. It is usual associated with substances (bituminous wood, coal, &c.) known to derived from plants. Externally we observe on it various impressions the branches and bark of trees; and inclosed in it are insects a rts of plants (as the wood, leaves, flowers, and fruit). According to · D. Brewster (*Edinb. Philosoph. Journ.* vol. ii.) its optical properties · those of an indurated vegetable juice. From these circumstances, as ·ll as from its chemical composition, amber is supposed to have been a inous exudation from some tree. Now as the wood, leaves, blossoms, 1 fruit of some coniferous plant are found in amber, this plant has ·n supposed to be the amber tree: and a microscopic examination of wood leads to the conclusion that the amber tree is a species, though)bably an extinct one, of the genus Pinus, closely allied to P. balsamea. ope, *On Succinic Insects*, in *Trans. Entom. Soc.* vols. i. and ii.)

PROPERTIES.—It occurs in irregular shaped pieces, usually flat and newhat rounded at the sides. Its colour is yellowish white (*succi-m album*), yellow (*s. citrinum*), or reddish (*s. rubrum*). It is usually nslucent, sometimes opaque or transparent: it is tasteless and odour-s. Its sp. gr. is about 1·07. It is brittle, yields readily to the knife, s a conchoidal vitreous or resinous fracture, and becomes negatively ctrical by friction: it contains various insects which, apparently, ıst have become entangled in it while it was soft and viscid. (For an count of these, consult Mr. Hope's paper before quoted; also Bur-ister's *Manual of Entomology*, p. 574).

Heated in the air, amber fuses at about 541° F., then inflames, and burns th a yellow flame, emitting a peculiar odour, and leaving behind a ht shiny black coal. It cannot be fused without undergoing some emical change. It evolves water, volatile oil, and succinic acid: the idual mass is termed *colophonium succini*. By destructive distillation a retort or alembic, amber yields first an acid liquor (which contains ccinic and acetic acids), then some succinic acid deposits in the neck the retort, and an empyreumatic oil (*oleum succini*) comes over, at first n and yellowish, afterwards brown and thick: towards the end of the eration, a yellow light sublimate is observed in the neck of the retort; s is called, by Berzelius, *crystallized pyrétine*; by Vogel, *volatile resin amber*; by Gmelin, *amber-camphor*. An inflammable gas is evolved ring the whole time of the operation.

COMPOSITION.—The *ultimate* constituents of amber are carbon, drogen, and oxygen. The *proximate* principles are a volatile oil, two ins, succinic acid, and a bituminous substance.

Ultimate Constituents.	Drassier.	Ure.	Proximate Constituents. (Berzelius.)
bon	80·59	70·68	Volatile Oil
lrogen	7·31	11·62	Two Resins
'gen	6·73	7·77	Succinic Acid
es (silica, lime, and alumina)	3·27		Bitumen
ber	97·90	90·07	Amber.

The *volatile oil* has a strong but agreeable odour. The *resins* are uble in both alcohol and ether: if an alcoholic solution of the two ins be prepared by heat, and then allowed to cool, one of the resins oosits. *Succinic acid* is white and crystalline, soluble in water, ırcely so in cold, but more so in boiling, alcohol. It is distinguished m benzoic acid by its insolubility in oil of turpentine. Succinate of monia throws down a reddish precipitate with the persalts of iron. e *bituminous matter* constitutes the principal part of amber: it is insoluble in alcohol, ether, the oils both volatile and fixed, and alkal[illegible] solutions.

CHARACTERISTICS AND PURITY.—The resins copal and animi [illegible] sometimes substituted for amber. They may be distinguished by [illegible] difference in their colour and fracture, and by their not emitting [illegible] peculiar odour of amber when thrown upon hot iron (*United Sta[illegible] Dispensatory*). Copal during its combustion is constantly falling in dro[illegible] and by this character may be distinguished from amber (*Kidd's Mineralog[illegible]*

PHYSIOLOGICAL EFFECTS.—Amber was formerly celebrated as a stim[illegible] lant and antispasmodic.

USES.—(*a.*) *Medicinal.*—It is not employed as a medicine in this co[illegible] try. It was formerly used in chronic catarrhs, amenorrhœa, hysteria, &[illegible] and was given either in the form of powder, in doses of from ten grains t[illegible] drachm, or in that of tincture, a formula for which is contained both [illegible] the French Codex and Prussian Pharmacopœia.

(*b.*) *Phamaceutical.*—Amber is used for the preparation of the *oil* [illegible] *acid.* The oil obtained by the destructive distillation of amber, wh[illegible] rectified by three distillations, constitutes the *oleum succini* of the Ph[illegible] macopœia.

OLEUM SUCCINI.—This oil, prepared as above mentioned, is a lo[illegible] irritant, and when rubbed on the skin acts as a rubefacient. Tak[illegible] internally it operates, like most other empyreumatic oils, on the nerv[illegible] system, and is used as a stimulant and antispasmodic. Its dose is fr[illegible] five to fifteen drops. In the former edition of the London Pharmacop[illegible] there was contained a formula for the preparation of the *spiritus ammo[illegible] succinatus*, made in imitation of the celebrated *eau de luce* (the history [illegible] which has been fully detailed by Beckmann, in his *History of Inventi[illegible]* vol. iv. p. 595). Its active ingredient is ammonia, but the oils of amber a[illegible] lavender, and mastich, entered into its composition. It is a powerful stim[illegible] lant, and was employed as an application to the nostrils in fainting a[illegible] hysteria; and also internally, in doses of from ten to thirty drops.

ACIDUM SUCCINUM.—This, though contained in the Dublin Phar[illegible] copœia, is, I believe, never used in medicine. It was supposed to [illegible] like the oil, antispasmodic, and was exhibited in doses of from fiv[illegible] twenty grains.

O'leum Anima'le.—An'imal Oil.

This perhaps is the most convenient place for noticing the empyr[illegible] matic oil obtained by the decomposition of animal substances by h[illegible] It is obtained in considerable quantities in the manufacture of iv[illegible] black (see p. 178), and is sold under the name of *animal* or *Dippel's oil.* [illegible] is identical in its nature with the *oleum cornu cervi*, or *oil of hartsh[illegible]* formerly used in medicine. As usually met with, it is a thick, bro[illegible] viscid oil, having a most repulsive odour. By distillation, howeve[illegible] may be rendered colourless and limpid, but is soon altered by the act[illegible] of air and light. Its ultimate constituents are carbon, hydrogen, nitrog[illegible] and oxygen. From its alkaline reaction it doubtless contains ammo[illegible] Unverdorben alleges that it contains four oily salifiable bases, to wh[illegible] he has given the names of *odorine*, *animine*, *olanine*, and *ammol[illegible]* Reichenbach has obtained *creasote* from it, and ascribes to this princ[illegible] supposed virtues of animal oil. Whatever may be its active prin-le, animal oil is undoubtedly a very powerful agent. In large doses acts as an energetic poison, operating in two ways, locally as an tant, remotely as a narcotic (Christison, *Treatise on Poisons*). Swal-ed in moderate doses, it stimulates the vascular and nervous systems, is esteemed antispasmodic. It has been employed as a local agent in ises, gangrene, porrigo, &c. Internally, it has been used to prevent attack of epilepsy or ague, as a stimulant in low fevers, and as anti-smodic in hysteria and other affections of the nervous system accom-ied with convulsive movements. Bremser (*Traité sur les Vers estin.*) used *Chabert's oil* (prepared by mixing three parts oil of tur-tine with one part Dippel's oil, and distilling three parts) as an helmintic in tape-worm. The dose of animal oil is a few drops, tiously increased.

Ac'idum Hydrocyan'icum.—Hydrocyan'ic Ac'id.

ISTORY.—The substance called *Prussian* or *Berlin blue* (*Cæruleum Bo-sicum* seu *Berolinense*) was accidentally discovered by Diesbach at the mmencement of the 18th century, and various conjectures were soon offered arding its nature. In 1746, Dr. Brown Langrish published some expe-ents made with laurel water in order to investigate its effects on ani-ls (*Physical Experiments upon Brutes*). In 1752, Macquer an-nced that Prussian blue was a compound of oxide of iron, and some ouring principle which he could not isolate; and in 1772, Guyton rveau concluded that this principle was of an acid nature. Scheele, 782, removed some of the mystery connected with Prussian blue, by aining *hydrous prussic acid* from it. In 1787 Berthollet ascertained acid to be a compound of carbon, nitrogen, and hydrogen. In 1800, 1802, Bohn and Schrader discovered it in laurel-water. Borda, ignatelli, and Rasori, first employed the acid in medicine, from 1801 806. In 1815, Gay-Lussac obtained the acid in its pure *anhydrous* e, and explained its composition. (The chemical history of hydro-nic acid is fully detailed in Thomson's *System of Inorganic Chemistry*, ii. 7th edition.) The medical history of it is contained in Dr. Gran-e's *Hist. and Pract. Treatise* on this acid, 2d ed. 1820.

YNONYMES AND ETYMOLOGY.—It has been denominated *prussic dum borussicum*), *zootic* (*acidum zooticum*), or *hydrocyanic acid*: first name indicates the substance (Prussian blue) from which it was ained, the second refers to its animal origin, and the third indicates constituents, hydrogen and cyanogen (so called from κύανος, *blue*; and νάω, *to produce*; because it is one of the constituents of Prussian e).

NATURAL HISTORY.—Hydrocyanic acid is a product peculiar to the anized kingdom. It may be readily procured from many *vegetables*, re especially those belonging to the sub-orders *Amygdaleæ* and *neæ*: as from bitter almonds, apple-pips, the kernels of peaches, icots, cherries, plums, and damsons; the flowers of the peach, cherry-rel, and bird-cherry; the bark of the latter, and the root of the untain ash. It is said to have been also obtained from plants of other ilies, as from *Rhamnus Frangula* and ergot of rye. In some of the etables now referred to, hydrocyanic acid does not exist ready formed, is a product of the process by which it is obtained. This has been fully proved in the case of the bitter almond, and is inferred in oth instances.

This acid is rarely, if ever, found in animals. One of its constitue (cyanogen) has, however, been detected, in combination with ir (forming Prussian blue) in the urine, the menstrual fluid, and the swe and with sulphur and potassium in the saliva. During the decompo tion of animal matters, cyanogen is frequently ge crated : as when blo and carbonate of potash are calcined in an iron pot. It has also be stated that when cheese is exposed to the action of water and the su it disengages ammonia, and if treated, in this state, by alcohol, yiel traces of hydrocyanic acid.

Preparation.—The processes for procuring this acid are very num rous. I shall only notice the most important of those which yield t dilute acid employed for medicinal purposes.

(*a.*) *By the action of dilute sulphuric acid on ferrocyanide of pot sium.*—The proportions directed in the London Pharmacopœia for t preparation of dilute hydrocyanic acid, are two ounces of the fer cyanide, an ounce and a half of sulphuric acid, and a pint and a half distilled water. "Mix the acid with four fluidounces of the water, a to these, when cooled and put into a glass retort, add the ferrocyanide potassium, first dissolved in half a pint of water. Pour eight fluidounc of the water into a cooled receiver; then, having adapted the retort, six fluidounces of acid, distilled with a gentle heat in a sand-bath, pa into this water. Lastly, add six more fluidounces of distilled water, as much as may be sufficient, that 12·7 grains of nitrate of silver, di solved in distilled water, may be accurately saturated by 100 grains this acid."

If the distillation be performed in a [tubulated] retort, as directed the Pharmacopœia, an adopter should be employed. When sm quantities are to be operated on, we may conveniently employ two Fl rence flasks (one as the receiver, the other as the distilling vessel), co nected by a glass tube curved twice at right angles. The receiver shou be kept very cool, ice or snow being used if it can be procured ; and t heat employed in distilling should be very moderate. The distilled liqu frequently contains a little sulphuric acid, and by standing deposits a sm portion of Prussian blue. A second distillation, cautiously conducted, w often separate the sulphuric acid: but I have seen Prussian blue form after the hydrocyanic acid has been distilled three times.

The theory of the process, founded on the experiments of Mr. Ever (*Lond. and Edinb. Phil. Mag.* Feb. 1835) is as follows:—Six equivale or 294 parts of protohydrated sulphuric acid react on two equivalents 426 parts of crystallized ferrocyanide of potassium (composed of fo equivalents cyanide of potassium, two of cyanide of iron, and six of wate and produce three equivalents or 384 parts of the bisulphate of pota three equivalents or 81 parts of hydrocyanic acid, one equivalent or 17 parts of a new salt (which I shall term the *biferrocyanide of potassiu* and nine equivalents or 81 parts of water. The bisulphate and the ne salt remain in the retort, while the hydrocyanic acid and the water dis over. In the Pharmacopœia an additional quantity of water is employ to assist the condensation of the acid.

;REDIENTS REACTING.				RESULTS.
,. Cryst. rocyan. assium 426	3 eq. Water 27			3 eq. Water 27
	3 eq. Water 27	3 eq. Hydrn. 3		3 eq. HydrocyanicAcid 81
		3 eq. Oxygn. 24		
	3 eq. Cyan. Potasm. 198	3eq. Cyanog. 78		
		3 eq. Potasm. 120	3 eq. *Poth.* 144	
	1 eq. Cyan. Potassium.... 66			1 eq. Biferrocyanide Potassium 174
	2 eq. Cyan. Iron 108			
Protohyd. phc. Ad. 294	6 eq. Water 54			6 eq. Water 54
	6 eq. Sulphuric Acid 240			3 eq. Bisulphte. Poth. 384

The salt here called biferrocyanide of potassium, is termed, by Mr. ;eritt, *yellow salt*. I have prepared it with the greatest care, but have vays found it to be white. Gay-Lussac also says it is white (*Ann. him. et Phys.* t. 46, p. 77). By exposure to the air it becomes blue.

(*b*.) *By the action of hydrochloric acid on cyanide of silver*.—This ocess, proposed by Mr. Everitt, yields an acid of uniform strength, and ay be followed when the acid is required for immediate use. The armacopœal directions for its performance are (or rather ought to be) follows:—Add 48½ grains of cyanide of silver to a fluidounce of disled water, mixed with 39½ grains of hydrochloric acid. "Shake all these a well-stoppered phial, and, after a short interval, pour off the clear quor into another vessel. Keep this for use, the access of light being evented." The proportions directed by Mr. Everitt are 40 grains of anide, 7 fluidrachms and 20 minims of water, and 40 minims of dilute drochloric acid (sp. gr. 1·129). This gentleman says, that practiners could obtain an ounce of the acid, prepared by this process, for e shilling, while the manufacturer could obtain 50 per cent. profit by it.

The *theory* of the process is as follows:—By the mutual reaction of ie equivalent or 134 parts of cyanide silver and one equivalent or 37 irts of hydrochloric acid, there are obtained one equivalent or 144 rts of chloride of silver, and one equivalent or 27 parts of hydroanic acid.

GREDIENTS REACTING.		RESULTS.
q. Cyande. Silver 134	1 eq. Cyanogen . . 26	1 eq. Hydrocyac. Ad. 27
	1 eq. Silver 108	
q. Hydrochlc. Acid 37	1 eq. Hydrogen . . 1	
	1 eq. Chlorine . . . 36	1 eq. Chloride Silver . 144

(*c*.) *By the action of hydrochloric acid on bicyanide of mercury*.—At pothecaries' Hall hydrocyanic acid was formerly prepared from one irt of bicyanide of mercury, one part hydrochloric acid (sp. gr. 1·15), id six parts of water. The mixture was distilled until six parts had issed over. The acid thus obtained had a sp. gr. 0·995, and its andard strength was such, that two fluidrachms of it dissolved 14 ains of the red oxide of mercury, thereby indicating a strength of about 9 per cent. of real acid.

The most convenient method of procuring *concentrated* or *anhydrous* ydrocyanic acid, is by the action of strong liquid hydrochloric acid on icyanide of mercury. The vapour should be passed over carbonate of me, to deprive it of hydrochloric acid; and over chloride of calcium, remove the water. The receiver should be immersed in a freezing iixture, consisting of ice and chloride of sodium.

The theory of the process is as follows:—Two equivalents or 74 parts f hydrochloric acid react on one equivalent or 254 parts of the icyanide of mercury, and form one equivalent or 274 parts of the bichloride of mercury, which remains in the retort, and two equivalents or parts of hydrocyanic acid, which distil over.

INGREDIENTS REACTING.				RESULTS.
2 eq. Hydrochl^c. Acid	74	2 eq. Hydrogen	2	2 eq. Hydrocyanic Acid
		2 eq. Chloride .	72	
1 eq. Bicyan^de. Mercury	254	2 eq. Cyanogen	52	
		1 eq. Mercury .	202	1 eq. Bichloride Mercury

(*d.*) *By the action of tartaric acid on cyanide of potassium.*—Th process was proposed by Dr. Clarke, and adopted by Mr. Laming. T formula of the latter is the following:—22 grains of the cyanide potassium are to be dissolved in 6 fluidrachms of distilled water, and this solution are to be added 50 grains of crystallized tartaric ac dissolved in 3 fluidrachms of rectified spirit. One fluidrachm of t decanted clear liquor contains one grain of pure hydrocyanic acid.

The objections to this process (which, however, has several advantag are the trouble and expense of procuring pure cyanide of potassiu and the liability of the salt to undergo spontaneous decomposition.

The theory of the process is the following:—Two equivalents or 1 parts of crystallized tartaric acid, one equivalent or 9 parts of water, a one equivalent or 66 parts of cyanide of potassium, react on each oth and produce one equivalent or 189 parts of the crystallized bitartrate potash, which precipitates, and one equivalent or 27 parts of hydrocyan acid, which remains in solution.

INGREDIENTS REACTING.				RESULTS.
1 eq. Water.	9	1 eq. Hydrogen .	1	1 eq. Hydrocya^c. A^d.
		1 eq. Oxygen . .	8	
1 eq. Cyanide Pot^m.	66	1 eq. Cyanogen .	26	
		1 eq. Potasium .	40	1eq. Pot^h. 48
2 eq. Crys. Tart^c. A^d.	150	2eq. Dry Tart. A^d.	132	1 eq. Crys. Bitar^e. Pot^h. 1
		1 eq. Water . .	9	
		1 eq. Water . .	9	1 eq. Water . . . . .

Properties. (*a.*) *Of anhydrous hydrocyanic acid.*—Anhydrous hydr cyanic acid is a solid at 0° F. (some state at 5° F.), having then th appearance of crystallized nitrate of ammonia: it readily melts, formin a limpid, colourless liquid, with an intense and peculiar odour; i taste is at first cool, then hot; at 45° its sp. gr. is 0·7058, and at 64½ 0·6969. In this state it is exceedingly volatile: a drop placed on pap freezes by its own evaporation. It unites with water and alcohol i every proportion. At 79° or 80° F. it boils, forming hydrocyanic aci vapour, which is combustible; and when mixed with oxygen, explode Two volumes of the vapour require two and a half volumes of oxygen g for their complete combustion. The products are two volumes of ca bonic acid gas, one volume of nitrogen, and one volume of aqueou vapour.

Anhydrous hydrocyanic acid undergoes speedy decomposition. D Christison says he has kept it unchanged for a fortnight in ice-col water.

(*b.*) *Of dilute hydrocyanic acid.*—Dilute or medicinal hydrocyanic aci is a colourless, transparent liquid, having the taste and smell of th strong acid, but in a lesser degree. Heated in a tube it gives off a com bustible vapour.

Composition.—The ultimate constituents of pure hydrocyanic aci are carbon, nitrogen, and hydrogen.

	Eq.	Eq. Wt.	Theory.	Gay-Lussac.
bon	2	12	44·4	44·45
·ogen	1	14	51·9	51·85
lrogen	1	1	3·7	3·70
lrocy^c^. A^d^.	1	27	100·0	100·00

	Vols.	Sp. Gr.
Carbon vapour	1 or 2	0·8333
Nitrogen gas	1	0·9722
Hydrogen gas	1	0·0694
Hydrocyanic vapour	2	0·9374

t it is more usual to regard this acid as a compound of hydrogen and ınogen, the latter substance being a bicarburet of nitrogen. On this w the composition will be as follows:—

	Eq.	Eq. Wt.	Per Cent.
nogen	1	26	96·3
ırogen	1	1	3·7
rocyanic Acid.	1	27	100·0

	Vols.	Sp. gr.
Cyanogen gas	1	1·8055
Hydrogen gas	1	0·0694
Hydrocyanic vapour	2	0·9374

The following diagrams illustrate the composition as well as the ducts of the combustion of the gaseous acid when exploded with ·gen gas:—

stituents.		Eq. Vol.	Before combustion.			After combustion.	
eq. ınog. = 26	=	1 eq. Hydro-cyanic acid va-po ur = 7	1 eq. Hydro-cyanic acid va-pour = 27	2 eq. Oxygen = 16	1 eq. Oxyg. = 8	1 eq. Carb. Ad. = 22	1 eq. Nitrog. = 14
eq. ydr. = 1				2 eq. Oxygen = 16		1 eq. Carb. Ad. = 22	1 eq. Aq. vap. = 9

STRENGTH OF THE DILUTE ACID.—In the Pharmacopœia, hydrocyanic d is directed to be prepared of such a strength that 100 grains of it l exactly precipitate 12·7 grains of nitrate of silver dissolved in water: he precipitate, which is cyanide of silver, should weigh 10 grains. nce the dilute acid should consist of—

Real Hydrocyanic Acid	2·0
Water	98·0
Dilute Hydrocyanic Acid (Ph. L.)	100·0

PURITY.—Dilute hydrocyanic acid should be perfectly colourless; composed acid is frequently, but not invariably, coloured. It uld be vaporizable by heat: this character shows the absence of ed impurities. The presence of metallic matter is recognized by lrosulphuric acid, which has no effect on the pure acid. If the acid ngly redden litmus, it must contain some other acid, most probably sulphuric or hydrochloric. The presence of any foreign acid is ily determined by the hydrargyro-iodo-cyanide of potassium. This salt easily formed by adding a concentrated solution of bicyanide of rcury to a solution of iodide of potassium: a precipitate of white or urly crystalline plates immediately takes place: these are the salt in estion. If a small portion of this salt be placed in diluted hydrocyanic d, no change is observed unless some foreign acid be present: in latter event the red biniodide of mercury immediately makes its pearance. For this test we are indebted to Dr. Geoghegan (*Dublin rnal*, Nov. 1835). Sulphuric acid may be detected by a solution of oride of barium: hydrochloric acid by nitrate of silver, which forms therewith white chloride of silver insoluble in boiling nitric acid whereas the white cyanide of silver is soluble in nitric acid at a boiling temperature. I would observe, that the presence of either of these acids is no further objectionable, than that it creates a difficulty in the determination of the strength of the hydrocyanic acid: while, on the other hand, it confers the advantage of rendering the hydrocyanic acid much less liable to decompose. The acid prepared from ferrocyanide of potassium will keep for years (Dr. Christison has had some unchanged for two years and a half, though it was exposed to day-light), owing, it is supposed, to the presence of some sulphuric acid. Mr. Barry adds a little hydrochloric acid to all his medicinal hydrocyanic acid, in order to preserve it. As air and light hasten, though they are not essential to, the decomposition of the acid, they should be carefully excluded.

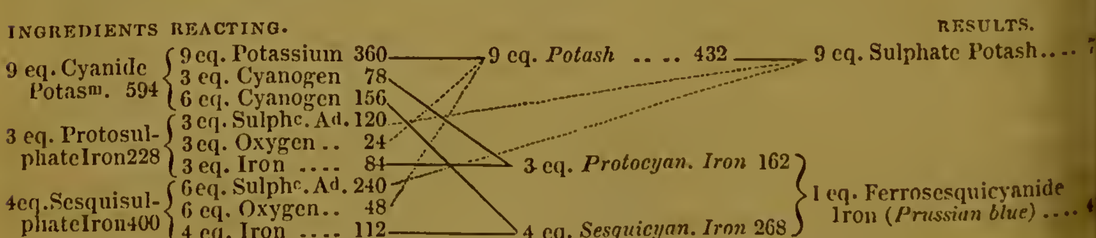
Characteristics.—The following are the best tests for hydrocyanic acid.

1. *The odour.*—The peculiar odour of hydrocyanic acid is well known. It must not be confounded with the odour of the volatile oil of bitter almonds. Orfila says, that this is the most delicate characteristic of the acid, since it is very marked when the liquid tests give very slight indications only. But I have not found this to be invariably the case: it depends much on the nature of the mixture containing the acid.

2. *Formation of Prussian blue* (*ferrosesquicyanide of iron*).—Add sufficient caustic potash to the suspected acid to saturate it; then a solution of some proto- and per-salt of iron: the common sulphate of iron of the shops, or the tincture of the chloride, answers very well, since both of these preparations usually contain the two (*prot-* and *per-*) salts of iron. A precipitate is thus obtained, which is liable to considerable variation in its colour, depending on the quantity of potash and the quality of the ferruginous salt employed; it may be yellowish brown, or greenish, or bluish. Then add dilute sulphuric or hydrochloric acid, when Prussian blue (ferrosesquicyanide of iron) will immediately make its appearance, if hydrocyanic acid were present.

The formation of Prussian blue is thus accounted for. When potash is added to hydrocyanic acid, water and cyanide of potassium are generated. By the reaction of this salt on a proto-salt of iron the protocyanide of iron is produced, while with a per-salt of iron it forms sesquicyanide of iron. The two ferruginous cyanides, by their union, constitute the ferrosesquicyanide or Prussian blue.

The following diagram explains the reaction of nine equivalents of cyanide of potassium on three equivalents of the protosulphate, and four equivalents of the sesquisulphate of iron.



3. *Nitrate of silver.*—This is by far the most delicate test of the presence of hydrocyanic acid. It causes a white precipitate of cyanide of silver, which is soluble in *boiling* nitric acid. By this latter character cyanide is distinguished from chloride of silver. If carefully

ied cyanide of silver be heated, it evolves cyanogen gas, known by its ombustibility and the colour (violet or bluish red) of its flame.

4. *Sulphate of Copper.*—This test is applied as follows:—Supersaturate th potash; then add sulphate of copper. A greenish blue precipitate obtained, which, by the cautious addition of a few drops of hydroloric acid, becomes white, if hydrocyanic acid be present. The ob-tions to the test are, that the results are not sufficiently striking, and at an inexperienced manipulator may fail in getting any evidence of drocyanic acid. When excess of potash is added to hydrocyanic acid, obtain water, cyanide of potassium, and free potash. On the addition sulphate of copper, hydrated oxide of copper, sulphate of potash in ution, and white cyanide of copper, are formed. The hydrochloric id is added to redissolve the oxide of copper.

5. *Tincture of guaiacum and sulphate of copper.*—If tincture of guaiacum added to a very dilute aqueous solution of hydrocyanic acid, a whitish ecipitate (resin of guaiacum) is thrown down. If now a few drops of a ution of sulphate of copper be added, a blue colour is produced, which rendered more intense by the addition of rectified spirit. Pagenstecher, Berne (*Quarterly Journal of Science*, vol. x. p. 182), first proposed cture of guaiacum and hydrocyanic acid as a test for copper. I find it tincture of guaiacum and sulphate of copper, applied as directed ove, form a very *sensible* test of the presence of hydrocyanic acid: but fortunately it is not *characteristic*, since other agents also develope a e colour with it. Thus spirit of nitric ether produces a blue colour h tincture of guaiacum.

Detection of this Acid in Cases of Poisoning.—As hydrocyanic d is a substance which readily undergoes decomposition, it is not ly to be met with in bodies which have been interred for many days. has, however, been recognized in one case, seven days after death, withstanding that the trunk had not been buried, but had been lying a drain (Chevallier, *Ann. d'Hygiène Publiq.* ix. 337). In recent cases acid is readily distinguished by its odour, with which, in some cases, whole body is impregnated. The tests for this acid, already men-ied, will sometimes detect the poison in the filtered contents of the mach; but the foreign matters present may in some instances prevent ir characteristic action. The best mode of proceeding, in that case, o introduce them into a tubulated retort, to add some sulphuric d to neutralize any ammonia which might be generated by the process outrefaction, and to distil by means of a vapour or water bath; then ly the tests already mentioned.

t has been suggested that hydrocyanic acid may be formed during the cess of distillation by the decomposition of the animal matters. But, Dr. Christison has justly observed, the objection appears only to rest conjecture, or presumption at farthest. It is to be recollected that ound cheese has, under certain circumstances, been found to contain acid, as already mentioned. It is not improbable that it may be nd in many animal substances during their spontaneous decomposition. urred rye has been found to contain it.

Physiological Effects.—(*a.*) *On vegetables.*—Hydrocyanic acid is oison to plants. The stamina of *Berberis vulgaris* and the leaves of *mosa pudica* lose their irritability when the stems bearing them are nersed in the dilute acid (Macaire, *Biblioth. Universelle*, xxxi. 244).

Seeds lose the power of germination by immersion in this acid. In thos parts of lactescent plants which are poisoned by it, the milky juice does not flow from the cells or vessels in which it is contained. By chemica means it has been shewn that the acid becomes absorbed (Decandolle *Physiol. Végét.* p. 1357). Ammonia has, in some cases, appeared t favour the recovery of plants which had been exposed to the vapour o the acid (Macaire, *op. cit.*).

(*b.*) *On animals generally.*—Hydrocyanic acid is an energetic poiso to all classes of animals. Experiments have been made with it o the following:—*Mammalia, Aves, Reptilia, Amphibia, Pisces, Gaste ropoda, Annelida, Crustacea, Insecta, and Infusoria* (Coullon, quoted b Wibmer, *Wirkung d. Arzneim.* 3 Bd. p. 110). The general effects ar very similar on all classes, and consist essentially of loss of sensation an voluntary motion, with convulsive movements. The cold-blooded animal are more slowly affected by it than the hot-blooded ones.

Dr. Christison states that twenty-five grains of the strong acid, applie to the mouth, killed a rabbit within ten seconds. I once caused th instantaneous death of a rabbit by applying its nose to a receiver fille with the vapour of the pure acid: the animal was killed without th least struggle. If a drop of the pure acid be placed on the throat of dog, or applied to the eye, death takes place in a few seconds. Inhalin the vapour decidedly produces death more quickly than any other mod of applying the acid.

(*c.*) *On man.*—*a. In small or medicinal doses.*—Small doses of hydr cyanic acid sometimes relieve certain morbid conditions (as of th stomach), without producing any remarkable alteration in the conditio of the general system. If the dose be cautiously increased, and i operation carefully watched, the following effects are usually observed bitter but peculiar taste; increased secretion of saliva; irritation in th throat; frequently nausea; disordered and laborious respiration (som times quick,[1] at others slow and deep); pain in the head, giddines obscured vision, and sleepiness. The vascular system is in some cas not obviously affected, but in others much affected, though not uniforml being sometimes quickened, at others reduced in frequency. In som instances faintness is experienced. Drs. Macleod and Granville (*Lond Med. and Physic. Journ.* vol. xlvi. pp. 359 and 363) have noticed saliv tion and ulceration of the mouth during its medicinal use.

β. In poisonous doses: convulsions and insensibility: if death occur, takes place slowly.—Immediately after swallowing the acid, a remarkab bitter taste is experienced; this is soon followed by a sensation of fain ness and giddiness, with salivation, and succeeded by tetanic convulsion and insensibility; the respiration is difficult and spasmodic; the odo of hydrocyanic acid may be recognized in the breath; the pupils a usually dilated, though sometimes contracted; the pulse is small imperceptible. When recovery takes place it is usually very rapid, an the whole period of suffering seldom exceeds half an hour. Howev exceptions, to this exist, in which the symptoms have been prolonged f several hours.

The following case, related by Dr. Geoghegan, (*Dublin Med. Jour* Nov. 1835), is an interesting illustration of these effects:—A gentlema aged 21, having been for some time subject to an uneasiness in the st mach, not actually amounting to gastrodynia, after having tried ma emedies in vain, was induced to have recourse to hydrocyanic acid. He ommenced with one minim of the Dublin Pharmacopœia, sp. gr. 0·998: his dose he repeated twelve times the first day, without any perceptible ffect. On the following day he took half a drachm, with the same esult. The third day his dose was a drachm, which he repeated the ourth day. On the fifth day he took a drachm and a half, still no effect f any kind. On the sixth day he increased his dose to two drachms. n about two minutes after taking this latter quantity, he experienced a ensation of extreme bitterness in the mouth, and having walked a few aces, was affected with great confusion, headache, and loud ringing in is ears. He now with difficulty retraced his steps, and leaning forward n a table, became insensible and fell backwards. In this state he reained altogether between three and four minutes, during which time he as violently convulsed. Two drachms of the spiritus ammoniæ aromacus were diluted with a little water, and applied as quickly as possible the mouth, but as the teeth were clenched it could not be swallowed. he solid sesqui-carbonate of ammonia was then applied assiduously to e nostrils; its beneficial effects were soon apparent, and he was shortly le to swallow a little fluid. Sensibility now speedily returned, and miting supervened, from which he experienced great relief; and at the piration of half an hour he was quite well, with the exception of pain d feeling of distension in the head, which continued for the remainder the day. After he had become insensible, and while leaning on the ble, his thighs became rigid, and were drawn up on the abdomen; and he was about falling, he was caught, and placed on the ground. The per extremities were then observed to be also rigid, and on drawing em from the side, they forcibly reverted to their former position; the es were shut, the teeth clenched, and the muscles of the face violently nvulsed. It is deserving of notice that the old complaint was cometely removed by this extraordinary dose.

γ. *In poisonous doses: death rapid with or without convulsions.*—In ese cases the death is so rapid that, in the human subject, the sympms have scarcely been observed. They are probably similar to those ticed in animals,—viz. imperceptible pulse, breathing not obvious, there may be two or three deep, hurried inspirations, insensibility, and ath. Convulsions may or may not be present. The presence or sence of convulsions, as connected with the time within which death curs in these cases, is sometimes of great moment. Some years ago e life of a prisoner almost turned on this point. The following is an tline of the case, which is more fully developed in Dr. Christison's *eatise on Poisons*, and in the *Medical Gazette*, vol. viii. pp. 577 and 7. An apothecary's maid-servant at Leicester, was found one morning ad in bed. The body lay in a composed posture—the arms crossed er the trunk, and the bed-clothes pulled smoothly up to the chin. At r right side lay a phial, from which about five drachms of the medicinal drocyanic acid had been taken, and which was corked and wrapped in per. It was suspected that she took the acid to occasion miscarriage, d that the apprentice was accessory to its administration; in consecnce of which he was put on his trial. Now, the important question the consideration of the medical witnesses was, could the deceased, er having drunk the poison, have had time to cork the phial, wrap it , and adjust the bed-clothes before insensibility came on? It was supposed that if the death were of that slow description to allow of thes acts of volition, convulsions would have occurred, and the bed-clothe would have been found disordered. On the other hand, those cases i which no convulsions occur usually terminate too quickly to allow of th above acts. The medical witnesses in the above case were not agreed i opinion: the majority thought that it was impossible the deceased coul have had the power of corking the bottle. The jury very properly foun the prisoner not guilty.

There are two points of inquiry connected with the action of this acid which are interesting, more particularly in a medico-legal point of view— namely, the time at which the poison begins to operate, and the period i which it proves fatal. No absolute answer can be given to either o these questions, since the strength and quantity of the acid exhibited and peculiarities (not known or understood) affect the result. Very stron acid, in large doses, begins to operate immediately on touching th throat, and death is almost instantaneous. The dilute acid, on the othe hand, sometimes does not produce any obvious effect for several minute and death may not occur for nearly half an hour. Of seven epilepti patients killed in one of the Parisian hospitals by hydrocyanic acid, som did not die for forty-five minutes. But I have not found the same quan tity of the same acid kill different individuals of the same species in th same period of time.

Morbid Appearances.—The post-mortem appearances in cases o poisoning by this acid are the following:—Glistening and staring expres sion of the eyes, but which, however, is not a constant phenomeno since it was not observed in the seven Parisian epileptics: nor is it pecu liar to this poison, for the same is observed after death by carbonic acid and in other cases (Christison) the odour of the acid is oftentimes ver obvious in the blood, brain, chest, or stomach: the venous system i usually gorged with blood, while the arteries are empty: the blood is, i many cases, fluid, dark, or bluish black, and viscid or oily: the vessels o the brain and spinal marrow are frequently gorged with blood; and th cerebral ventricles sometimes contain a serous or sanguineous liquor; th lungs are, in some instances, natural—in others, turgid with blood: th internal lining of the stomach is sometimes red.

It has been stated by Magendie, that after death by the strong acid the muscles are not sensible to the galvanic influence. But this condi tion is very rarely present; indeed I have never observed it in animal killed by this acid; but Dr. Christison states he has occasionally foun it. I have examined a considerable number of animals (principally rabbit destroyed by hydrocyanic acid, and have always found the muscles to b powerfully affected by the galvanic influence: nor have I once met wit a single case in which the heart had ceased to beat when the chest ha been laid open immediately after death.

Modus Operandi.—There are several interesting subjects of inquir connected with the operation of hydrocyanic acid, which, as they ar principally theoretical, I shall briefly notice under this head.

(*a*.) *Local action.*—Dr. Christison says that Robiquet's fingers becam affected with numbness, which lasted several days, in consequence o their exposure for some time to the vapour of this acid (*Treatise o Poisons*, 3d ed. p. 698). This effect would appear to depend on th ocal action of the poison on the nerves,—a mode of operation which we re constrained likewise to admit in the case of some other narcotics. See p. 13: also Müller's *Physiology*, by Baly, vol i. p. 630). Some of he local effects produced by hydrocyanic acid are those of an irritant: uch are, the acrid impression made by the vapour on the nose and outh—the ptyalism—the vomiting and purging—and the redness of the ucous membrane of the stomach.

(*b.*) *Absorption.*—That hydrocyanic acid becomes absorbed, is proved y its having been detected by Krimer (quoted by Dr. Christison, p. 15), the blood of animals poisoned with it, and by the odour of it exhaled y various parts of the body.

(*c.*) *Are the remote effects of this acid caused by its absorption?*—In any cases the operation of hydrocyanic acid on the system is so rapid, nd death so speedily follows the application of the poison, that we cannot satisfactorily account for the effects by the slow process of absorption: and hence many persons have felt themselves constrained to admit e agency of the nerves. I have before (p. 27) alluded to this subject, nd have quoted a passage from Müller's *Physiology*, in which the operaon by absorption is defended. Further information on this point will e found at p. 627, vol. i. of this celebrated work. The principal arguents which have been adduced in favour of the agency of absorption are e following: *first*, that the acid produces no remote effects when pplied either to the nerves or brain: *secondly*, that applied to the tongue r stomach, it operates as an energetic poison, although the nerves of ese parts were previously divided: *thirdly*, that if the acid be applied a part where circulation is arrested, the operation of the poison is revented: *fourthly*, the activity of the acid is in proportion to the osorbing powers of the part with which it is placed in contact. See p. 18).

(*d.*) *Organs affected.*—The parts specifically affected by this acid are e brain and true spinal system. The pain in the head, the insensibity, and the coma, are evidence of the cerebral affection; while the tanic convulsions depend on the disorder of the true spinal system. Marx (*die Lehre von d. Giften*, 1er. Bd. 2e. Abt. S. 154,) mentions the llowing experiment performed by Wedemeyer (*Versuche über das Nernsystem*, S. 241, Vers. 7), and which shews the independent action of e acid on the spinal marrow: the spinal cord of a dog was divided etween the last dorsal and first lumbar vertibræ, so that the hind legs ere completely paralyzed and insensible to mechanical irritants: hydroyanic acid was then introduced into one of the hind legs;—in one inute symptoms of poisoning commenced, the hind as well as the fore gs were violently convulsed,—and in twelve minutes the animal was ead. The affection of the respiratory and circulatory systems produced y hydrocyanic acid is probably only secondary: that is, is the result of e influence of this agent over those parts of the nervous system from hich the respiratory organs and heart derive their nervous power. he insensibility caused by hydrocyanic acid occurs too rapidly, in many ases, to be the result of asphyxia caused by paralysis of the muscles of spiration.

(*e.*) *Condition of the brain and spinal marrow.*—The precise pathological condition of the brain and spinal cord of an animal under the nfluence of hydrocyanic acid, cannot be positively determined, and is, therefore, a matter of conjecture. Whatever it may be, it is probably identical with that which occurs during an epileptic paroxysm, and with that produced by loss of blood: for the essential symptoms (insensibility and convulsions occurring suddenly) are the same in all three states,—and ammonia has been found to relieve them (see p. 171). Dr. Hall (*Lect. on the Nerv. Syst.* p. 139), has shewn that the convulsion from hæmorrhage is spinal. Dr. Holst, Professor of Materia Medica in the University of Christiana, Norway, told me of a case of epilepsy under his care, in which it was observed that the pulse in one arm was always imperceptible during the paroxysm. On a post-mortem examination it was discovered that an anomalous distribution of the arteries existed,—so that this arm was supplied with blood which had circulated through the brain. Hence it would appear that during the epileptic paroxysm the cerebral circulation was impeded. Does this happen in poisoning by hydrocyanic acid?

(*f.*) *Cause of death.*—In most cases the immediate cause of death is obstruction of respiration. In some instances it is stoppage of the heart's action. There are cases, however, in which the death is too immediate to be produced by obstructed respiration, while, on opening the chest, the heart is found still beating: this I have observed in experiments on rabbits with strong hydrocyanic acid.

(*g.*) *Cumulative effects.*—Hydrocyanic acid is not usually regarded as a cumulative poison; but a case mentioned by Dr. Baumgärtner (quoted by Dr. Christison), as well as some other circumstances, seem to favour the reverse opinion (see Dr. Christison's *Treatise*).

Uses.—We are indebted to the Italians (Borda, Brugnatelli, and Rasori) for the introduction of hydrocyanic acid into the Materia Medica. It was first employed by them at the commencement of the present century; namely, from 1801 to 1806 (Granville, *Treatise on Hydrocyanic Acid*, 2d ed. 1820).

(*a.*) *Internal.*—By the founders of the theory of contrastimulus this acid was regarded as a powerful asthenic or contrastimulant, and, therefore, as peculiarly useful in all diseases dependent on, or connected with excitement. Hence it was employed in inflammatory affections. But subsequent experience has fully shewn that in these cases it possesses little or no remedial power.

In this country the reputation of hydrocyanic acid, as a medicinal agent, is chiefly founded on its effects in alleviating certain anomalous stomach complaints. It appears, from Dr. Granville's statements (*op. cit.*), that laurel-water (which contains this acid) was used in these affections by Hufeland, Haller, Thuessen, Swediaur, and Sprengel, between the years 1780 and 1796. But the first person who actually recommends hydrocyanic acid for them is Sprengel (*Pharmacologia*), in 1814. In 1819, Dr. A. T. Thomson detailed a case, which led him to infer that this acid would be an important agent in the treatment of dyspeptic affections. But the profession are principally indebted to Dr. Elliotson (*Numerous Cases illustrative of the Efficacy of the Hydrocyanic Acid in Affections of the Stomach*, 1820) for a full investigation of its powers in these complaints.

Every practitioner is familiar with a stomach complaint in which pain of a spasmodic character is the leading symptom, but which is not essentially accompanied by pyrexia, as in gastritis—by tendency to faint, as in ardialgia—by indigestion, as in dyspepsia, nor by loss of appetite; hough one or more of these conditions may attend it. By some nosolo-ists (as Sauvages and Sagar) it has been regarded as a distinct disease, nd has been termed *gastrodynia.* It is not unfrequently accompanied y vomiting and præcordial tenderness, which, however, cannot be egarded as indicative of inflammation, for various reasons; one of which the alleviation of it often obtained by the use of stimulants and antispas-nodics. What may be the precise pathological condition of this malady know not. Dr. Barlow (*Cyclopædia of Practical Medicine,* art. *Gas-rodynia*) thinks the primary disease to be irritation or excitement of the nucous membrane of the stomach, whereby a redundant, dense, mem-ranous, and opaque mucus is secreted, which accumulates and oppresses he stomach. The pain he supposes to arise from a contractile effort of he stomach to detach and expel the offending matter: but the imme-iate and permanent relief sometimes obtained by the use of hydrocyanic cid, is, I conceive, almost fatal to this hypothesis. Some time since I rescribed the acid for a lady who had suffered for months with gastro-ynia, and who was persuaded, from her sensations, she had some organic isease. The remedy acted in the most surprising manner: in a few ours, to the astonishment of herself and friends, she was apparently uite well, and has since had no return of her complaint. It can hardly e imagined, that irritation of stomach can be rapidly removed by a ubstance which is itself an irritant. For my own part, I conceive the ffection to be, essentially, a disordered condition of the nerves supply-ng the stomach, or of the nervous centres from whence those nerves are erived: and that it is frequently, but not invariably, accompanied with the rritation of stomach alluded to by Dr. Barlow. But be the proximate ause of the disease what it may, the beneficial effects of the hydro-yanic acid, in some instances of gastrodynia, are most astonishing, hile in others it totally fails. In all the cases in which I have tried it, have obtained either perfect success or complete failure: I have met ith no cases of partial relief. It not only allays pain, but relieves omiting; and in the latter cases, frequently when all other remedies fail. Dr. Elliotson mentions the following as the stomach affections relieved y it:—1st. those in which pain at the stomach was the leading symp-om: 2dly, those in which the gastrodynia was accompanied by a dis-harge of fluid, constituting what is called pyrosis, or the water-brash: dly, when the excessive irritability of the stomach produces vomiting; nd, 4thly, those disorders of the stomach, which, in some of their symp-oms, resemble affections of the heart. Dr. Prout has found it useful in astrodynia connected with colica pictonum.

I have also found it useful in a painful affection of the bowels nalogous to that of the stomach, and which, therefore, might ith propriety be termed *enterodynia.* The most remarkable case of this ind which I have met with, was that of a gentleman, a relative of one f my pupils. He had suffered for several months excruciating pain in he bowels, commencing daily about two o'clock, and only ceasing at ight. It was, apparently, a consequence of an ague. He had been nder the care of several country practitioners, and had tried a number f remedies (including opium and sulphate of quinia) without the least enefit. I advised the employment of the hydrocyanic acid, and ccordingly five minims were administered at the commencement of a paroxysm: the remedy acted like a charm: all the unpleasant symptom immediately disappeared. Several doses of the acid were given befor the time of the succeeding paroxysm, but the disease never returned and after employing the acid for a few days longer, he went back to th country completely cured.

I have seen hydrocyanic acid used with great success to allay vomiting and purging in severe forms of the ordinary English cholera, wher opium has completely failed. In Asiatic or malignant cholera it ha occasionally appeared to be serviceable.

As a remedy for affections of the pulmonary organs, hydrocyanic aci was at one time in great repute. It was said to be capable of curin slight inflammation of the lungs without the necessity of blood-letting of suspending or curing incipient phthisis, while in confirmed cases i smoothed the approach of death; of curing hooping-cough, and of removing all the symptoms of spasmodic asthma (see Dr. Granville' *Treatise* before referred to, and also Magendie's *Recherches sur l'emplo de l'Acide Prussique*, 1819). Experience has shown the fallacy of mos of these statements. I have employed hydrocyanic acid in a considerabl number of cases of phthisis, and have occasionally fancied that it relieve the cough and night-sweats; but these effects were only temporary. Cases of genuine spasmodic asthma are rare; but in two instances in which I have seen the acid employed, no relief was obtained. In allaying cough (especially the kind called spasmodic) I have, on several occasions, found it useful; but it has so frequently disappointed my expectations, that I now rarely employ it in any pulmonary diseases. I have never observed any ill effects from its use in these cases, though others assert they have.

It has been employed in affections of the nervous system. Cases of hysteria, epilepsy, chorea, and tetanus, have been published, in which this remedy has been found beneficial. I have seen it employed in the three first of these affections, but without any evident relief. It has been proposed and tried in hydrophobia: it apparently mitigated the symptoms. Dr. Hall (*Lect. on the Nerv. Syst.* p. 155) proposes that in addition to the use of this acid, tracheotomy, as suggested by Mr. Mayo, should be tried.

Hydrocyanic acid has been administered as an anodyne in several painful affections; namely, cancer, tic-douloureux, rheumatism, &c., but with a few exceptions, it has not been found serviceable.

As an anthelmintic it has been extolled by Brera; but the following fact mentioned by Dr. Elliotson, will, I imagine, show its true value: —"I have frequently employed it perseveringly without expelling one worm, when a dose of calomel has instantly brought away hundreds."

(*b.*) *External.*—The local employment of the acid has not been attended with very great success.

In chronic skin diseases, especially impetigo, prurigo, and psoriasis, the acid has been recommended by Dr. A. T. Thomson to allay pain and irritation. Schneider, of Dusseldorf, has employed 1½ drachms of hydrocyanic acid, six ounces of spirit, and as much rose water, in scaly diseases attended with severe itching, especially in eruptions upon the genital organs. On several occasions I have tried hydrocyanic washes in prurigo, but without obtaining any obvious relief. Dr. Elliotson says he has found it efficacious in sores behind the ears, and in scabs of the e; and adds, to an irritable face it is very soothing, if employed before d after shaving. In cancer of the uterus, lotions containing this acid ve been applied to allay the pain, by Frisch, of Nyborg. Osiander has o employed, in the same disease, cherry-laurel water, the active prin- le of which is this acid. In gonorrhœa, injections containing hydro- nic acid have been employed with benefit. Schlegel has tried also cherry-laurel water with the same result. Lastly, the dilute acid has en proposed as an effectual and agreeable mode of destroying vermin.

ADMINISTRATION.—The best mode of exhibiting this acid internally is the form of mixture. I generally give from three to five minims of the ute acid in about an ounce of some mild vehicle (simple water answers y well), and repeated three or four times a day. Gum or syrup and ne flavouring ingredient (as orange-flower water, used on the continent) y be added. Some persons give it in almond emulsion.

As a wash, two fluidrachms of the dilute acid of the shops may be ployed mixed with half a pint of distilled (or rose) water as a lotion in n diseases. Frequently about half an ounce of rectified sprit is added, l Dr. Thomson recommends, in addition to this, sixteen grains of tate of lead. The external use of this acid, in all cases (more espe- lly if there be sores) requires great caution. Its effects on the nervous tem and on the pulse must be carefully watched. In some cases it ses giddiness and faintness; and Mr. Plumbe says, in two instances it duced intermission of the pulse.

ANTIDOTES.—The most important agents in the treatment of poisoning hydrocyanic acid, as well as by the substances which contain it (viz. cherry-laurel, bitter almonds, the volatile oil of these substances, &c.), *chlorine*, *ammonia*, *cold affusion*, and *artificial respiration*.

a.) *Chlorine* is the most powerful of these. It was first proposed by uz in 1822. It has been subsequently strongly recommended by hner, Simeon, and Orfila. It should be applied both internally and ernally if possible. If chlorine water (*aqua chlorinii*, Ph. D.) be at d, this should be given in doses of one or two tea-spoonfuls properly ted with water. In the absence of this, weak solutions of the chloride me or the chloride of soda may be administered. Nitro-hydrochloric l largely diluted might be given where none of the above agents could procured. The patient should be allowed to inhale, very cautiously, impregnated with chlorine gas (developed by the action of dilute rochloric acid on chloride of lime). Enemata containing chlorine er or a solution of chloride of lime should also be employed.

b.) *Ammonia.*—The spirit of sal ammoniac was proposed by Mead *chan. Account of Poisons*, 5th edit. p. 275, 1756) as an antidote for el water. In 1822, ammonia was recommended by Mr. J. Murray as antidote for hydrocyanic acid; and its value has been admitted by hner, Orfila, Dupuy, and Herbst: but it is certainly inferior to rine; and, therefore, should be used only in the absence of this. If patient be able to swallow, the liquor ammoniæ, diluted with eight or parts of water, should be exhibited, and the vapour of ammonia or its onate inhaled: the latter practice is most important, and should not mitted. Orfila says that ammonia is of no use when introduced into stomach, but that the inhalation of the vapour will sometimes preserve Great caution is requisite in the employment of it (see p. 169). In absence of ammonia the inhalation of the vapour of burnt feathers might be employed. Ammonia cannot be useful, as an antidote, b[y] its chemical properties merely, since hydrocyanate of ammonia is [a] powerful poison.

(*c.*) *Cold affusion* has been strongly recommended by Herbst (*Archi[v] f. Anat. et Phys.* 1828; quoted by Dr. Christison), and is admitted b[y] Orfila to be a valuable remedy, though he thinks it inferior to chlorin[e]. Herbst says that its efficacy is almost certain when it is employed befo[re] the convulsive stage of poisoning is over, and that it is often successf[ul] even in the stage of insensibility and paralysis.

(*d.*) *Artificial respiration* ought never to be omitted. Of its efficacy [I] am convinced from repeated experiments on animals. I once recovered [a] rabbit by this means only, after the convulsions had ceased, and th[e] animal was apparently dead. It is an operation easily effected, and w[ill] be found a powerful assistant to chlorine or ammonia, by enabling it [to] get into the lungs when natural respiration is suspended. To produ[ce] respiration, make powerful pressure with both hands on the anteri[or] surface of the chest, the diaphragm being at the same time pushed upwa[rd] by an assistant. Inspiration is effected by the removal of the pressu[re] and the consequent resiliency of the ribs.

Other remedies (as turpentine) have been recommended, but they will n[ot] bear comparison (if, indeed, they possess any efficacy) with those no[w] mentioned. Blood-letting has been advised, in vigorous subjects, wh[en] respiration has been established, and the skin is livid (Devergie, *M[éd.] Lég.* t. ii. p. 825).

ORDER 8.—PHOSPHORUS AND PHOSPHORIC ACID.

Phos'phorus —Phos'phorus.

HISTORY.—This substance was discovered in 1669, by Brandt, [an] alchymist at Hamburgh; and received its name from being luminous [in] the dark (from φῶς, *light;* and φέρω, *I carry*).

NATURAL HISTORY.—Phosphorus is found in both kingdoms [of] nature.

(*a.*) *In the inorganized kingdom.*—Phosphorus is comparatively rare [in] the mineral kingdom. Various phosphates are found native, but in sm[all] quantities: those of lime, lead, iron, copper, manganese, uranium, a[nd] yttria, may be mentioned as examples. Phosphate of lime is an imp[or]tant constituent of the organic exuviæ entombed in the fossilifero[us] rocks.

(*b.*) *In the organized kingdom.*—Phosphoric acid, free, or combined w[ith] lime, potash, or iron, is found in various vegetables (Decandolle, *Ph[ys.] Végét.* pp. 383, 387, and 390). Phosphorus is a constituent of anima[ls]: in some cases it is in combination with oxygen, and a base, as in t[he] bones, urine, &c.: in other instances, as in the brain, it is uncertain [in] what form it exists.

PREPARATION.—Phosphorus is procured from bone-ash (*sub-* or $\frac{4}{3}$ *ph[os]phate of lime*), by digesting it in sulphuric acid; by which sulphate a[nd] superphosphate of lime are procured: the first, for the most part, pre[ci]pitates, while the latter remains in solution. The solution is to [be] evaporated nearly to dryness, then mixed with charcoal, dri[ed] and distilled in an earthen retort. The charcoal abstracts the oxyg[en] n the phosphoric acid of the superphosphate, setting free the phospho-, which is volatilized.

ROPERTIES.—It is a pale yellow, semitransparent, crystallizable, hly combustible solid. Mitscherlich says the crystals are rhombic lecahedrons; so that they belong to the regular or tessular system. ht, especially violet light, reddens it.

ts sp. gr. is 1·77.—At ordinary temperatures it is flexible, but at 32° rittle. It melts at 105°, and boils at 550° F. It gives off a small ntity of vapour at ordinary temperatures. In the atmosphere its es are luminous in the dark, in consequence of a slow combustion: y have the odour of garlic. By keeping in water, phosphorus becomes ted by a white substance, by some regarded as an oxide, by others as hydrate of phosphorus. Phosphorus is insoluble in water, but soluble ether, and the oils both fixed and volatile. It may be reduced owder by melting it under water, and shaking in a closed vessel until l. Its equivalent by weight is 16.

HARACTERISTICS.—Phosphorus in substance is easily recognized by vaxy appearance; by its fuming in the air, and being phosphorescent uminous in the dark; by friction or gentle heat causing it to inflame; , lastly, by its burning with a most intense white light and a white ke of phosphoric acid. A solution of phosphorus in oil or ether, be known by its garlicky odour, and, when rubbed on the skin, by endering the latter luminous in the dark.

HYSIOLOGICAL EFFECTS.—(*a.*) *On vegetables.*—According to Marcet poisonous to plants.

.) *On animals generally.*—Water impregnated with phosphorus, acts n aphrodisiac to drakes (Alph. Leroy, quoted by Bayle, *Biblioth. de ap.* t. ii. p. 28). Phosphuretted oil acts as a stimulant to horses: d drawn from a vein had a phosphoric odour (Pilger, quoted by le). If phosphuretted oil be injected into the jugular vein, or into cavity of the pleura of a dog, white vapours of phosphorus are evolved the mouth, and death shortly takes place. The phosphorous acid mes the lungs in its passage through the delicate pulmonary vessels. oduced into the stomach of animals, phosphorus acts as a caustic on. The corrosion is supposed to depend on the action of the sphorous acid (formed by the combination of the phosporus with the gen of the air contained in the alimentary canal) on the tissue with h it is in contact.—(Orfila, *Toxicol. Génér.*)

.) *On man.*—In *small doses*, phosphorus acts as a powerful and sible stimulant, exciting the nervous, vascular, and secreting organs. eates an agreeable feeling of warmth at the epigastrium, increases frequency and fulness of the pulse, augments the heat of skin, htens the mental activity and the muscular powers, and operates as a erful sudorific and diuretic. Its aphrodisiac operation has been recog- d by Alphonse Leroy, and Bouttatz (Bayle, *op. cit.*), by experiments e on themselves. In *somewhat larger doses* it causes burning pain, iting and purging, with extreme sensibility of the stomach, which for several days (see an experiment made by Sundelin on himself, *db. d. Heilm.* 2er. Bd. s. 213). In *still larger doses*, it causes mmation of the stomach and bowels. Its activity as a caustic n depends, according to Orfila, on its absorbing oxygen, and thus becoming converted into an acid which acts as a corrosive, like the oth mineral acids. Hence, therefore, etherial and oleaginous solutions a more active poisons, inasmuch as the oxidation of the phosphorus effected more rapidly. Comparatively small doses have in some cas proved fatal. In Dr. Christison's *Treatise on Poisons* are references several cases: in one $1\frac{1}{2}$ grains, in another instance 3 grains, caused dea Cases, however, are reported, in which 6, 10, and even 12 grains ha been swallowed without any hurtful effects; but doubts have been ent tained as to the correctness of the statements. Thus the authors of t *Dictionnaire de Matière Médicale* think that the phosphorus employed these cases must have undergone some chemical change. I once adm nistered 16 grains of phosphorus to a man without any injurious effec and, judging from its physical characters, I should say the phospho was that usually met with in commerce. The man here alluded to w Chabert, some years ago renowned in London under the name of t "*Fire King.*" I carefully weighed out 16 grains, placed them in a spo and put them in his mouth; and he washed them down with a tumbl ful of water. He offered to take this dose daily. How he counterac the ill effects, I know not; but I suspect he excited vomiting, for with ten minutes after swallowing the phosphorus, he left the room for abou quarter of an hour.

USES.—In this country, phosphorus is rarely employed, and, theref it will be unnecessary to enter minutely into its uses. It has b strongly recommended in those cases attended with great prostration the vital powers, as in the latter stages of typhus fever, dropsies, &c.; some chronic diseases of the nervous system, as epilepsy, paraly melancholy, mania, amaurosis, &c., when these occur in debilitated su jects. In some of the exanthemata, as measles, it has been administe to promote the re-appearance of the eruption when this, from so cause, had receded from the skin; in impotentia virilis of old and deb tated subjects; in cholera, &c. Paillard recommends phosphorus as caustic, in the place of moxa, than which, he says, it is more conveni and safer. (*Med. Gaz.* vol. ii. p. 254).

ADMINISTRATION.—Phosphorus cannot be given with safety in t solid form. It may be administered dissolved in ether, and formulæ the preparation of an ethereal solution (*tinctura etherea cum phospho* Fr. Cod.) will be found in Magendie's *Formulaire*, and in the Fren *Codex*. But some objections have been raised to its use. It is said t upon the evaporation of the ether the phosphorus will be set free, a may inflame the stomach. A solution of phosphorus in fixed oil (*Ole phosphoratum*, Ph. Boruss.) is, therefore, more commonly employ Magendie's formula for this is the following:—Digest, during fift days, in a dark place, one part by weight of phosphorus, cut in v small pieces, in sixteen parts of olive or almond oil, in a stoppe bottle. To communicate an aromatic flavour, a few drops of the essen of bergamot may be added to the decanted liquid. The solution termed *aromatic phosphorized oil* (*huile phosphorée aromatisée*). Of t oil from 25 to 30 drops may be given in 24 hours: it may be admin tered in some mucilaginous liquid, or in an emulsion.

ANTIDOTES.—In poisoning by phosphorus, our objects are to prev or stop the oxidation of the phosphorus, and to neutralize the result ɜid as fast as it is formed. To fulfil the first of these indications, ırge quantities of mild demulcent liquids are to be exhibited, so as to ıvelop the phosphorus and exclude it from the air contained in the imentary canal. Magnesia should be given, in order to neutralize the ıosphorous and phosphoric acids. Parts burned with phosphorus are to washed with a weak alkaline solution, to remove any adhering acid hich might serve to keep up irritation.

Ac'idum Phosphor'icum.—Phos'phoric Ac'id.

History.—Phosphoric acid was first distinguished by Marggraf, in 740.

Natural History.—(See Phosphorus).

Preparation.—In the London Pharmacopœia, dilute phosphoric acid ıe only officinal form of phosphoric acid) is ordered to be prepared by lding an ounce of phosphorus to four fluidounces of nitric acid, mixed ith ten fluidounces of distilled water, in a glass retort placed in a sand- ıth; then apply heat until eight fluidounces are produced. Let these again put into the retort that eight fluidounces may distil, which are be rejected. Evaporate the remaining liquor in a platinum capsule ıtil only two ounces and six drachms remain. Lastly, add to the acid, hen it is cold, as much distilled water as may make it accurately mea- ıre twenty-eight fluidounces.

In this process six equivalents or 96 parts of phosphorus react on five ıuivalents or 270 parts of real nitric acid, and abstract fifteen equiva- ıts or 120 parts of oxygen, with which they form six equivalents or 6 parts of phosphoric acid, while five equivalents or 150 parts of the ıoxide of nitrogen are evolved.

INGREDIENTS REACTING.			RESULTS.
q. Nitric Acid 270	5 eq. Nitrogen	70	5 eq. Binox. Nitrogen . . 150
	10 eq. Oxygen .	80	
	15 eq. Oxygen .	120	6 eq. Phosphoric Acid . . 216
q. Phosphorus		90	

If strong nitric acid be employed, instead of the dilute acid ordered in c Pharmacopœia, the re-action is so energetic that an explosion and ımbustion are sometimes the consequence. In such cases some nitrate ammonia is usually developed: the ammonia being formed by the ıion of the nitrogen of the acid with the hydrogen of the water.

Properties.—The aqueous solution of phosphoric acid (*acidum phos- ıoricum dilutum*, Ph. L.) prepared as above, is a colourless and odour- ss liquid. It possesses the usual characteristics of an acid; that is, it sour to the taste, reddens litmus, and neutralizes bases. Its sp. gr., ɜcording to Mr. Phillips, is 1·064. By evaporation it acquires the con- stence of treacle (*hydrated phosphoric acid*): and when exposed to a gher temperature, it loses water and becomes *pyrophosphoric acid*. t a dull red heat a further evolution of water takes place, and a compound formed, called *metaphosphoric acid:* this is fusible, and by cooling con- etes into a transparent solid, called *glacial phosphoric acid*.

Characteristics.—If phosphoric acid be saturated with an alkali oda) so as to form a soluble phosphate, it may be distinguished from all other acids by the following characters: it throws down, with the solubl salts of lime, lead, and baryta, white precipitates (phosphates) soluble i nitric acid: with the nitrate of silver it causes a yellow precipita (subsesquiphosphate of silver) soluble in nitric acid and in ammonia hydrosulphuric acid causes no change of colour or precipitate with it: i the soluble phosphate be heated to redness, it is converted into a pyro phosphate, which gives, with the nitrate of silver, a white precipita (pyrophosphate of silver).

PURITY.—Diluted phosphoric acid, prepared according to the Pharma copœia, generally, if not invariably, contains traces of nitric acid. Sul phuric acid may be recognized by chloride of barium, which produce with it a white precipitate insoluble in nitric acid. Hydrochloric acid i detected by nitrate of silver, which causes a white precipitate also inso luble in nitric acid, but soluble in ammonia. The presence of metalli matter may be known by hydrosulphuric acid. Saturated with carbona of soda, no phosphate insoluble in water should be thrown down.

COMPOSITION.—Pure anhydrous phosphoric acid is thus composed:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius.	Dulong.	Davy
Phosphorus	1	16	44·44	44·05	44·8	42
Oxygen	$1\frac{1}{2}$	20	55·56	55·95	55·2	57
Phosphoric Acid	1	36	100·00	100·00	100·0	100

Mr. Phillips says, that 100 grains of the dilute acid of the Pharmacopœi saturate 42 grains of [crystallized] carbonate of soda. If the whole the free acid were phosphoric, the composition of the dilute acid woul be as follows:—

Phosphoric Acid	10·5
Water	89·5
Dilute Phosphoric Acid	100·0

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—This acid is poisono to plants (Gœppert, quoted by Decandolle, *Phys. Végét.*)

(*b.*) *On animals.*—Very few experiments have hitherto been made wit it on animals. Orfila (*Toxicolog. Génér.*) found that a strong solution it acted like sulphuric acid. Thrown into the veins of a dog, it coag lated the blood and killed the animal within ten minutes. Introduce into the stomach, it acted as a powerfully corrosive poison.

(*c.*) *On man.*—Diluted phosphoric acid produces the usual effects the diluted mineral acids, and which I have before noticed (pp. 80, 8 and 96). It is, therefore, denominated tonic and refrigerant, and may b employed wherever the mineral acids are indicated. It is milder, mor assimilable, and, therefore, less likely to disagree with the digesti organs than sulphuric acid, with which, in its action, it is usually com pared. These qualities it perhaps derives from its being, as Burdac (*Arzneimittellehre*, Bd. 3, S. 395, 1809) expresses it, "less heteroge neous to the human organism, since it has a considerable share in th composition of it." The same authority also observes, that besides fu filling the indications of the mineral acids, "it much exalts the excitab lity when the organism is weak."

/arious effects have been ascribed to this acid, which require to be her investigated ere they are admitted. Thus Hecker (*Arzneimittel.* . 2. S. 305) says, it has a specific operation on the nervous system, in ue of which it possesses the power of allaying pain and spasm. itin (*Beitrage zur ausüb. Heilk.* Bd. 2. S. 139) considers it to be owed with a specific power of influencing secreting surfaces and the es, whereby it is enabled to ameliorate various morbid conditions of se parts. Sundelin (*Heilmittell,* Bd. 2, S. 234) regards it as a stimu-t and tonic to the sexual organs. Various effects have been ascribed it by Herder (*Hufeland's Journ.* Bd. 9, St. 3, S. 148).

Jses.—Phosphoric acid has been employed in the same cases in ich sulphuric and other mineral acids have been used, and under the ie regulations. It may be employed for a longer period, without dis-ing the digestive functions, than the other agents of this class.

t has been used in certain cases rather on theoretical than practical unds. Thus its power of dissolving phosphate of lime has led to its ployment in those forms of lithiasis attended with phosphatic de-its in the urine,—in ossification of the arteries and cardiac valves,— in exostosis and other osseous tumours. Lentin used it as a local nt to check caries, from a notion that this disease depends on a defi-icy of phosphoric acid in the part affected. Woulff applied it to mote the formation of bone.

There are several other diseases against which this acid has been ninistered. Thus it has been given in blenorrhœa and leucorrhœa, when secreted fluid was thin and acrid (Sundelin),—in profuse suppura-ı, to diminish the quantity and improve the quality of the secreted tter,—in hysterical affections of young and irritable subjects, Sundelin found it useful,—in impotency of the male (Berends),—in diabetes, in jaundice.

ADMINISTRATION.—Internally the dilute phosphoric acid should be en in doses of from ten minims to half a drachm, properly diluted. xed with eight or ten times its volume of water, it may be employed ı wash in caries.

ANTIDOTES.—(See *Sulphuric Acid.*)

ORDER 9.—SULPHUR AND ITS NON-METALLIC COMPOUNDS.

Sul'phur.—Sul'phur or *Brimstone.*

HISTORY.—Sulphur has been known from the most remote periods of iquity. It is mentioned by Moses (*Genesis,* xix. 24), Homer (*Iliad,* xvi.) and other ancient writers.

NATURAL HISTORY.—It is found in both kingdoms of nature.

a.) *In the inorganized kingdom.—Native* or *virgin sulphur* occurs in two ns: either imbedded in rocks (*common native sulphur*), or produced by limation (*volcanic sulphur*). In Sicily it is found in beds in a blue y formation, which, in the opinion of Dr. Daubeny, is more recent n chalk, but is of the same age with the gypsum beds in the neigh-rhood of Paris. Solfatara (called by the ancients *Forum Vulcani* or *Court of Vulcan*), a kind of half-extinct volcano, in the vicinity of

Fig. 47.

Warm Spring of Solfatara.

Naples, is celebrated for its native su-phur, which is collected in considerable quantities for the purposes of commer (Sir W. Hamilton, *Campi Phlegræi*, 177 Sulphur is also found in the mineral kin-dom in a state of combination. Th sulphurous acid gas rushes out from vo canoes. Sulphuric acid is found nat both in the free and combined states: h drosulphuric acid gas is evolved from t pure sulphurous or hepatic waters, a from the soil in some parts of Italy a other places: lastly, sulphur is found combination with sulphur. Dr. Thomson (*Outlines of Mineralogy*, & vol. i. p. 76) mentions fourteen native sulphurets and seventeen sulphur sal

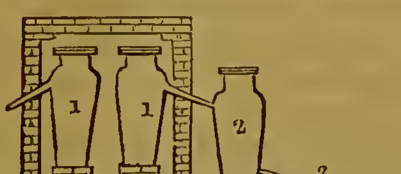
(*b.*) *In the organized kingdom.*—Sulphur is found in *Liliaceæ* (as in ga lic); in *Cruciferæ* (as in mustard); in *Umbelliferæ* (as in asafœtida), a in many other orders of plants. The alkaline and earthy sulphates a frequently met with in vegetables. Sulphur is also a constituent of so animal substances (thus it is found in eggs, urine, &c.); sulphates a found in the urine.

Preparation.—Sulphur is procured in two ways; by the purificati of native sulphur, or by the decomposition of the native sulphurets. T sulphur of British commerce is almost exclusively obtained in the fi way. It is brought principally from Italy and Sicily. During the ye 1830 no less than 236,338 cwts. of rough brimstone were imported fr Italy and the Italian islands (*Parliam. Ret.* 367, ordered to be print April 1832).

(*a.*) *Purification of native sulphur.*—In Sicily, from whence most this substance is procured, the native sulphur is submitted to a rude pr cess of fusion: it is collected in heaps, which are set fire to on the su face: the heat developed by the combusion of one portion fuses anoth (Daubeny, *Description of Volcanoes*, p. 197).

Another mode of purifying native sulphur is to distil it in earthen po These are arranged in two rows in a large oblong furnace (fig. 48, 1,

Fig. 48.



Distillation of native sulphur.

the top of each pot, which serves for the in troduction of the sulphur and for the remov of the residuum, being kept closed during t operation. The upper and lateral part each pot communicates with an inclined tu of about two inches diameter and fourte long. When the fire is lighted in the fu nace, the sulphur fuses and sublimes, a passes through this tube into another pot (placed on the outside of the furnace, and perforated near its bottom allow the melted sulphur to flow into a pail (3) containing water, whe it congeals, and forms the rough or crude sulphur (*sulphur crudum* (Dumas, *Traité de Chimie*, t. 1er. p. 121).

Crude sulphur is purified in this country. The process former adopted was to submit it to fusion in an iron cauldron: the earthy imp rities subside, and the liquid sulphur is ladled out and cast in mould he improved method of purifying it is to submit it to distillation in a rge cast-iron still: the receiver, which is made of iron, is kept cool by mersion in water. The sulphur obtained by this process is called *fined sulphur*. When cast in wooden moulds it constitutes *stick*, *roll*, *cane sulphur* (*sulphur in baculis,—s. rotundum,—s. in rotulis*). If it be quired to obtain the sulphur in a pulverent form, the above process of stillation is modified, thus:—The communication between the still and e iron receiver is shut off, while another is opened with a large chamber sulphur-house, on the walls of which the sulphur condenses in a pulverent m: in this state it constitutes *sublimed sulphur*, or *flowers of sulphur lphur sublimatum*, seu *flores sulphuris*). When washed with water to parate a little adhering acid, it is termed *washed sulphur* (*sulphur lotum*). ie method of purifying sulphur adopted at Marseilles, as described by umas (*op. cit.*), is somewhat different to that now described, and which ave seen practised in the neighbourhood of London.

(*b.*) *Decomposition of metallic sulphurets.*—In some places sulphur is ocured by the decomposition of metallic sulphurets (iron or copper). Anglesea it is (or was) prepared by roasting copper pyrites, by which rt of the sulphur is burned, while the remainder is volatilized and col-ted in chambers connected with the domes of the furnaces by means horizontal flues (*Aikin's Dict. of Chem.* vol. ii.)

The dregs remaining after the purification of sulphur are called *horse imstone* (*sulphur vivum; sulphur caballinum; sulphur griseum*).

Properties.—At common temperatures, pure sulphur is a brittle, stallizable solid, of a yellowish green colour, without smell, and with very weak and almost imperceptible taste. The specific gravity of linary sulphur is about 1·99, but, when free from air-bubbles, 2·087. is a bad conductor of electricity, and, therefore, by friction becomes werfully electric. It is a bad conductor of heat, and when grasped in warm hand crackles, and sometimes breaks to pieces. It is fusible, latilizable, and combustible. In atmospheric air it burns with a pale ie flame, and emits a large quantity of fumes having a peculiar suffo-ing odour (*sulphurous acid.*)

It is called *dimorphous* because it has two distinct primary forms. The mary form of the crystals of native sulphur, or of those deposited from solution in bisulphuret of carbon, is a right rhombic octahedron; ile that of the crystals obtained by the fusion and slow cooling of phur, is an oblique rhombic prism. Now these two forms are incom-tible, and cannot be derived the one from the other: the first belongs the *rectangular* or *rhombic right prismatic system*; the second to the *tangular* or *rhombic oblique prismatic system.*

When sulphur is heated to 340°, it becomes viscid; and by increasing heat the viscidity increases, until the temperature arrives at between 0° and 500°. If while in this state it be suddenly cooled, as by throw-g it into water, it remains quite soft, so that it may be drawn out into eads. The cause of this change, which seems to be merely physical, not understood. The atomic weight of sulphur is about 16.

Characteristics.—Sulphur is easily distinguished from other bodies, its colour, its fusibility, its volatility, and its burning with a blue me, and the evolution of sulphurous acid gas, the odour of which can easily recognized.

Impurities.—Rough sulphur is always mixed with variable quantities of foreign substances. Vauquelin (*Ann. de Chim.* 25, 50) distilled 20 grains, and obtained a residuum of 0·82, composed of silica, carbonate of lime, iron, bituminous charcoal, alumina, and magnesia, but the propor-tion of earthy matters is generally more considerable. Sulphur obtained from pyrites sometimes contains orpiment (*sesquisulphuret of arsenicum*). The purity of any specimen is determinable by dissolving it in oil of turpentine, which does not act on the foreign matters. It should be per-fectly volatile.

Physiological Effects. (*a.*) *On vegetables.*—Sulphur does not appear to be injurious to vegetables, for seeds vegetate and produce thriving plants when sown in sulphur.

(*b.*) *On animals.*—The veterinary school at Lyons found that a pound of sulphur killed horses by producing violent inflammation, recognizable during life by the symptoms, and after death by the morbid appearances. (Christison's *Treatise on Poisons.*)

(*c.*) *On man.*—In *small* and *repeated doses* sulphur acts as a gentle stimulant to the secreting organs, especially to the skin and the mucous membranes, (particularly the bronchial membrane). It promotes the capillary circulation of these parts and increases their secretions. Sunde-lin (*Heilmittell.* Bd. 1, s. 196) says it operates specifically on the mucous membrane of the rectum, and thereby promotes critical hæmorrhoidal secretions. That it becomes absorbed is shewn by the odour of hydro-sulphuric acid which it communicates to the sweat, urine, and milk, and by silver articles becoming blackened in the pockets of patients who are under the influence of it. By the Germans, sulphur is called a resolvent, and is ranked with the mercurial and antimonial preparations. (See Sundelin, *op. cit.*, and Vogt, *Pharmakodyn.*) That is, they regard it as an agent powerfully influencing the nutrition of organs, and, therefore, well adapted for ameliorating various disordered conditions, by what is usually denominated in this country an alterative action. "From mer-curial and antimonial medicines," says Sundelin, "sulphur is distinguished by its great diffusibility, in virtue of which it comes near the exciting tonic agents [*e. g.* the carminative fruit of Umbelliferæ], and also by not possessing the defluxing (*verflüssigenden*) properties of these agents."

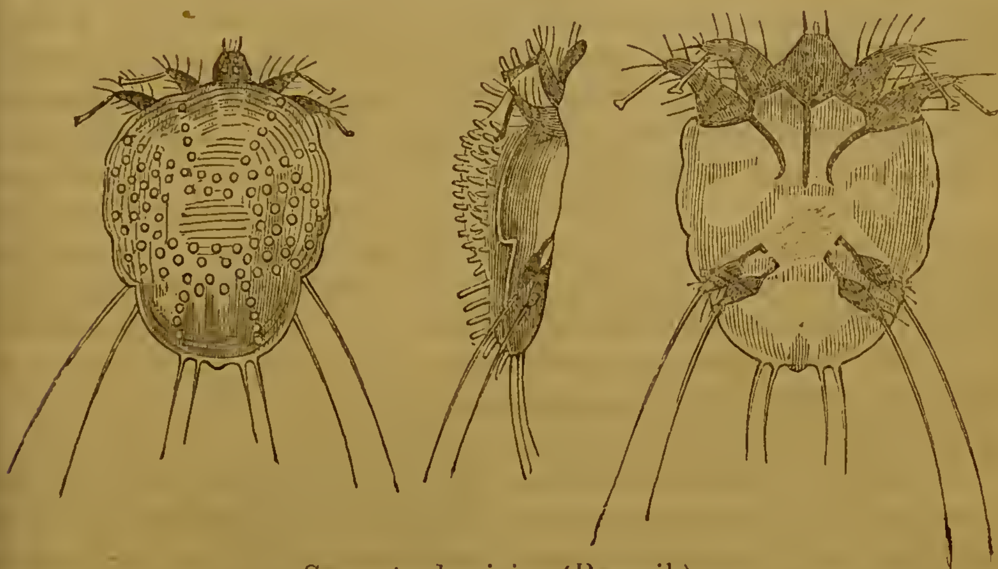
In *larger doses* (as one or two drachms) sulphur acts as a mild pur-gative, without exciting the pulse or occasioning griping. As the stools are usually solid, Dr. Paris (*Pharmacologia*, vol. i. art. *Cathartics*) con-cludes that the action of sulphur on the bowels is confined to the muscular coat.

Uses.—Sulphur is employed both internally and externally.

(*a.*) *Internally.*—It is given for various purposes. *In affections of the rectum*, as stricture, hæmorrhoids, and prolapsus, it is a valuable agent as a mild purgative. I have frequently employed it when patients have great disgust for castor oil. In order to promote its purgative effect, it will be sometimes necessary to conjoin magnesia or the bitartrate of potash. *In chronic cutaneous diseases*, more especially prurigo, impetigo, and scabies, the internal use of sulphur is sometimes attended with great benefit. *In pulmonary affections*, as chronic catarrhs and asthma, it is said to be sometimes useful. *In rheumatic and gouty affections* also. Some have employed it as an *anthelmintic*. Vogt (*op. cit.*) employs it as a *resolvent* in inflammation: as in croup, bronchitis, peripneumonia, and abdominal inflammation. In some constitutional diseases (as scrofula d secondary syphilis) it has been used as an *alterative*. Tortual has ...posed sulphur as a preservative against measles: but, as might be ...pected, experience shews sulphur possesses no prophylactic power of ...s kind, and that the only preservative is isolation.

(*b.*) *Externally.*—Sulphur is a most valuable remedy in various skin ...eases, more especially *scabies;* and notwithstanding many substitutes ...ve been proposed for it in the latter disease, none are so generally ...ccessful. It is supposed by some that the curative powers of sulphur ... this disease depend on its poisonous influence over the so-called ...*h-insect* (*Sarcoptes hominis* of Raspail, the *Acarus Scabiei* of other ...iters): a little parasite belonging to the class *Arachnida* of articulated ...imals, and, therefore, improperly termed an *insect* (Raspail, *Mémoire ... l'Insecte de la Gale*, Paris 1834).

Fig. 49.



Sarcoptes hominis—(Raspail.)

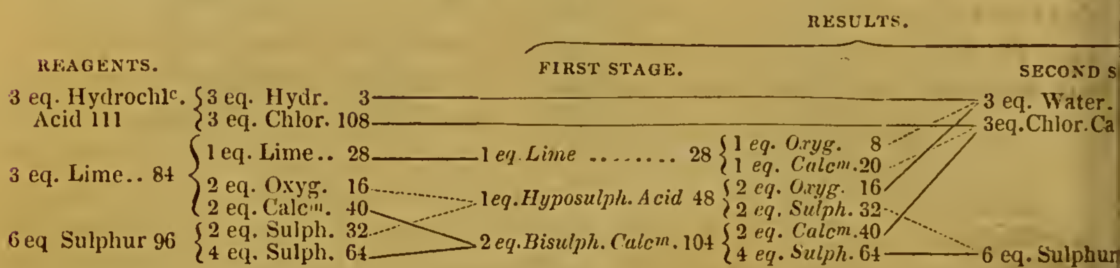
...t before adopting this explanation of the *modus medendi* of sulphur, ...s to be proved that the animal is the *cause* of the disease: for, at ...sent, it has not been satisfactorily shewn whether it be the cause, ...ct, or mere accompaniment of itch. Rayer (*Treatise on Diseases of ... Skin*, by Dr. Willis, p. 344) observes, that it is indubitable that the ...nber of these insects bears no proportion to that of the vesicles. " It ...further," he adds, " rare to discover these insects on the abdomen and ...groins, where the eruption of scabies is nevertheless very common and ...y apparent; moreover, scabies is known to continue when no more ...ri are to be discovered." Besides scabies, sulphur is a most valuable ...plication to various other skin diseases, as porrigo, impetigo, &c.

...ADMINISTRATION.—Internally, sulphur is usually given with syrup, or ...cle, in the form of an electuary, or suspended in milk. The dose of ...is a purgative, is from one to three or four drachms. As an alterative ... sudorific, the dose is about half a drachm. The preparation sold ...er the name of *milk of sulphur*, or *precipitated sulphur*, is a more ...venient and agreeable preparation for internal use, than the ordinary ...limed sulphur.

...Externally sulphur is principally employed in the form of ointment. ...e *unguentum sulphuris* (Ph. L.) consists of three ounces of sulphur to ...f a pound of lard: twenty minims of the oil of bergamot are added to counteract, in part, the unpleasant odour of sulphur. The *unguentu sulphuris compositum* is composed of half a pound of sulphur, two ounc of powdered white hellebore, half a pound of soft soap, a pound and half of lard, and thirty minims of the oil of bergamot: it is a much mo irritant application than the simple ointment of sulphur. Both a employed for the cure of itch, and, sometimes also, in the various for of porrigo which affect the heads of children.

1. *Sulphur Præcipitatum.*—This preparation, commonly term *milk of sulphur* (*lac sulphuris*), was known to Geber. It may be pr pared by boiling one part of sublimed sulphur, two parts of slacked li and eight parts of water. To the filtered solution add sufficient hyd chloric acid to precipitate the sulphur, which is to be washed and drie

The *theory* of the process is the following:—When sulphur and li are boiled in water, six equivalents or 96 parts of sulphur react on th equivalents or 84 parts of lime, and produce two equivalents or 1 parts of bisulphuret of calcium, and one equivalent or 76 parts of t hyposulphite of lime. By the action of three equivalents or 111 parts hydrochloric acid on these two salts, we obtain three equivalents or 1 parts of chloride of calcium, six equivalents or 96 parts of sulphur, a three equivalents or 27 parts of water.



Properties.—Precipitated sulphur agrees in most of its propert with sublimed sulphur, but is much whiter, and is in a finely pulver form. Berzelius says, that when melted, it gives out a little sulphuret hydrogen; and on cooling, resumes the yellow colour it had bef it was boiled with the alkali.

Composition.—It is composed of sulphur with a little water; a hence it is frequently termed *hydrate of sulphur.* According to Buch however, when well dried, it contains hardly a trace of water, and, the fore, any present under ordinary circumstances must be regarded hygroscopic; so that the term hydrate is hardly applicable to it.

Impurities.—If sulphuric be substituted for hydrochloric acid, in manufacture of this substance, sulphate of lime will be formed, and mi with the precipitated sulphur. The impurity may be detected volatilizing the sulphur in a crucible, or by solution in oil of turpentin liquor potassæ.

The Effects, Uses, and Doses, are the same as those of comm sublimed sulphur.

2. *Oleum Sulphuratum.*—Sulphur is soluble in both volatile a fixed oils, and formulæ are still found in some continental works for preparation of pharmaceutical compounds of them. A formula for s phurated oil is still retained in the Edinburgh Pharmacopœia, but been omitted in the last edition of the London Pharmacopœia. T preparation was formerly denominated *balsam of sulphur.*

It is prepared by boiling one part of sublimed sulphur in eight part ive oil. The compound thus procured cannot be regarded as a mere olution of sulphur in oil, since the odour of hydrosulphuric acid, which possesses, proves that the oil has undergone partial decomposition: in ct, the heat to which the oil is raised in order to boil it, causes a emical change.

It is a dark reddish-brown viscid substance, having an extremely unleasant odour. Its local action is that of an acrid: its remote operation at of a stimulant, causing thirst and febrile heat. It has been supposed possess expectorant and diaphoretic properties. It is applied to foul lcers, and is employed internally in chronic pulmonary affections. The ose of it is from 40 to 50 drops: but its unpleasant taste and smell most preclude its use.

Ac'idum Sulphu'ricum.—Sul'phuric Ac'id.

History.—This acid appears to have been known to Geber as early as e seventh century (Thomson's *Syst. of Inorg. Chem.* vol. ii. p. 29.) In e state in which we usually meet with it in English commerce, it is rmed *oil of vitriol*, or the *protohydrate of sulphuric acid.*

Natural History.—It is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—It is found in the waters of some volanic regions, and is evidently produced by the combustion of sulphur.

Fig. 50.

Cascade of Vinagre, in Colombia.

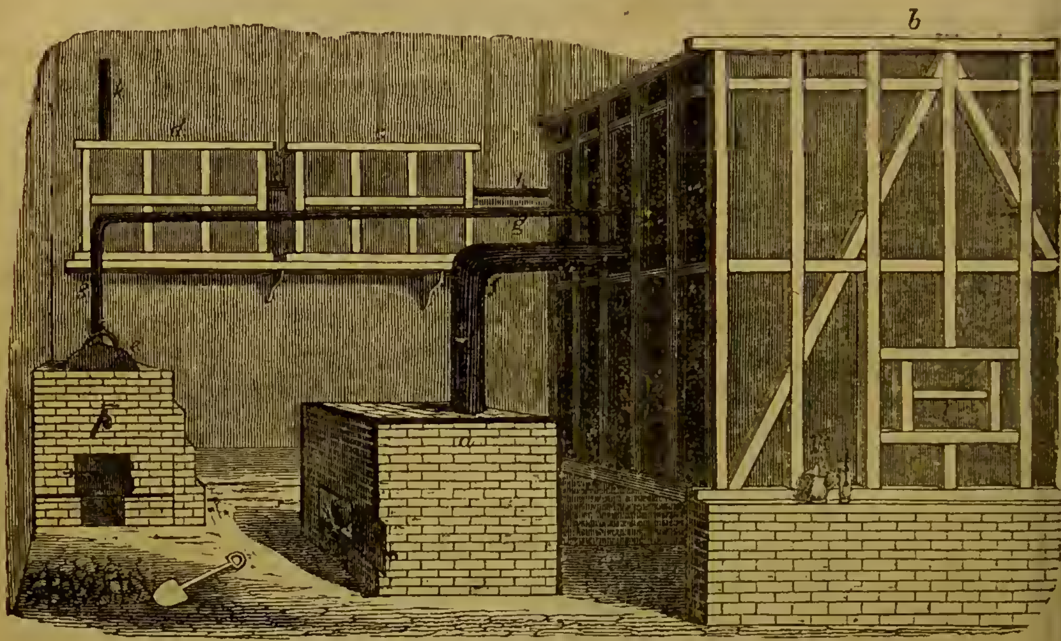
The *Rio Vinagre.* (Vinegar River), which descends from the volcano of Puracé, in Colombia, to Popayan, has received its name from its acid properties, which it derives from being impregnated with sulphuric and hydrochloric acids (A. de Humboldt, *Vues des Cordillères*, p. 220).

Issuing from the crater of Mont Ida, in Java, is a river which also contains this acid. Dr. Thomas Thomson (*Mineralogy*, vol. i. p. 75) states, that in Persia there is an earth so strongly impregnated with it, that it is used by the natives as an acidulous seasoner of food. This author also says (*op. cit.* p. 77), that there are no less than twenty-seven ilphates (consisting of combinations of sulphuric acid with one or more ases) in the mineral kingdom. The most abundant of these is the sulhate of lime.

(*b.*) *In the organized kingdom.*—The sulphates of lime, potash, and oda, have been found in plants (Decandolle, *Phys. Végét.* p. 390). The ulphates of potash and soda are mentioned by Berzelius (*Traité de Chim.* 7^{me}, p. 393) as constituents of human urine.

Preparation.—The most improved method of manufacturing oil of itriol adopted in this country is the following:—Crude sulphur is urned on an iron plate in a furnace, and the gas (sulphurous acid), hereby produced, is conveyed by a pipe or chimney into a leaden chamber, the bottom of which is covered to the extent of four or five inch with water. The furnace door has two apertures to regulate the supp of atmospheric air. After combustion has continued for several hour an iron pot containing a mixture of the nitrate of potash or soda and of vitriol, is introduced into the furnace, and steam is conveyed in the leaden chamber. So that sulphurous acid, nitric or nitrous ac (generated by the action of the oil of vitriol on the nitrate of potash, an volatilized by the heat produced by the combustion of the sulphur), an steam, are conveyed into the leaden chamber, and by their mutual rea tion produce sulphuric acid, which is absorbed by the water at the bo tom of the chamber. To prevent loss in the process, the residual gas are conveyed through two other small leaden chambers (also containin water) before they are allowed to escape into the air.

FIG. 51.



Oil of Vitriol Manufactory.

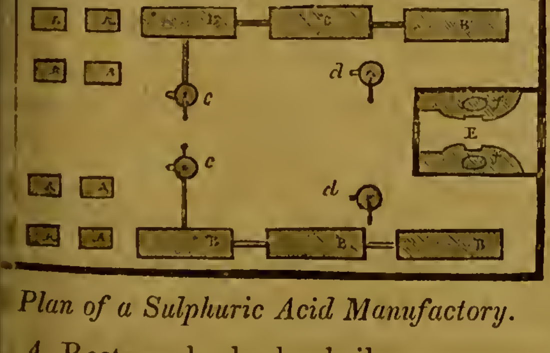
(*a*) Furnace.
(*b*) First leaden chamber.—In the manufactoryfrom which the above sketch was made, this chamber was 70 feet long, 20 feet wide, and 20 feet high; but the size varies considerably in different establishments.
(*c*) Second ditto.
(*d*) Third ditto.
(*e*) Steam boiler.
(*f*) Pipe or chimney of the furnace.
(*g*) Steam pipe.
(*h*) Pipe conveying the residual gas from the first to the second leade chamber.
(*i*) Pipe conveying the gas not absorbe in the first and second chambe into the third.
(*k*) Waste pipe conveying the una sorbed gas into the atmosphere.
(*l*) Man-hole, by which the workm enter the chamber when the proce is not going on.
(*m*) Pipe for withdrawing a small portio of sulphuric acid from the cha ber, in order to ascertain its sp. g by the hydrometer.

When the liquid in the leaden chamber has acquired a specific gravity about 1·5, it is conveyed by leaden pipes into rectangular leaden boiler where it is evaporated and concentrated until its sp. gr. is 1·70; but i some manufactories this part of the process is omitted. The final co centration is effected by boiling it down in *glass* or *platinum retorts*: th latter, notwithstanding their great cost, are now usually adopted. The price, of course, depends on their size. Mr. Parkes (*Chem. Essay* vol. i. p. 535) had one which held thirty gallons, and cost about £360 ut sometimes they are made so large, that they are worth £1000 each. ı this apparatus the acid is deprived of a part of its water and some ılphurous acid, and when it has attained a sufficient degree of concenation, it is drawn off by means of a platinum syphon into carboys.

The theory of the process is the following:—When sulphurous and ıtric acids come in contact, the first loses, the second gains, oxygen, ; which sulphuric and nitrous acids are formed. Dry nitrous acid ıd sulphurous acid gases undergo no change when mixed; but, if a ıttle moisture be admitted, re-action takes place, and a crystalline comound, of sulphuric acid, hyponitrous acid, and water, is formed. This, lling into water, is immediately decomposed: sulphuric acid is disılved, and the hyponitrous acid is resolved into nitrous acid and binoxide 'nitrogen, which escape with effervescence in a gaseous form. The nitrous ·id thus disengaged, with that produced by the union of the binoxide ith oxygen of the atmosphere, becoming mixed with more sulphurous :id and water, gives rise to a fresh portion of the crystalline compound. ıne part of the nitrous acid is converted by the water present into nitric :id and binoxide of nitrogen; while another portion loses the whole of s oxygen, by which a little nitrogen gas is disengaged. In oil of vitriol anufactories the crystalline compound is rarely formed, owing to the ccess of aqueous vapour present. Sometimes, however, it is deposited in e pipe which conveys away the superfluous vapour, as in the instance entioned by Dr. Henry (*Ann. Phil.* vol. xi. new series, p. 368). For rther information respecting the manufacture of sulphuric acid, see the ıpers of Gaultier de Claubry, in *Ann. de Chim.* xlv. 284; and *Dict. de Indust.* tom. i. pp. 108, *et seq*).

The old method of manufacturing oil of vitriol, and, indeed, one still llowed in some places, consists in burning a mixture of eight parts of ılphur and one part of nitrate of potash (or nitrate of soda) on iron or aden plates, either within the leaden chamber or in a furnace on the ıtside of it (Parkes's *Chemical Essays*, vol. i. 465). Fig. 51 is the ground 'an of a manufactory of this kind. Iron pyrites (bisulphuret of iron) is ımetimes substituted for sulphur.

FIG. 52.



Plan of a Sulphuric Acid Manufactory.

A, Rectangular leaden boilers.
B, Leaden chambers.
E, Retort house.
c, Leaden pump for acid.
d, Water pump.

In this process the greater part of the sulphur combines with oxygen of the air to form sulphurous acid: but a portion abstracts oxygen from the nitric acid of the nitrate, and thereby becomes sulphuric acid, which, with the potash of the nitre, forms sulphate of potash. Binoxide of nitrogen is evolved by the decomposed nitric acid, and this, combining with oxygen of the air, becomes nitrous acid. The mutual action of sulphurous and nitrous acid gases has been before explained.

At Goslar, Nordhausen, and other parts of Saxony, sulphuric acid is ıade thus:—Crystallized sulphate of iron is calcined, by which the greater ortion of its water of crystallization is expelled. It is then distilled in arthen vessels, by which *fuming sulphuric acid* is procured, while sesquioxide of iron is left in the retort. If this acid be heated in a glass retort, it yields real or anhydrous sulphuric acid.

PROPERTIES. (*a.*) *Of anhydrous sulphuric acid.*—It is a crystalline solid, having very much the appearance of asbestos. It gives out dense white fumes in the air, like fluoride of boron. It melts at 66° F. and boils at from 104° to 122° F. The sp. gr. of the liquid acid, at 78° F is 1·97.

(*b.*) *Of the Nordhausen or fuming sulphuric acid.*—This is usually a dark brown oily-like liquid, which gives out copious white fumes in the air. Its sp. gr. is about 1·9. It is imported in stone bottles, having a stoneware screw for a stopper.

(*c.*) *Of oil of vitriol or English sulphuric acid.*—When pure it is a colourless, transparent, inodorous, highly acrid, and corrosive liquid. It possesses the usual properties of a powerful mineral acid in a very eminent degree, such as reddening the vegetable blues, saturating bases and displacing other acids. Its affinity for water is most intense, and by virtue of this, it absorbs aqueous vapour from the atmosphere, and chars animal and vegetable substances. When mixed with water there is a mutual condensation with the evolution of heat. Various substances when heated in sulphuric acid decompose it; they abstract oxygen and evolve sulphurous acid. This is the case with charcoal, organic substances, phosphorus, sulphur, and several of the metals, as copper, tin, and mercury.

The sp. gr. of this acid at 60° F. is about 1·84. Genuine *commercial* acid should never surpass 1·8455; when it is denser, we may infer sophistication or negligence in the manufacture (Brande's *Man. of Chemistry*). Acid of sp. gr. 1·845 freezes at — 15° F. and boils at 620° F. In commerce the acid has frequently a sp. gr. of only 1·8433, and its boiling point is 545° F. (Phillips's *Transl.*)

COMPOSITION.—Pure or anhydrous sulphuric acid is thus composed:—

	Eq.	Eq.Wt.	Per Cent.	Berzel.		Vol.	sp. gr.
Sulphur	1	16	40	40·14	Sulphurous acid gas	1	2·222
Oxygen	3	24	60	59·86	Oxygen gas	0·5	0·555
Sulphuric acid	1	40	100	100·00	Sulphuric acid vapour	1?	2·777

The composition of oil of vitriol or English sulphuric acid is as follows:—

	Strongest (sp. gr. 1·845)			Commercial (sp. gr. 1·8433).		
	Eq.	Eq.Wt.	Per Cent.	Eq.	Eq.Wt.	Per Cent.
Real sulphuric acid	1	40	81·6	1	40	78
Water	1	9	18·4	1¼	11·25	22
Oil of vitriol	1	49	100·0	1	51·25	100

According to this statement the strongest oil of vitriol which can be procured (sp. gr. 1·845) is the *protohydrate of sulphuric acid,* while that met with in commerce is a ⅘ *hydrate of sulphuric acid.*

The *German* or *Nordhausen sulphuric acid* consists of—

	Eq.	Eq.Wt.	Per Cent.			Eq.	Eq.Wt.
Real sulphuric acid	2	80	89·88	Or	Real sulphuric acid	1	40
Water	1	9	10·11		Protohydrate sulphuric acid	1	49
Nordhausen sulphuric A^d.	1	89	99·99			1	89

Characteristics.—Free sulphuric acid or the soluble sulphates are ;ognized by a solution of any of the barytic salts, which throws down a avy white precipitate (sulphate of baryta) insoluble in acids or alkalies. this precipitate (or any insoluble sulphate) be ignited with charcoal, it decomposed and converted into a sulphuret, which, on the addition of drochloric acid, evolves hydrosulphuric acid, known by its odour and blackening paper moistened with acetate of lead. If sulphuric acid heated with organic matter, sulphurous acid is given out: this may be own by its odour, and by its occasioning the formation of the blue lide of starch when mixed with iodic acid and starch.

To determine whether sulphuric acid is free or combined with a base, . Christison (*Treatise on Poisons*, 3d ed. p. 142) recommends the uid to be boiled with pure carbonate of lead. If any free sulphuric id be present sulphate of lead will be formed, which, being insoluble dilute nitric acid, may be thereby distinguished from carbonate of lead. it this test is liable to objection: alum and other supersulphates re-act carbonate of lead like free sulphuric acid; and, furthermore, sulphate ammonia is decomposed at a boiling temperature by carbonate of lead.

Impurities.—Pure sulphuric acid should be colourless: the presence organic matter, as cork, communicates a brownish or black colour. e acid of commerce usually contains traces of sulphate of lead: s may be detected either by adding water, when the white sulate is precipitated; or by the addition of hydrosulphuric acid to dilute sulphuric acid, when a very slight change of colour is served, owing to the formation of sulphuret of lead. "What remains er the acid has been distilled to dryness does not exceed the $\frac{1}{400}$ t of its weight."—(*Ph. Lond.*) The residuum here referred to is phate of lead.

Physiological Effects. (*a.*) *On vegetables.*—In the concentrated state phuric acid chars the parts of plants to which it is applied. In the ute form it destroys vegetables in a few hours (Marcet, in Decandolle's *ys. Végét.* p. 1345).

(*b.*) *On animals generally.*—The action of sulphuric acid on animals ierally is precisely the same as that on man. Thrown into the veins ι dog, Orfila found that it coagulated the blood, and caused immediate ith.—(*Toxicol. Génér.*)

(*c.*) *On man.*—Properly diluted and administered *in small but repeated ies*, sulphuric acid acts as a tonic and refrigerant, like the other mineral ds (see pp. 80, 84, 96). Thus it promotes the appetite, diminishes rile heat, allays excessive thirst, checks profuse sweating, and, not frequently, reduces the frequency of the pulse. Sometimes it increases secretion of urine, and likewise renders this fluid unusually acid. ıder its use the milk frequently acquires a griping quality.

The continued use of it, however, generates a slow kind of gastro-eritis: heat and pain are experienced in the throat, stomach, and estines; the digestive functions become disordered; gripings are perienced; sometimes purging, and subsequently fever. Of all the neral acids, save the phosphoric, this may be administered for the gest period without occasioning the above symptoms.

Concentrated sulphuric acid acts as an energetic caustic poison, omptly disorganizing the different tissues with which it is brought in itact. Its chemical action depends principally on its affinity for water, so that it chars or carbonizes the parts with which it is placed in contact. But its power of coagulating albuminous liquids, of combining with albumen to form a sulphate of this organic substance, and of dissolving fibrin, as well as coagulated albumen, contribute to its energetic escharotic action on the animal tissues. The parts to which the acid is applied become, in the first place, white; but by the more prolonged action of the poison, they assume a brownish or blackish appearance, so that we can thereby frequently distinguish poisoning by this from poisoning by nitric acid; since this last-mentioned agent produces a yellow colour when applied to the skin. Black spots are frequently observed in the stomachs of those who have swallowed the acid; and in the surrounding parts the blood is usually coagulated in the blood-vessels. Such are the topical chemical effects of this acid. But besides these there are other phenomena of a local nature which may be denominated vital, since they depend on the re-action of the living parts. I refer now to the acute inflammation set up in the tissues in the immediate neighbourhood of those destroyed.

When strong sulphuric acid has been swallowed the symptoms of poisoning are the following:—Alteration, or even destruction, of the soft parts about the mouth; burning pain in the throat, stomach, and bowels; frequently alteration of the voice, from the swelling and disorganization of the parts about the larynx; breath fœtid, from the decomposed tissues; constant and abundant vomiting of matters, which may be bloody or otherwise, but which effervesce by falling on a marble hearth; bowels variously affected, sometimes constipated, though usually purged, the stools being bloody. The constitutional symptoms are principally those arising from a disordered action of the vascular system: thus the pulse is frequent and irregular, feeble, often imperceptible; extremities cold; great feebleness, or even fainting, with cold sweats. The same constitutional symptoms are observed when the stomach is wounded or ruptured. One remarkable characteristic is, that the mental faculties are unaffected even up to a few minutes before death.

USES.—1. *Medicinal.* (*a.*) *Internal.*—In *febrile diseases* it may be administered, largely diluted, as a refrigerant, to diminish thirst and preternatural heat; though, in most of these cases the vegetable acids are to be preferred. In the latter stage of fever (especially the kinds called typhoid) considerable benefit is sometimes gained by the use of a vegetable bitter (as calumba or cinchona) in combination with the diluted sulphuric acid. To assist the appetite and promote digestion, it is administered to patients recovering from fever. *To check profuse sweating* in pulmonary and other affections, whether phthisical or not, it is sometimes a valuable agent, as I have found on many occasions. No other remedy is so efficacious in relieving colliquative sweatings as this. In *hæmorrhages*, as those from the nose, lungs, stomach, and uterus, it is commonly administered as an astringent, but its efficacy is doubtful. So also in purpura hæmorrhagica it is given with the same intention; but though I have several times employed it, I have not observed any evident benefit derived therefrom.

In those forms of *lithiasis* attended with phosphatic sediments in the urine, the use of the mineral acids is at times beneficial. The sulphuric is preferred to the hydrochloric acid, since it can be continued for a longer period without occasioning gastric disorder. In *skin diseases* specially lichen and chronic nettle-rash, it is sometimes serviceable. In those forms of *dyspepsia* connected with an alkaline condition of the stomach, as in pyrosis, the sulphuric has been found to succeed better than hydrochloric acid (Dr. R. D. Thomson, *British Annals of Med.* March 31, 1837).

(*b.*) *External.*—As a local agent, sulphuric acid is employed as a caustic, irritant, or astringent. As a caustic it has no advantage over many other agents, except that which arises from its liquid form, which, in most cases, renders it disadvantageous. For example, the difficulty of localizing it would be an objection to its employment in the production of an issue, but would be an advantage in applying it to wounds caused by rabid animals or poisonous serpents, since the liquidity of the acid enables it to penetrate into all parts of the bites. In entropium, or that disease in which the eyelid is inverted, or turned inwards upon the eye, this acid has been applied as a caustic. In this complaint the friction of the eyelashes on the globe is most distressing, giving rise not only to inflammation, but even ulceration of the cornea. Now, when the disease is permanent, two modes of curing it have been proposed; either to remove a fold of the integument by the knife, so that, by the subsequent cicatrization, the lid may be drawn outwards—or to destroy a portion of the skin by a caustic, as sulphuric acid. The latter plan of treatment has been practised successfully by several eminent oculists, among whom I may name Mr. Guthrie and Mr. Lawrence. So also in ectropium, in which the lid is everted or turned outward, Mr. Guthrie has applied the concentrated acid to the inner side of the everted lid with advantage.

An ointment containing sulphuric acid has been employed as a rubefacient in paralysis, and in the second stage of inflammation of the joints, when the violence of the disease has subsided; as a styptic to wounds, to suppress hæmorrhage from numerous small vessels; and as a cure for scabies. Lastly, this acid, properly diluted, is employed as an astringent gargle in ulcerations of the mouth and throat; but after using it the mouth should be well rinsed, to prevent the action of the acid on the teeth.

2. *Pharmaceutical.*—Sulphuric acid is used in the manufacture of various preparations contained in the Pharmacopœia, as some of the acids, ether, the vegetable alkalies, several salts, &c.

Administration.—For internal use we generally make use of the *diluted sulphuric acid* of the Pharmacopœia, or the *elixir of vitriol.*

1. *Acidum Sulphuricum Dilutum.*—This compound is prepared by adding, gradually, a fluidounce and a half of sulphuric acid to fourteen fluidounces and a half of distilled water. Condensation ensues, and heat is evolved. Mr. Phillips states, that a fluidrachm of it contains about ten grains of the strong acid, and will saturate 28 grains of crystallized carbonate of soda. The dose of it is from ten to thirty minims diluted with two or three table spoonfuls of some mild liquid. The most convenient preparation of it is the *compound infusion of roses.* It is sometimes given with conserve of roses.

2. *Acidum Sulphuricum Aromaticum.*—This preparation, which is contained in the Edinburgh, Dublin, and United States Pharmacopœias, is known in the shops as *elixir of vitriol.* The Dublin formula for it is the following:—"Take of rectified spirit two pints, sulphuric

acid (by weight) six ounces. Add the acid to the spirit gradually: digest the mixture in a closed vessel, with an inferior heat, for three days; then add of cinnamon bark (bruised) an ounce and a half, ginger root (bruised) an ounce. Digest the mixture again for six days; and, lastly, filter through paper placed in a glass funnel." An analogous preparation, but containing a much greater number of aromatics, is contained in the French Codex, under the name of *tinctura aromatica sulfurica*. It has been usually supposed that some sulphuric ether was generated in this preparation, but the late Dr. Duncan observes—" I have ascertained that there is no reaction upon the sulphuric acid, at least that not a particle of gas is evolved by the mixture of alcohol and sulphuric acid in the proportions indicated." It is not improbable that some sulphovinic acid may be formed: the evolution of gas is not essential to the formation either of this compound or of ether. Elixir of vitriol is used in the same cases and doses as the dilute sulphuric acid.

3. *Unguentum Acidi Sulphurici* (*Ph. Dub.*)—This compound is prepared by mixing, in a glass or earthenware mortar, a drachm of sulphuric acid with an ounce of lard. The mixture is of a slight buff colour. It is a powerful stimulant.

Antidotes.—In cases of poisoning by sulphuric acid, the antidotes are, chalk, whiting, or magnesia suspended in water. In the absence of these, soap-suds, infusion of wood-ashes, weak solutions of the alkaline carbonates, white of eggs, gelatine, milk, oil, or in fact any mild diluent should be instantly administered. The subsequent treatment is that for gastro-enteritis. External parts burnt with oil of vitriol should be washed with a solution of soap or simple water.

Ac'idum Sulphuro'sum.—Sul'phurous Ac'id.

History.—Homer (*Iliad*, xvi.) mentions sulphur fumigations: Stahl, Scheele, and Priestley, were the first to submit this acid to an accurate examination. It has been termed *volatile sulphurous acid*, and, from the old mode of procuring it, *spirit of sulphur by the bell* (*spiritus sulphuris per campanam*).

Natural History.—It escapes from the earth, in a gaseous form, in the neighbourhood of volcanoes.

Preparation.—For chemical purposes it is prepared by mixing two parts of mercury with three parts of strong sulphuric acid, applying heat, and collecting over mercury. The results are, the bipersulphate of mercury and sulphurous acid.

For medical purposes, however, it is rarely, if ever, necessary to procure it in this way. By the combustion of sulphur in atmospheric air this gas is readily obtained; and when we are about to employ it, either as a disinfectant or vapour bath, this method is always followed.

Properties.—At ordinary temperatures and pressures it is a colourless and transparent gas, and has a remarkable and well-known odour. It is neither combustible nor a supporter of combustion. It reddens litmus and bleaches some colouring matters, especially infusion of roses, but the colour is restored by sulphuric acid. It is irrespirable, and has a sp. gr. of 2·2. It readily dissolves in water: recently boiled water takes up 33 times its volume of this gas. By cold and pressure, sulphurous acid gas is readily condensed into a limpid liquid.

Characteristics.—This acid is readily known by its peculiar odour (that of burning sulphur). If the puce-coloured or binoxide of lead be added to it, the white protosulphate of lead is formed. An aqueous solution of this acid, mixed with iodic acid, deoxidizes the latter, and sets iodine free, which may be recognized by its producing a blue colour with starch. The sulphates evolve sulphurous acid by the action of strong sulphuric acid.

CONSTITUENTS.			RESULTING COMPOUND.
2 eq. Oxygen = 16	and 1 eq. Sulphur = 16.	=	1 eq. Sulphurous Acid = 32.

Composition.—If 16 parts (by weight) of sulphur be burned in one volume or 16 parts (by weight) of oxygen gas, we obtain one volume or 32 parts (by weight) of sulphurous acid gas.

The composition of this substance may, therefore, be thus expressed:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Sulphur	1	16	50	49·968
Oxygen	2	16	50	50·032
Sulphurous Acid	1	32	100	100·000

Physiological Effects. (*a.*) *On vegetables.*—It is a most powerful poison to plants even in very minute quantities (Christison, *On Poisons*, 4th ed. p. 750).

(*b.*) *On animals generally.*—The effects on animals have not been examined: but they are probably those of an irritant and an asphyxiating agent.

(*c.*) *On man.*—Applied to the skin this acid gas causes heat, pain, and itching. If an attempt be made to inhale it in the pure state, it excites spasm of the glottis. Diluted with air it may be taken into the lungs, and there acts as a local irritant, causing cough, heat, and pain.

Uses.—It has been used as a disinfectant, as a remedy for the cure of itch, and as a nasal stimulant in syncope.

As a *disinfectant* it is mentioned by Homer. The mode of using it for this purpose is very simple. A pot containing burning sulphur is introduced into the room or place to be fumigated, and the doors and windows carefully closed.

As a remedy for itch, baths of sulphurous acid gas are mentioned by Glauber in 1659. They are commonly termed *sulphur baths*, and may be had at most of the bathing establishments of the principal towns of this country. At the Hôpital St. Louis, in Paris, a very complete apparatus for the application of this remedy in diseases of the skin has been erected by D'Arcet. It is a kind of box, inclosing the whole body, with the exception of the head. The sulphur is placed on a heated plate in the lower part of the box. From ten to twenty baths, or even more, are requisite for the cure of itch. "Sulphureous fumigations," says Rayer (*Treatise on Diseases of the Skin*, by Dr. Willis, p. 347), "which are employed in some hospitals, are not attended with expense, leave no unpleasant smell, and do not soil the linen; but the long continuance of the treatment necessary to relieve the disease, more than counterbalances these generally insignificant recommendations." There are various other diseases of the skin in which baths of sulphurous acid have been found more or less successful, such as chronic eczema, lepra, psoriasis, impetigo, and pityriasis. (For further information on this subject, consult

Mémoire et Rapports sur les Fumigations Sulphureuses, par J. C. Galés, 1816: *Observations on Sulphurous Fumigations*, by W. Wallace: *An Essay on Diseases of the Skin*, by Sir A. Clarke).

As a stimulant in syncope or asphyxia this gas has been recommended by Nysten. It is readily applied by holding a burning sulphur match under the nose.

ANTIDOTES.—When sulphurous acid gas has been inhaled, the patient should be made to respire the vapour of ammonia. A few drops of the solution of this substance should be swallowed.

Io'didum Sul'phuris.—I'odide of Sul'phur.

HISTORY.—This compound was first described by Gay-Lussac (*Ann. de Chimie*, xcl.)

PREPARATION.—It is prepared by heating gently four parts of sulphur with one part of iodine. Part of the iodine volatilizes, and the remainder unites with the sulphur.

PROPERTIES.—It is a black crystallizable compound, having the colour and radiated appearance of sesquisulphuret of antimony. It has the odour of iodine, and stains the cuticle, paper, &c. like this substance. Its elements are easily separated by heat.

COMPOSITION.—Its composition has not been determined. It is probably the following:—

	Eq.	Eq.Wt.	Per Cent.
Iodine	1	126	88·732
Sulphur	1	16	11·267
Iodide of sulphur	1	142	99·999

CHARACTERISTICS.—Boiled in water the iodine volatilizes with the steam, and the sulphur is deposited nearly in a state of purity.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—Dr. Cogswell (*Experim. Essay on Iodine and its Compounds*) gave three drachms to a bitch: the animal lost her appetite, was dull, and on the fourth day could not support herself properly upon her legs. On the twelfth day she was well.

(*b.*) *On man.*—It has not been exhibited internally. It probably operates like iodine. Its local operation is that of a powerful stimulant and resolvent.

USES.—Iodide of sulphur has been principally employed, in the form of ointment, in various skin diseases. In *lupus* it has been found most efficacious by Biett (Cazenove and Schedel, *Abrégé pratiq. sur les Malad. de la Peau*), as well as by Rayer (*Treatise on Diseases of the Skin*, translated by Dr. Willis.) The last mentioned writer places it in the foremost rank of local remedies for this disease. In *acne indurata* and *rosacea* it has proved highly useful in the hands of Biett (*op. cit.*), Rayer (*op. cit.* p. 476), and Dr. Copland (*Dict. of Pract. Med.* art. *Acne*, p. 31). In *lepra* Rayer has observed good effects from its use; but in one case in which he tried it, it caused so much irritation that its use was obliged to be discontinued. In *herpes pustulosus labialis* it has been employed with great success by Dr. Volmar (Dierbach, *die neuesten Entdeck in d. Mat. Med.* 2te. Ausg. 1er. B. S. 449). In *tinea capitis* it has also been recommended (*Med. Gaz.* vol. xx. p. 879.)

Dr. Copland (*op. cit.* art. *Asthma*, p. 149) has employed the inhalati the vapour of this substance in humoral asthma with temporary vantage.

Administration.—The *ointment of iodide of sulphur* is composed of lide of sulphur and lard. The proportions vary according to circum-nces: usually from 10 to 30 grains of the iodide to an ounce of lard. agendie's formulæ are 1 part of iodide to 18 or 19 of lard.

Ammo'niæ Hydrosul'phas.—Hydrosul'phate of Ammo'nia.

History and Synonymes.—This compound is said to have been first pared in the seventeenth century by Boyle or Beguin: hence the ms *Boyle's fuming liquor* and *Beguin's sulphuretted spirit*, applied to variety of it. The ordinary designation of it is *hydrosulphuret of monia*, or *hepatized ammonia.* Berzelius calls it *sulphuret of ammo-m.*

Natural History.—It is evolved from decomposing animal matter, in privies, with hydrosulphuric acid and nitrogen.

Preparation.—It is prepared, according to the Edinburgh, Dublin, l United States Pharmacopœias, by passing hydrosulphuric acid gas lphuretted hydrogen) into water of ammonia to perfect saturation.

Properties.—As thus prepared the solution of hydrosulphuret of monia is a liquid, having a greenish yellow colour, a very fœtid odour, l an acrid disagreeable taste. The mineral acids decompose it, evolve lrosulphuric acid, and precipitate sulphur. A considerable number of tallic solutions have precipitates produced in them by the addition of lrosulphate of ammonia. Thus with the salts of lead, bismuth, er, and copper, the precipitates are blackish; with those of antimony, ; with those of cadmium and tin (persalts), and with the arsenites the addition of an acid), yellow; lastly, with the salts of zinc, ite. In all these cases the precipitates are sulphurets of the respective tals.

By exposure to the air it attracts oxygen and deposits sulphur: its ion on metallic solutions is then considerably modified. For example, wo or three fluidrachms be exposed to the air, in a wine-glass, for a or two, the solution will then be found to have the property of ısing a red precipitate with the salts of lead, yellow with tartar etic, and white with arsenious acid.

Characteristics.—Its odour will readily distinguish it. As a sul-uret or hydrosulphuret it is known by its action on the metallic solu-ıs already noticed. Caustic potash causes the evolution of am-nia.

Composition.—It is composed of hydrosulphuric acid and ammonia, the following proportions:—

	Eq.	Eq.Wt.	Per Cent.
rosulphuric Acid	1	17	50·00
nonia	1	17	50·00
rosulphate of Ammonia	1	34	100·00

	Vol.
Hydrosulphuric Acid gas	1
Ammoniacal gas	2

The fuming liquor (*liquor fumans Boyli*) obtained by distilling four ts of slacked lime, two of hydrochlorate of ammonia, and one of sulphur, contains, according to Gay-Lussac (*Cours de Chimie*, Leçon 20) hydrosulphate of ammonia, with excess of sulphur; but in what state combination has not been determined.

Physiological Effects. (*a.*) *On vegetables.*—The vapour of th compound is injurious to vegetation.

(*b.*) *On animals.*—I am unacquainted with any experiments ma with it on animals; but analogy leads us to believe that its action is th of a powerful poison, analogous to other alkaline sulphurets, and hydrosulphuric acid.

(*c.*) *On man.*—In *small but repeated doses* it acts powerfully on t secreting organs, the action of which it promotes, but at the same ti modifies. Its principal influence is directed to the skin (on which acts as a sudorific), and to the pulmonary mucous membrane. In *some what larger doses* it occasions nausea and giddiness. In *still larg doses* it causes nausea, vomiting, diminished frequency of pulse, gid ness, extreme languor, drowsiness, and sleep. *Excessive doses* would, course, produce death, though I am unacquainted with any case of th kind.

In the gaseous state it acts, when inhaled, as a powerfully asphyxiati agent. Instances of its deleterious operation, in conjunction wi hydrosulphuric acid, have occurred in France, in workmen exposed the vapours from the pits of the necessaries. The symptoms are, sudd weakness, insensibility, and death; or where the vapours are less co centrated, there are sometimes delirium and convulsions.

Uses.—In this country it has been principally employed in *diabet mellitus*, with the view of reducing the morbid appetite and increas action of the stomach, as well of the system in general (*Rollo*, on *Diabet Mellitus*, p. 28, ed. 2nd). Combined with alcohol, F. Hoffmann adn nistered it under the name of *liquor anti-podagricus*, as a powerful sud rific in gout. It has also been used in old pulmonary catarrhs; and Brauw and Gruithuisen in vesical catarrh (Vogt, *Pharmakodyn.*)

Administration.—It is given in doses of from four to six drops, some proper vehicle (distilled water is the best). On account of its spec decomposition, it should be dropped from the bottle at the time using it.

Antidotes.—The antidotes for hydrosulphate of ammonia, as well for hydrosulphuric acid, are chlorine and the chlorides of lime and so In cases of asphyxia by the inhalation of these substances, the tre ment consists in placing the patient on his back in the open air, wi his head somewhat elevated; applying cold affusion to the face a breast; producing artificial respiration of air, through which chlorine diffused, by pressing down the ribs and forcing up the diaphragm, a then suddenly removing the pressure; using strong friction in the cou of the vertebral column, chest, soles of the feet, &c., and injecti into the stomach, stimulants; as, a weak solution of chlorine (or chloride of lime) or brandy, &c. In the event of hydrosulphuret ammonia being by accident swallowed in poisonous doses, dilute so tions of chlorine, or of the chlorides of lime or soda, should be imm diately given, and the contents of the stomach removed by the stoma pump as soon as possible.

Order 10. Compounds of Potassium.

Potas'sa.—Pot'ash.

History.—Caustic alkaline solutions were probably known to the reeks and Romans. We learn from Pliny (*Hist. Nat.* lib. xxviii. cap. li.), iat soap was made in his time from tallow and wood-ashes; and we may ierefore conclude that some method was known of depriving the alkaline arbonate of its carbonic acid. Geber (*Invention of Verity*, ch. iv.) escribes the method of making caustic alkali. Black, however, in the ear 1756, first distinguished, chemically, the caustic alkalies from their arbonates. Potash was formerly called *kali*, or the *vegetable alkali.*

Natural History.—Potash in combination with acids is found in oth kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Potash is found, in the mineral ingdom, in combination with sulphuric, nitric, silicic, and perhaps caronic acids. As an ingredient of rocks, it is more abundant than soda.

(*b.*) *In the organized kingdom.*—In organized beings potash is met with ı combination with phosphoric, sulphuric, nitric, carbonic, and various rganic acids. It occurs more abundantly in vegetables than in animals.

Preparation. (*a.*) *Of aquæ potassæ.*—To prepare a solution of caustic otash, add fresh burned lime to a solution of the carbonate of potash. ı the London Pharmacopœia the proportions employed in the manufacre of *liquor potassæ* are fifteen ounces of the carbonate, eight ounces of me, and a gallon of boiling distilled water. The lime, when slacked ıd mixed with half a gallon of water, is to be added to the carbonate of otash dissolved in the remaining half gallon of water. The mixture is be kept in a close vessel, and frequently shaken. When cold, the pernatant clear liquor is to be poured off: this is the *liquor potassæ* of e Pharmacopœia.

In this process the lime abstracts carbonic acid from the carbonate of otash, and the potash thus set free dissolves in the water.

REAGENTS.			RESULTS.	
ater			Liquor Potassæ (Ph. L.)	
q. Carb. Potash	70	1 eq. Potash . . . 48		
		1 eq. Carbon^c. A^d. 22		
q. Lime	28		1 eq. Carbon^e. Lime . .	50

is best to avoid filtering the liquid, but to decant it. If, however, a ter be employed, it should be of cotton or linen, and the atmospheric r should be, as much as possible, excluded; as the solution readily composes paper and woollen cloth, and abstracts carbonic acid from e air.

(*b.*) *Of hydrate of potash.*—If liquor potassæ be evaporated to dryness a clean iron vessel, and the residual mass fused and poured into moulds, obtain the *hydrate of potash* of the Pharmacopœia, and which was merly called *potassa fusa, kali purum, lapis infernalis sive septicus*, or *uterium potentiale.*

(*c.*) *Of potash with lime.*—To render the potash less deliquescent it is bed with an equal weight of lime, by which is procured the mixture med *potassa cum calce.*

Properties. (*a.*) *Of hydrate of potash.*—The solid sold in the shops as *potassa fusa*, or hydrate of potash, is usually more or less coloured (brownish, greyish, or bluish), and not completely soluble in water and alcohol, in consequence of the presence of foreign matters; for pure hydrate of potash is white, and dissolves in both water and alcohol. During the solution in water heat is evolved. Its solubility in alcohol enables us to separate it from the carbonate and bicarbonate of potash, both of which are insoluble in this liquid. It has a strong affinity for water, which it rapidly attracts from the atmosphere, and in consequence becomes liquid. At a low red heat it fuses, and at a higher temperature is volatilized. It is odourless, but has a caustic, urinous taste. It rapidly decomposes organic substances. It possesses the properties of an alkali in an eminent degree.

(*b.*) *Of liquor potassæ.*—This liquid is limpid, colourless, transparent and inodorous. Its taste is acrid: when prepared according to the London Pharmacopœia, its sp. gr. is 1·063. It has a soapy feel when rubbed between the fingers. It strongly attracts carbonic acid from the atmosphere, and, therefore, should be kept in close vessels. It corrodes flint glass, and is, on that account, directed to be kept in green glass bottles.

Characteristics.—Potash free or combined is recognized by the following characters:—The hydrosulphurets, ferrocyanides, and carbonates produce no precipitate with it. Tartaric (in excess), perchloric, and carbazotic acids, occasion precipitates of the bitartrate, perchlorate, and carbazotate of potash respectively. Chloride of platinum throws down a yellow precipitate with potash or its salts. Lastly, the potash salts communicate a violet tinge to the flame of alcohol.

The causticity of potash is shewn by its communicating a green colour to the infusion of red cabbage or syrup of violets; by its reddening turmeric, and restoring the blue colour of litmus reddened by an acid; by its not whitening lime water, or effervescing on the addition of an acid; by its soapy feel; by its solubility in alcohol; and by its dissolving alumina.

Impurities.—Liquor potassæ usually contains a small quantity of carbonate of potash. This may be recognized either by lime-water, which renders the liquid turbid, or by a dilute mineral acid, which causes effervescence. When pure liquor potassæ has been saturated with nitric acid it gives no precipitate on the addition of carbonate of soda, chloride of barium, or nitrate silver: if the first cause a precipitate it would indicate some earthy or metallic impregnation; if there be a precipitate with the second, which is insoluble in nitric acid, we infer the presence of a sulphate; if the third cause a precipitate, soluble in ammonia, but insoluble in nitric acid, a chloride is present.

Potassa fusa of the shops contains various impurities, such as sesquioxide of iron, carbonate of potash, and silica. These, however, do not materially affect its medicinal value, and will not, therefore, require further notice.

Composition.—Pure *anhydrous potash* has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Potassium	1	40	83·34	83·05
Oxygen	1	8	16·66	16·95
Potash	1	48	100·00	100·00

The *hydrate of potash* is thus composed:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius.
Potash	1	48	84·2	84
Water	1	9	15·8	16
Hydrate of Potash	1	57	100·0	100

e strength of the *liquor potassæ* may be ascertained by taking its gr. The following extract from Mr. Dalton's table (*New System of em. Philos.* part ii. p. 476) illustrates this:—

Atoms.		Potash per cent. by weight.	Spec. Gravity.	Boiling Point.
Potash.	Water.			
1	8	39·6	1·47	265 deg.
1	10	34·4	1·42	246
		26·3	1·33	229
		19·5	1·23	220
		13·	1·15	215
		9·5	1·11	214
		4·7	1·06	213

nce it appears that the liquor potassæ of the London Pharmacopœia, se sp. gr. is 1·063, consists of—

Potash	4·7
Water	95·3
Liquor Potassæ (Ph. L.)	100·0

'HYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—Caustic potash promptly roys the parts of living plants with which it is placed in contact, and 1 in the dilute state kills haricots (*Phaseolus vulgaris*) in a few hours. rcet, in Decandolle, *Phys. Végét.*)

.) *On animals generally.*—It acts on animals generally as an ener-c caustic poison. It is, says Orfila (*Toxicol. Génér.*), of all poisons that ch most frequently perforates the stomach. He found that injected into jugular vein of a dog it coagulated the blood, and caused speedy h. It is, however, remarkable that when mixed with the blood of the body, it not only does not coagulate it, but actually prevents pontaneous coagulation. Magendie has observed that by the exhi-n of alkalies to dogs, the urine acquires alkaline properties.

.) *On man.*—The local action of caustic potash is exceedingly ener-c. This is especially the case with solid potash. The alkali, of se, neutralizes any free acid in the part to which it is applied, and mposes whatever ammoniacal salts may be present, causing the ution of ammoniacal gas. Its chemical action on the organized es is most powerful, as may be well illustrated by experiments. Thus, little potash solution be rubbed between the fingers, the epidermis mes corroded and dissolved, and a soapy feel is thereby produced. piece of fibrin (muscle, for example) be digested in a solution of sh, an unpleasant ammoniacal odour is evolved, a little alkaline sulphuret is formed, and the fibrin is dissolved: the compound of fibri and potash thus formed may be termed *fibrate of potash.* The additio of an acid precipitates the fibrin somewhat altered in its properties, an combined with some of the precipitant. The same kind of effect is pro duced by the action of potash on albumen: thus, this substance unit with the alkalies to form soluble compounds, which may be term *albuminates.* Gelatine is also readily dissolved by alkalies, with th deposition of any phosphate of lime which it may contain. These ph nomena are to a certain extent comparable to those of saponification. appears, therefore, that the caustic alkalies form soluble compounds wi substances which enter largely into the composition of the organiz tissues. Hence the observation of Orfila, that alkalies are of all corrosi poisons those which most frequently perforate the stomach, is readi accounted for; for the intestinal mucus readily dissolves in alkali whereas it is coagulated by acids; so that the former are much mo quickly brought in contact with the living tissues. These resist, for certain time, the chemical influence of the caustics, but the affiniti being powerful, the vital properties soon cease to offer opposition—t part dies, and then the alkalies commence their chemical action on t tissues, which they speedily dissolve. Hence, if a large quantity potash be swallowed, the most violent symptoms are observed, thou they are of the same general kind as when the mineral acids have be taken.

When liquor potassæ is taken in small doses, and properly diluted, saturates the free acids contained in the stomach, and which the rece investigations of physiologists have shown to be so essential to the dige tive functions. Hence the continued use of alkalies must be always inj rious, since they disorder the assimilative process by altering the chem cal properties of the healthy ventricular secretion.

If the quantity of potash swallowed be more than sufficient to ne tralize the free hydrochloric acid, but insufficient to have any chemi action on the living tissues, it acts as a slight irritant, increases the sec tions of the alimentary canal, becomes absorbed, and alters the qualit of the secreted fluids, more particularly those of the urine. Moreov the modification thus produced in the quality of the renal secretion accompanied by an increase in the quantity, so that the alkalies ra among our most powerful diuretics—an effect which may be in p owing to the local stimulus which they communicate to the secreti vessels in their passage through them.

By continued use the alkalies give rise to increased activity of different secreting organs, and of the absorbing vessels and glan effects which are analogous to those caused by mercury. After some ti the digestive function becomes disordered, the appetite fails, the bl becomes thinner and darker coloured, and loses its power of spontane coagulation when drawn from the body; the whole system, and more p ticularly the digestive organs, become enfeebled; and a state precis similar to that of scurvy is brought on. It is said if the alkalies temporarily suspended the blood speedily re-acquires its coagulabil but loses it again when we resume their employment. These phenom deserve especial notice, as being precisely analogous to those of scurvy a disease which has been usually supposed to be brought on by the

' salt and salted provisions, and to be prevented or cured by vegetable ·ids (especially the citric) and fresh provisions. It appears, therefore, the highest degree probable, that scurvy, and the effects caused by the ng-continued employment of the alkalies, are analogous conditions of stem.

Uses.—Caustic potash is employed for various purposes in medicine, e principal of which are the following:—

(*a.*) *As an escharotic.*—Potassa fusa is sometimes used as a caustic, ough its employment is not free from objection; for its great deliescence occasions some difficulty in localizing its action. It may be nployed for the production of an issue, but we must proceed thus:—pply to the part one or two layers of adhesive plaster, in the middle of hich is an aperture of the exact size of the intended issue. Then oisten the *potassa fusa*, or the *potassa cum calce*, and rub on the part ntil discoloration is observed. Wash, and apply a linseed-meal poul-·e; and when the eschar is detached, insert the pea. In bites by isonous animals—as venomous serpents, mad dogs, &c., this escharotic ay be used with advantage. Mr. Whateley recommends the *potassa sa* as the agent for arming caustic bougies to be applied in strictures of e urethra; but the practice appears so dangerous (particularly on count of the deliquescence and violent action of the caustic), that I lieve it is now rarely, if ever, resorted to. There are many other cases which this substance is employed as a caustic; for example, to destroy rts and fungoid growths of various kinds, and to open abscesses, more pecially those in the groin; but for the latter purpose the lancet is be preferred.

(*b.*) As an *antacid* we resort to the *liquor potassæ* in various affections the digestive organs, which are attended with an inordinate secretion acid, known by the acid eructations, cardialgia, and other dyspeptic mptoms. It must, however, be evident, that the neutralization of the id is merely palliative. But the continued employment of alkalies fre-uently diminishes, temporarily, the tendency to acid secretion. Com-only it is found that the cases calling for the employment of alka-s are those benefited by tonics, and hence I believe the alkali is, in ost cases, best given in some mild or tonic infusion; such, for example, the infusion of calumba, or of gentian, or of quassia; the sulphate of inia oftentimes disagreeing with the stomach in these cases; besides hich, it would be decomposed by the alkali. The beneficial effects of kalies are said to be particularly observed in those forms of dyspepsia hich result from the inordinate use of spirituous liquors.

Of course the liquor potassæ would equally neutralize acid which may ve been accidentally or purposely swallowed; but it is rarely given for is purpose, on account of its irritant qualities, and because many other ents (as chalk, whiting, magnesia, and soap) are equally efficacious as tacids, while they are free from the objections which exist in these ses to the use of the caustic alkalies.

(*c.*) *To modify the quality of the urine*, liquor potassæ is a most luable agent. I have already stated that, under the employment of kalies, not only may the natural acidity of the urine be destroyed, but en an alkaline property communicated to it; so that, whenever the cretion of lithic acid, or of the lithates, is inordinate, the alkalies esent themselves to our notice as chemical agents for counteracting this condition. It has been supposed by some that the efficacy of th caustic alkalies in preventing the deposition of lithic acid grave consists in their holding it in solution — an explanation apparentl inconsistent with the fact that the carbonated alkalies and magnesi are equally efficacious, though they are incapable of dissolving i We are, therefore, led to the conclusion, that the alkalies, by the chemical influence, actually prevent the formation of this acid, or neu tralize the free acid in the urine, which is the immediate cause of th precipitation of the lithic acid; whether by an action on the digesti organs or otherwise we know not. In resorting to these agents in urinar deposits, we should be careful to avoid employing them when there any tendency to the deposition of the phosphates. The phosphate lime, which naturally exists in the urine, is held in solution in this liqui by some acid, as seems proved by the fact, that the addition of a causti alkali precipitates it. Berzelius thinks that the acid is the lactic; M Brett (*Medical Gazette*, vol. xvii. p. 847), that it is the carbonic aci The nature of the acid is, however, of secondary importance. It is gen rally admitted that the solvent is an acid, and that by the use of alkali it may be obviated or neutralized, and the urine rendered alkaline. No what will be the necessary consequence of this? Evidently the deposi tion of phosphate of lime; so that the use of alkalies may actually cau the appearance of *white sand* in the urine; and in patients predispos to its formation, its quantity may be increased. These facts, then, hav an important bearing on practice. "I have known," says Mr. Brand (*Quart. Journ. of Science*, vol. ii. p. 198), "soda-water exhibited in case of stone in the bladder, *produce* abundance of white sand, which th ignorance of the patient and his medical attendant led them to refer the solvent power of the medicine upon the stone, which they though was gradually giving way and being voided; whereas great mischi was doing, by giving the urine more than its usual tendency to depos the phosphates, and, consequently, to augment the size of the calculus In the treatment of the lithic acid diathesis, it is to be remembered th the use of alkalies is, to a certain extent, a palliative mode of treatmen and that, to be successful, it should be conjoined with other means of cur

(*d.*) The alkalies have been lately celebrated for producing benefici effects in those *inflammations* which have a disposition to terminate i exudation and adhesion; that is to say, those that frequently give rise t the formation of false membranes or of adhesions; such, for example, croup, pleurisy, and peritonitis. If experience should subsequently con firm the assertions already made respecting their efficacy, we shall hav another analogy between the operation of alkalies and of mercur Theoretically, it has been argued, the alkalies are likely to be benefici in these diseases on two accounts; first, they have a tendency to dimini the supposed plasticity of the blood, which some have assumed (thoug without proof) to be connected with the exudation; and, secondly, w find these albuminous deposits readily dissolve, out of the body, in alk line liquids: but arguments of this kind are to be received with gre caution. In conclusion, I may add that Eggert recommends the alkali as specifics against croup, though Sundelin (*Heilmittell.* 1er. Bd. S. 18 found them inoperative. Hellwag employed them to cause the remov of the deposited lymph; Memminger gave them with benefit in hooping cough; Mascagni in pleurisy and peripneumony (Vogt, *Lehrbuch*

Pharmakodyn. 2er. Bd. p. 529). It is asserted that in the latter complaints the alkalies render the expectorated matter less viscid, and at the same time act powerfully as diaphoretics and diuretics.

(*e.*) In *induration* and *enlargement of the lymphatic* and *secreting glands* the alkalies have also been recommended: for example, in bronchocele, mammary tumors, affections of the testicle, diseases of the mesenteric glands, induration of the liver and salivary glands, &c. I have seen the liquor potassæ remarkably beneficial in excessive enlargement of the lenticular or glandular papillæ at the base of the tongue.

(*f.*) In *syphilis* and *scrofula* also the alkalies have been employed with advantage. Some of the most obstinate and troublesome forms of the venereal disease frequently occur in scrofulous subjects, in whom mercury will not only be useless, but absolutely prejudicial. In two or three cases of this kind I have seen the liquor potassæ, taken in the compound decoction of sarsaparilla, of great benefit. Though scrofula may be relieved by the use of alkalies, there is no ground for believing that they have any power of curing this malady, as some have asserted.

(*g.*) The alkalies have been employed as *diuretics in dropsy*, especially when this disease arises from glandular enlargements, or other causes likely to be relieved by these remedies.

(*h.*) In *irritable conditions of the urinary organs* a combination of liquor potassæ and tincture of opium will be frequently found most beneficial, notwithstanding that alkalies are classed among the incompatibles of opium.

(*i.*) There are several other diseases in which the employment of alkalies has been recommended; such as *skin diseases*, which are scaly (as lepra and psoriasis); *chronic rheumatism*; in *uterine complaints*, as an emmenagogue; and in some chronic *diseases of the lungs*. Sometimes a very dilute solution of potash has been used as a *stimulating wash* to ulcers.

Administration.—The mode of employing the *potassa fusa* in the making of an issue I have already described. For internal exhibition, the liquor potassæ is used in doses of ten drops gradually increased to the extent even of a drachm, carefully watching its effects. It may be administered in the infusion of orange-peel. Table beer is said, by Dr. Paris, to disguise completely the nauseous flavour of the alkali; but, of course, if the beer be at all sour, the acid will neutralize the alkali, and destroy its antacid properties. Veal broth is another liquid for its administration; and we are told that Dr. Chittick's nostrum for the stone was the fixed alkali in this liquid.

Antidotes.—In poisoning by the alkalies, the antidotes are either acids or oil, both of which form salts with the alkalies, and diminish their causticity. Chereau prefers oil, which should be given to the extent of several pounds. Vinegar, lemon or orange juice, even the very diluted mineral acids, should be resorted to, if oil be not at hand.

Potas'sii Io'didum.—I'odide of Potas'sium.

History.—This salt, called also *ioduret of potassium*, and more commonly *hydriodate of potash*, was first employed in medicine by Dr. Coindet.

Natural History.—Iodine and potassium are contained in sea-water, as well as in sea-weeds, but whether the iodine is in combination with potassium or with some other metal (sodium or magnesium) it is impossible to say with certainty.

Preparation.—There are two principal methods of procuring this salt.

(*a.*) *Process of the Pharmacopœia.*—This consists in adding two ounces of iron filings to six ounces of iodine mixed with four pints of water, stirring them frequently with a spatula for half an hour. Apply a gentle heat, and, when a greenish colour appears, add four ounces of carbonate of potash, first dissolved in two pints of water, and strain. Wash the residue with two pints of boiling distilled water, and again strain. Let the mixed liquor be evaporated, that crystals may be formed.

The *theory* of this process is as follows:—One equivalent or 126 parts of iodine combine with one equivalent or 28 parts of iron. The resulting iodide of iron is decomposed by one equivalent or 70 parts of carbonate of potash, by which one equivalent or 166 parts of iodide of potassium and one equivalent or 58 parts of protocarbonate of iron are procured.

REAGENTS.			PRODUCTS.
1 eq. Iodide Iron 154	1 eq. Iodine . 126		1 eq. Iodide Potas^{m}. 166
	1 eq. Iron . . 28		
1 eq. Carb^{te}. Potash 70	1 eq. Potassium 40		
	1 eq. Oxygen 8	1 *eq. Protoxide Iron* 36	
	1 eq. Carbon. A^{d}. 22		1 eq. Carb^{te}. Iron . 58

(*b.*) *Dr. Turner's process.*—This is the simplest, and I believe the most eligible method. It consists in adding to a hot solution of pure potash as much iodine as the liquid will dissolve, by which means a reddish-brown fluid is obtained. Then pass hydrosulphuric acid through the liquid until it becomes colourless. Apply a gentle heat, to expel any excess of the acid; filter to get rid of the free sulphur, and exactly neutralize the free acid present, with potash; then crystallize. When the potash comes in contact with iodine two salts are formed, iodide of potassium and iodate of potash: the latter is decomposed by the hydrosulphuric acid, the hydrogen of which forms water, by combining with the oxygen of the iodate; sulphur is precipitated, and iodide of potassium remains in solution. This process has been subsequently modified thus: Iodate of potash is decomposed by exposing it to a red heat in a platinum crucible, instead of hydrosulphuric acid.

Properties.—This salt occurs in white, somewhat shining, transparent, or semi-opaque cubes, or octahedrons. Its taste is acrid saline, somewhat similar to common salt: it is without odour. It is readily fusible, and at a red heat volatilizes unchanged. It decrepitates when heated, in consequence of the water which is mechanically lodged between the plates of the crystal. Both water and alcohol readily dissolve it: it requires only two-thirds of its weight of water to dissolve it at 60° F. Iodine is readily dissolved by an aqueous solution of this salt.

Characteristics.—This salt is known to be an iodide by the following characters:—(*a.*) With a solution of bichloride of mercury it occasions a vermilion-red precipitate of the biniodide of mercury, which is very soluble in excess of iodide of potassium. (*b.*) With acetate of lead it forms a yellow precipitate of the iodide of lead. (*c.*) With the nitrate of silver, a yellow precipitate of the iodide of silver. (*d.*) With the protonitrate of mercury or with calomel a greenish yellow precipitate of the

›tiodide of mercury. (*e.*) On the addition of starch and a few drops either sulphuric or nitric acid, or of a solution of chlorine, (according Devergie, a mixture of chlorine and nitric acid succeeds best) the ie iodide of starch is formed. (*f.*) Chloride of platinum produces a wnish red solution of iodide of platinum.

That the base of this salt is potassium is shewn by the following characters:—(*a.*) Perchloric acid occasions a white precipitate of perchloe of potash, while the supernatant liquid becomes yellowish brown. An excess of a strong solution of tartaric acid produces a white preitate of the bitartrate of potash. (*c.*) Carbazotic acid forms yellow edle-like crystals of carbazotate of potash. (*d.*) If a pack-thread be ked in a solution of the iodide, and the wetted end dipped into melted low, and applied to the exterior cone of the flame of a candle, this ie assumes a pale or whitish violet colour.

Composition.—This salt consists, as its name indicates, of iodine and tassium.

	Eq.	Eq.Wt.	Per Cent.	Gay-Lussac.
Iodine	1	126	76	76·2
Potassium	1	40	24	23·8
Iodide Potassium	1	166	100	100·0

The crystals contain no water of crystallization.

Adulteration.—Iodide of potassium is frequently largely adulterated th carbonate of potash. In 1829 I analyzed a sample which contained per cent. of the latter salt (*Med. and Phys. Jour.* September, 1829.) In specimen Dr. Christison procured 74·5 per cent. of carbonate of tash, 16 of water, and only 9·5 of iodide of potassium (*Treatise on isons,* 3d edit. p. 182.) It is reported that this adulterated salt is nufactured in the neighbourhood of Glasgow. The impure salt may distinguished, by its wanting any regular crystalline form; by adding ew particles of it to lime-water a milky fluid is obtained, whereas the uid remains transparent if the iodide be pure; by its destroying the our of tincture of iodine, whereas the pure salt does not affect it; and tly, by alcohol, which dissolves iodide of potassium, but not carbonate potash.

Traces of the chlorides and sulphates are not unfrequent in commerl iodide of potassium. To detect the chlorides add nitrate of silver, ich precipitates the carbonates, chlorides, and iodides, and digest the cipitate in ammonia, which re-dissolves the chloride, but not the lide of silver. On the addition of nitric acid to the ammoniacal solun, the chloride is thrown down, while the carbonate is converted into rate of silver. The sulphates may be detected by chloride of barium, ich will occasion a white precipitate (sulphate of baryta) insoluble in ric acid.

I have met with a variety of iodide of potassium, which, by keeping, dergoes decomposition, evolves an odour of iodine, and becomes yellow. ave also samples of iodide of potassium (crystallized in octahedrons), ntaining traces of lead and tin, derived I presume from the vessels in ich the salt has been made or crystallized.

Physiological Effects. (*a.*) *On plants.*—The effects of this salt on getables have not been ascertained.

(*b.*) *On animals generally.*—The experiments of Devergie on dogs ferred to in his *Médecine Légale,* t. ii. p. 536), as well as those of Dr.

Cogswell on rabbits (*Experim. Essay on Iodine*, 1837), have shewn th to these animals, iodide of potassium is a powerful poison. It operat as a local irritant, and thereby inflames the tissues with which it is plac in contact. Four grains injected into the jugular vein of a dog caus convulsions, and death within a minute. Two drachms introduced in the stomach gave rise to vomiting and great depression: the latt increased until death, which occurred on the third day: after dea ecchymosis, ulceration, and redness of the stomach, were observe (Devergie, *op. cit.* p. 506.) Dr. Cogswell injected three drachms of t iodide beneath the skin of the back of a dog: the animal died on t third day: on chemical examination iodine was detected in the blo from the heart, in the brain and spinal cord, the liver, spleen, stomac muscles, tongue, and the bones freed from their appendages; likewi in the contents of the bladder. (Cogswell, *op. cit.* p. 91.)

(*c.*) *On man.*—Both the physiological effects and therapeutical uses iodide of potassium shew that the operation of this salt is analogous that of iodine.

The *local action* of iodide of potassium is that of an irritant. Wh taken internally in large doses it not unfrequently occasions nause vomiting, pain and heat of stomach, and purging. Applied to the sk in the form of ointment it sometimes produces slight redness. This s is much less energetic in its action than free iodine, and, therefore, m be given in larger doses and continued for a longer period, without evin ing the same tendency to produce disorder of the stomach and intestin canal. Lugol (*Essays*, translated by Dr. O'Shaughnessy, p. 65) fou that baths at 100° F. containing three ounces of iodide of potassium pr duced temporary itching only; whereas baths at the same temperatu containing ten scruples of iodine caused prickling, then itchiness, smar ing, rubefaction (which was not commensurate with the itchiness), pun tuated, separated, or confluent, and subsequently desquamation of t epidermis. The chemical action of iodide of potassium on the tissues slight, as indeed might be expected, seeing that no obvious changes a produced when a solution of this salt is mixed with albumen, fibrin, gelatine, the three most abundant organic constituents of the anim body.

Iodide of potassium *becomes absorbed* and is carried out of the syst by the different secretions, in which, as well as in the blood, it may easily detected (Buchanan, *Med. Gaz.* vol. xviii. p. 519; Wallace, *Lanc* for 1835-36, vol. ii. p. 6: the latter authority failed to detect it in t blood). Moreover, it deserves especial notice that it has been found the urine several days after it has been swallowed. (Christison, *Treat on Poisons*, 3rd ed. p. 185.)

The *remote* or *constitutional effects* of iodide of potassium are v analogous to those of iodine. Diuresis is a common consequence of use. Relaxation of bowels is not unfrequent. Occasionally ptyalism h been observed. (Dr. Clendinning, *Med. Gaz.* vol. xv. p. 869, and I Wallace, *Lancet*, for 1835 and 36, vol. ii. p. 8.) Dr. Wallace mentio irritation of throat as being produced by this salt. Atrophy of t mammæ is a very rare effect of it, but a case is mentioned by Mr. Ne Hill, (*Edinb. Med. and Surg. Journ.* vol. xxv. 1826, p. 282.) Headac watchfulness, and other symptoms indicative of the action of this salt the nervous system, have been noticed by Dr. Clendinning and Dr. Walla ıcreased secretion from, and pain of, the mucous membrane lining the ısal passages, have been observed. I have repeatedly remarked that the ocket-handkerchiefs used by patients who are taking this salt acquire distinct odour of iodine.

Great discrepancy exists in the statements of authors as to the effects given doses of iodide of potassium. "The average dose of this me- cine," says Dr. Williams (*Med. Gaz.* vol. xiv. p. 42) "is eight grains; ırried beyond that quantity it purges; and even limited to that quantity, requires some management to obviate nausea." In two cases mentioned Dr. Wallace (*Lancet*, for 1835-6, vol. ii. p. 9) a drachm of this salt ıken in divided doses caused vomiting, colicky pains, slight diarrhœa, equency of pulse, and exhaustion. These statements, then, shew that iis salt possesses very active properties, and coincide with the expe- ence of many practitioners, and with the results obtained from experi- ents on animals. But we have, in opposition to the above, the idence of Dr. Elliotson (*Lancet*, vol. i. 1831-2, p. 728) and of Dr. uchanan (*Med. Gaz.* vol. xviii. p. 519). The first tells us that six rachms may be given daily (in doses of two drachms) for many weeks ithout inconvenience; and the second states half an ounce may be ven at a dose without producing pain of the stomach or bowels, ırging, or any hurtful effect. Furthermore, both physicians vouch for ıe purity of the salt employed. It is difficult to explain such discrepant atements. But I cannot help thinking that peculiarities of constitution ıd morbid conditions of system (especially affections of the stomach) e principally concerned in modifying (either increasing or diminishing) e tolerance to this salt. I do not think that the different effects ›served can be wholly ascribed to alterations in the quality or lulterations of the medicine employed, though I have published a case *Ied. Gaz.* vol. xvii. p. 839), shewing that the adulterated is much less :tive than the pure salt.

Uses.—Having so fully detailed (p. 117 *et seq.*) the uses of iodine, it unnecessary to notice at any length those of iodide of potassium; since ey are for the most part identical. Thus it has been employed in onchocele, scrofula, in chronic diseases accompanied with induration ıd enlargement of various organs, in leucorrhœa, secondary syphilis, ›riostitis, articular rheumatism, dropsies, &c. As a remedy for the ırd periosteal node brought on by syphilis, it was first employed by r. Williams (*Med. Gaz.* vol. xiv. p. 42) who obtained with it uniform ıccess. At the end of from five to ten days its mitigating effects are lt; the pains are relieved, the node begins to subside, and in the ajority of cases disappears altogether. In these cases Dr. Clendinning *Ied. Gaz.* vol. xv. p. 833) has also borne testimony to its efficacy. In e tubercular forms of venereal eruptions, Dr. Williams found it ›neficial. In Dr. Wallace's lectures (*Lancet*, for 1835-36, vol. ii. and for 336 and 1837, vols. i. and ii.) are some valuable observations on the use iodide of potassium in venereal diseases. In chronic rheumatism :companied with alteration in the condition of the textures of the joint, is, in some cases, remarkably successful (Dr. Clendinning, *Med. Gaz.* ıl. xv. p. 866; and Dr. Macleod, *Med. Gaz.* vol. xxi. p. 361). As an gredient for baths, Lugol (*Essays*, p. 75) found the iodide would not ıswer alone, but that it was useful as a solvent means for iodine.

Administration.—Iodide of potassium may be employed alone or in conjunction with iodine, forming what is called ioduretted iodide of potassium.

1. *Of Iodide of Potassium.—Internally* it has been given in doses varying from three grains to half an ounce (see p. 283). To be beneficial, some think it should be given in small, others in large doses. Not having had any experience of the effects of the enormous doses before referred to, I can offer no opinion thereon. It may be administered dissolved in simple or medicated water, or in some bitter infusion. The more usual mode of exhibiting it is in combination with iodine, in the way presently to be noticed.

For *external application* iodide of potassium is used in the form of ointment. The *unguentum potassæ hydriodatis* of the Dublin Pharmacopœia consists of a scruple of iodide to an ounce of lard; but for ordinary purposes it should contain at least a drachm of iodide. By keeping it undergoes decomposition and acquires a yellow colour, a little iodine being set free. It has an advantage over the compound iodine ointment of the London Pharmacopœia, that it does not stain the skin.

2. *Of Ioduretted Iodide of Potassium.*—A solution of iodide of potassium readily dissolves free iodine, and the compound is usually termed ioduretted iodide of potassium. Iodine and iodide of potassium are also used together in the form of ointment.

For *internal administration* there are three preparations of ioduretted iodide of potassium which have been employed: the *ioduretted mineral water* of Lugol; the *compound solution of iodide of potassium* of the London Pharmacopœia; and the *compound tincture of iodine* of the same work.

(*a.*) *Ioduretted mineral water.*—This is Lugol's favourite preparation. He uses it of three different degrees of strength.

	No. 1.	No. 2.	No. 3.
Iodine	gr. $\frac{3}{4}$	i	i$\frac{1}{4}$
Iodide of Potassium	gr. i$\frac{1}{2}$	ii	ii$\frac{1}{2}$
Distilled Water	℥ viii	℥ viii	℥ viii.

The solutions are yellowish or orange coloured, and are quite transparent. When sweetened it is readily taken by children, but the sugar should be added at the time of administration, as in the course of a few hours it effects a chemical change in the solution. From six to eight ounces should be taken daily.

(*b.*) *Compound solution of iodide of potassium.*—The *liquor potassii iodidi compositus* of the London Pharmacopœia consists of:—

Iodine	gr. v.
Iodide of Potassium	gr. x.
Distilled Water	℥ xx.

It is a brown coloured solution, and may be usefully employed in the diseases of children. Dose for adults from two to six or more fluidrachms.

(*c.*) *Compound tincture of iodine.*—The *tinctura iodinii composita* of the London Pharmacopœia consists of:—

Iodine	℥ i.
Iodide of Potassium	℥ ii.
Rectified Spirit	O ii.

This solution may be mixed with water without any deposition of line. The dose of it at the commencement is ten minims, which ıy be gradually increased.

For *external application* ioduretted iodide of potassium is used in the rm of aqueous solution, or of ointment.

(*a.*) *Caustic, rubefacient, and stimulant solutions.*—These are employed Lugol of the following strengths:—

	Stimulating Washes.			Rubefacient Solution.	Caustic Solution.
	No. 1.	2.	3.		
›dine	gr. ii.	gr. iii.	gr. iv.	ʒ iv.	℥ i.
ydriodate Potash	gr. iv.	gr. vi.	gr. viii.	℥ i.	℥ i.
›istilled Water	lb. i.	lb. i.	lb. i.	℥ vi.	℥ ii.

Lugol uses the stimulating washes in scrofulous ulcers, ophthalmia, ›tulous abscesses, &c. When the scrofulous surfaces require stronger :citement than usual, he employs the rubefacient solution. In tuber-:lar tumors which have obstinately resisted all other means of treatment, e rubefacient solution may be applied in admixture with linseed meal ›rming the *ioduretted cataplasm* of Lugol). To prepare the mixture, e poultice is first made in the ordinary manner; and when moderately ›ol, a sufficient quantity of the rubefacient liquid poured on it with a ›ooden measure. The caustic solution is used for touching the eyelids ıd nasal fossæ, to repress excessive granulations, &c.

(*b.*) *Ioduretted baths.*—These are employed by Lugol in the treatment ' scrofula. They are to be made in wooden vessels.

IODURETTED BATHS FOR CHILDREN.

Age.	Water.	Iodine.	Iodide of Potassium.
	(Quarts.)	(Troy Grains.	(Troy Grains.)
4 to 7	36	30 to 36	60 to 72
7 . . 11	75	48 . . 60 . . 72	96 . . 120 . . 144
11 . . 14	125	72 . . 96	144 . . 192

IODURETTED BATHS FOR ADULTS.

Degree.	Water.	Iodine.	Iodide of Potassium.
	(Quarts.)	(Drachms Troy.)	(Drachms Troy.)
No. 1.	200	2 to 2½	4 to 5
No. 2.	240	2 . . 2½ . . 3	4 . . 5 . . 6
No. 3.	300	3 . . 3½	6 . . 7

(*c.*) *Ioduretted ointment.*—The *unguentum iodinii compositum*, Ph. L., › made by rubbing half a drachm of iodine with a drachm of iodide of otassium and a fluidrachm of rectified spirit: then mix with two ounces f lard.

ANTIDOTES.—No chemical antidote is known. In a case of poisoning, ıerefore, the first object will be to evacuate the contents of the stomach, xhibit demulcent and emollient drinks, combat the inflammation by the sual antiphlogistic measures, and appease the pain by opiates.

Potas'sii Bro'midum.—Bro'mide of Potas'sium.

History.—This salt, also called *hydrobromate of potash*, was first described by Balard in 1826 (*Ann. de Chim.* xxxii.)

Natural History.—(See Iodide of Potassium).

Preparation.—The modes of preparing bromide of potassium are analogous to those of the iodide.

In the Pharmacopœia the bromide is directed to be made by adding first an ounce of iron filings and afterwards two ounces of bromine to a pint and a half of distilled water. Set them by for half an hour, frequently stirring with a spatula. Apply a gentle heat, and when a greenish colour is produced, pour in the carbonate of potash dissolved in a pint and a half of water. Strain and wash what remains in two pints of boiling distilled water, and again strain. Let the mixed liquors be evaporated so that crystals may be formed.

In this process bromide of iron is first formed, and afterwards decomposed by carbonate of potash, by which protocarbonate of iron and bromide of potassium are produced.

REAGENTS. RESULTS.

1 eq. Brom^e. Iron 106 { 1 eq. Bromine 78 ——— 1 eq. Brom^de. Potass^m. 118
{ 1 eq. Iron . . 28
1 eq. Carb. Pot^h. 70 { 1 eq. Potass^m. 40
{ 1 eq. Oxygen 8 ------- 1 *eq. Protox. Iron* 36
{ 1 eq. Carb. A^d. 22 ——— 1 eq. Carbonate Iron . 58

Another mode of procuring this salt is to mix bromine with a solution of caustic potash, by which bromide of potassium and bromate of potash are formed (see diagram, p. 123). The bromate of potash may be converted into bromide of potassium by heat or hydrosulphuric acid.

Properties.—This salt crystallizes in whitish transparent cubes, or rectangular prisms. It is inodorous: its taste is pungent, saline, and similar to common salt, but more acrid. It is permanent in the air. When heated it decrepitates, and at a red heat fuses without suffering decomposition. It is very soluble in both cold and hot water, and slightly so in alcohol.

Characteristics.—That this salt is a bromide is known by the characters before mentioned (see the characteristics of the bromides, at p. 124). That its base is potassium is shewn by the characters of this metal mentioned when noticing iodide of potassium (see p. 281.)

Composition.—This salt consists of bromine and potassium in the following proportions:—

	Eq.	Eq. Wt.	Per Cent.	Balard.	Liebig.
Bromine	1	78	66·1	65·56	67·42
Potassium	1	40	33·9	34·44	32·58
Bromide Potassium	1	118	100·0	100·00	100·00

The crystals contain water lodged mechanically between their plates, but no combined water (water of crystallization).

Purity.—The purity and goodness of this salt may be known by the following characters:—The form of the crystals, their freedom from colour, l their neutrality with respect to litmus and turmeric. A solution of ; salt should give no precipitate with chloride of barium, shewing the ence of carbonates and sulphates. The method employed by Rose *urn. de Pharm.* t. 23, p. 489) for detecting minute quantities of the orides in bromides, is the following :—If pure bromide of potassium ed with excess of bichromate of potash be distilled with concentrated huric acid in a tubulated retort, to which is adapted a receiver con- ing excess of solution of caustic ammonia, pure brome distils over, and ammoniacal liquor remains perfectly colourless. But if the bromide tained a chloride, both brome and the chromate of chloride of omium distil over, and the ammoniacal liquor becomes yellow: omic acid may be detected in the solution by the usual tests.

Physiological Effects.—(*a.*) *On vegetables.*—The effects on plants e not been ascertained.

b.) *On animals.*—Thirteen grains of bromide of potassium dissolved in er, and injected into the jugular vein of a dog, coagulated the blood, sed convulsions and death in a few minutes (Barthez, *Journ. de Chim. d.* t. 5me. p. 214). The same experimenter introduced a drachm of salt into the stomach of a dog without any ill effects, save vomiting. two drachms, and even a drachm and a half, killed dogs in three s, when retained in the stomach by a ligature of the gullet, with ks of inflammation in the gastro-intestinal membrane. Maillet (*Journ. Chim. Méd.* t. 3, 2e. Serie, p. 225) gave two ounces to a dog without ill effect; and he observes, that according to the principle, that the e of a saline substance for the horse should be eight times that for the , a pound of bromide of potassium would have no ill effect on ses.

c.) *On man.*—The effects of bromide of potassium on man require her investigation. They appear to be analogous to those of iodide of ssium. Dr. Williams (*Elements of Medicine*, vol. i. p. 338) gave five ns of this salt three times daily for fourteen months, without any rious effect.

n most cases it acts as a diuretic. In irritable conditions of the ali- tary tube it is apt to occasion diarrhœa. Three cases are mentioned by Williams, in which, on account of this state of the bowels, more than or five grains could not be exhibited at a time, and even then it was sionally necessary to give opium. Under the continued use of it, rgements of the spleen and liver, and swellings of the lymphatic ds, have disappeared; so that it appears to agree with iodine, mer- , and the alkalies, in exercising that kind of influence over the nutri- of the body which has been designated by the terms resolvent, rative, and deobstruent. Dr. Williams thinks that it possesses usual, if not specific, powers in the cure of diseases of the spleen."

Uses.—In 1828, Pourché (*Journ. de Chim. Méd.* tom. iv. p. 594) em- ed this salt with benefit in the treatment of bronchocele and scrofula: as taken internally, and applied externally in the form of ointment. 1836 it was introduced into the London Pharmacopœia, in conse- nce of the great success obtained from the use of it in a case of rged spleen, under the care of Dr. Williams (*op. cit.*) In this, and hree other successful cases of the same disease, it was used internally . Dr. Williams also gave it with success in a case of ascites. Ma- lie (*Formulaire*, 8me. ed. 1835) employs it as an anti-scrofulous remedy, as an emmenagogue, and against hypertrophy of the ventricles. Prieg (quoted by Dierbach, *die neuesten Entdeck. in d. Mat. Med.* 1837) appli it externally in the form of ointment in tinea capitis.

Administration.—It is exhibited in the form of pill or solution doses of from four to ten grains three times a day. An ointment this salt is made by mixing an ounce of lard with from a scruple to tw drachms of the bromide. To this some persons add free brome.

Antidotes.—In a case of poisoning by this salt the treatment will the same as for iodide of potassium.

Potas'sii Sulphure'tum.—Sul'phuret of Potas'sium.

History.—Geber (*Invention of Verity*, ch. vi.) was acquainted wi the solubility of sulphur in an alkaline solution; but Albertus Magn taught the method of procuring sulphuret of potassium by fusion. T preparation kept in the shops is a mixture of the sulphuret of potassiu and sulphate of potash, and was formerly called *sulphuret of potash*, *liver of sulphur*.

Preparation.—It is ordered to be prepared by rubbing one ounce sulphur with four ounces of carbonate of potash, and heating them in covered crucible until they have united.

In this process the water and carbonic acid of the carbonate of pota are expelled. The oxygen and potassium of a portion of the pota unite with separate portions of sulphur to form sulphuric acid and sulphuret of potassium respectively. The sulphuric acid combines wi some undecomposed potash to form sulphate of potash. Supposi the carbonate of potash to be anhydrous, and the sulphuret of potassiu to consist of one equivalent of each of its constituents, the followi diagram will explain the changes:—

REAGENTS.			RESULTS.
4 eq. Carbte. Potash . . 280	4 eq. Carbc. Acid . . . 88		4 eq. Carb. Acid
	1 eq. Potash 48		1eq. Sulphe. Poth.
	3eq. Poth. 148	3 eq. Oxyg. 24	eq. Sulphc. Ad. 40
		3eq. Potm. 120	
4 eq. Sulphur 64	1 eq. Sulphur 16		
	3 eq. Sulphur 48		1eq. Sulpht. Potm.

Berzelius (*Traité de Chim.* t. 2me. p. 301) says that if 100 parts common anhydrous carbonate of potash be heated with 58·22 of sulph the products are tersulphuret of potassium and sulphate of potash. less than this quantity of sulphur be employed, a portion of carbon remains undecomposed.

Properties.—When fresh prepared, it has a liver-brown colour; a hence its name *hepar sulphuris*. Its taste is acrid, bitter, and alkali If quite dry it is inodorous, but when moistened it acquires the odour hydrosulphuric acid. Exposed to the air, it undergoes decompositi from the action of the aqueous vapour and oxygen. It becomes gr and moist, and ultimately whitish. This change depends on the abs tion of oxygen, in consequence of which part of the sulphur is deposit while a portion of the sulphuret of potassium is converted into hy sulphite, afterwards into sulphite, and ultimately into sulphate of pota Sulphuret of potassium is soluble in water.

Characteristics.—Hydrochloric acid causes the evolution of hyd ılphuric acid gas and the precipitation of sulphur; the solution of ıe sulphuret in water produces a reddish or black precipitate with a ılution of lead. That it contains potassium may be determined thus:—dd excess of hydrochloric acid to a solution of it; boil, and filter. he before-mentioned tests for potash may be then applied.

COMPOSITION.—According to Berzelius this preparation consists of *rsulphuret of potassium*, *sulphate of potash*, and *carbonate of potash*.

PHYSIOLOGICAL EFFECTS. (*a.*) *On plants.*—There can be no doubt ıt that this compound is a powerful poison to plants, though I am not quainted with any experiments made with it.

(*b.*) *On animals generally.*—From the experiments of Orfila (*Toxicol. énérale*) on dogs, sulphuret of potassium appears to be a powerful nartico-acrid poison. Six drachms and a half, dissolved in water, and troduced into the stomach, caused convulsions and death in seven nutes.

(*c.*) *On man.*—In *small doses* (as from four to ten grains) it acts as a neral stimulant, increasing the frequency of the pulse, augmenting the at of the body, promoting the different secretions, more especially those the mucous membranes, and sometimes exciting local irritation, marked pain, vomiting, and purging. By continued use it acts as a resolvent alterative, and on this account is employed in certain forms of inflamıtion.

In *large doses* it is an energetic narcotico-acrid poison. In two stances it proved fatal in fifteen minutes: the symptoms were, acrid te, slight vomiting, mortal faintness, and convulsions, with an imporıt chemical sign, the tainting of the air of the chamber with the odour hydrosulphuric acid (Christison, p. 228).

Its local action is that of a powerful irritant: hence the acrid taste, rning pain, and constriction in the throat, gullet, and stomach, with niting and purging. But the nervous system also becomes affected, is proved by the faintness, the almost imperceptible pulse, the consions, and (in some cases) sopor. These symptoms are analogous to se caused by the hydrosulphuric acid; which, in fact, is copiously eloped in the stomach.

USES.—Internally it has been administered in very obstinate skin dises, such as lepra and psoriasis, which have resisted all the ordinary ans of cure. It has also been employed as a resolvent in inflammans attended with lymphatic exudation, as croup, and in glandular argements. In chronic rheumatism, gout, hooping-cough, and various ıer diseases, against which it was formerly employed, it is now rarely ver administered. It ought not to be given as an antidote for metallic soning, since it is itself a powerful poison.

Externally it is applied in the form of lotions, baths, or ointment. In onic skin diseases, such as eczema, scabies, lepra, &c. it is employed a bath, in the proportion of four ounces to thirty gallons of water. ese baths are said to be particularly useful in the treatment of scabies children, but twenty at least are requisite to effect a cure. (Rayer, *eatise on Diseases of the Skin*, p. 346.) Lotions are sometimes made local cutaneous affections, containing a larger quantity of the sulphuret an ounce to two quarts of water).

ADMINISTRATION.—Internally it may be administered in the dose of three or four grains gradually increased. It may be given either in solu tion or in the form of pill made with soap. For external use it i employed in solution in water, as already described, or in the form o ointment, composed of half a drachm of the sulphuret to an ounce of lard

ANTIDOTES.—In the event of poisoning by this substance the antidot is a solution of chloride of soda or of chloride of lime.

Potas'sæ Bisul'phas.—Bisul'phate of Pot'ash.

HISTORY AND SYNONYMES.—The mode of preparing this salt w taught by Lowitz and Link at the latter end of the last century. The sa has had various names, such as *supersulphate of potash*, *sal enixum*, *ac vitriolated tartar*, and *sal auri philosophicum*.

PREPARATION.—It is ordered to be prepared by dissolving two poun of the salt left after the distillation of nitric acid in four pints of boilin water, then adding one pound of sulphuric acid to it, boiling down th mixture, and setting aside to crystallize. It is also a product of vario other manufactures.

PROPERTIES.—It is crystallizable, the primary form of the crystal bein either a right rhombic prism, or the right rhombic octahedron. It has very acid taste, and reacts strongly as an acid on vegetable colours, an decomposes the carbonates with effervescence. It is soluble in abo twice its weight of water at 60°. By a red heat it evolves sulphuric aci and is converted into the neutral sulphate of potash.

COMPOSITION.—It consists of—

	Eq.	Eq.Wt.	Per Cent.	Geiger.
Sulphuric Acid	2	80	54·80	54·77
Potash	1	48	32·87	32·53
Water	2	18	12·33	12·70
Crystallized Bisulphate Potash	1	146	100·00	100·00

CHARACTERISTICS.—The presence of sulphuric acid may be recognize by the chloride of barium; while the potash may be detected by th characters already mentioned for this substance. From the neutral su phate of potash it is distinguished by its acid taste, its action on litm and the alkaline carbonates, and by its greater solubility.

PHYSIOLOGICAL EFFECTS AND USES.—It is rarely used as a medicin It possesses the combined properties of sulphuric acid and sulphate potash. The excess of acid renders its local operation that of an astri gent. When swallowed, it operates as a mild purgative, and may l employed in the same cases as the sulphate, over which it has the adva tage of greater solubility. Conjoined with rhubarb it covers the bitt taste of the latter without injuring its medicinal properties. Dr. Bark (*Observations on the Dublin Pharmacopœia*, p. 138) says it may be used form a cheap effervescing purgative salt, as follows:—73 grains of bisu phate of potash and 72 grains of crystallized carbonate of soda, to l separately dissolved in two ounces of water, and taken in a state effervescence.

ADMINISTRATION.—The dose of it is from gr. x. to ʒij. proper diluted.

Potas'sæ Sul'phas.—Sul'phate of Pot'ash.

HISTORY AND SYNONYMES.—The mode of preparing this salt was taught Oswald Croll in 1643. It has been known by various appellations, h as *specificum purgans Paracelsi*, *Arcanum duplicatum*, *vitriolated i*, *vitriolated tartar*, *sal polychrest* (literally signifying *salt of many uses irtues*), *sal de duobus*, &c.

NATURAL HISTORY.—Sulphate of potash is found in both kingdoms of ure.

a.) *In the inorganized kingdom.*—It has been met with in small quan-es in some mineral waters of Saxony and Bohemia, in native alum, alum-stone, and in a mineral called *polyhalite*, in which Stromeyer nd no less than 27·6 per cent. of the sulphate of potash.

b.) *In the organized kingdom.*—It has been found in the root of Poly-a Senega, Winter's bark, the bulb of garlic, myrrh, opium, &c. The od and urine of man also contain it.

PREPARATION.—It is obtained from the residuum of the distillation of ic acid, either by igniting it in a crucible to expel the excess of phuric acid, as directed in the Pharmacopœia, or by saturating it with bonate of potash.

PROPERTIES.—It crystallizes in single or double six-sided pyramids, primary form of which is the right rhombic prism. It is hard, lorous, has a saline bitter taste, and is unchanged by exposure to the When heated it decrepitates. At 60° F. it requires sixteen times veight of water to dissolve it: it is insoluble in alcohol. It is decom-ed by tartaric acid, which forms with it crystals of bitartrate of potash.

COMPOSITION.—The crystals contain no water of crystallization. They thus composed:—

	Eq.	Eq.Wt.	Per Cent.	Wenzel.
Sulphuric Acid	1	40	45·45	45·25
Potash	1	48	54·55	54·75
Sulphate of Potash	1	88	100·00	100·00

CHARACTERISTICS.—I have already mentioned these, when describing bisulphate.

PHYSIOLOGICAL EFFECTS.—It acts as a very mild purgative, without asioning any heat, pain, or other symptoms of irritation. Its opera-is, in fact, too mild for ordinary use.

USES.—It is particularly serviceable as a laxative in disordered condi-s of the alimentary canal, as diarrhœa and dyspepsia, in hepatic rders, and in hæmorrhoidal affections. It is best given in combina-with rhubarb. Thus, from five to ten grains of rhubarb, with from en grains to two drachms of this salt, will be found to act mildly and iently in many cases of dyspepsia and diarrhœa. It is an excellent ient for children. The objections to its employment are its slight bility, and that when given in large doses to children it is apt to luce vomiting. It is useful, on account of its hardness, for triturating dividing powders, as in the *pulvis ipecacuanhæ compositus*.

DOSE.—It is given in doses of from fifteen grains to four or five hms.

Potas'sæ Ni'tras.—Ni'trate of Pot'ash.

History.—At what time this salt became known is difficult now determine. As it is found in various parts of the East, on the surface the earth, it appears probable that it must have been known at a ve early period. Furthermore, if the Chinese and Hindoos were acquaint with the art of making gunpowder and fireworks at a very early peri of history, they must have employed, and, therefore, been acquainted wi nitre. Geber, (*Invention of Verity*) however, is the first who distinct mentions it. But the terms *neter* of the Old Testament (*Prov.* ch. xxv. 2 *Jer.* ch. ii. 22), translated *nitre,*—*νίτρον* of Herodotus (*Euterpe*, lxxxvi and Theophrastus (*De Igne*)—and *nitrum*, of Pliny (*Hist. Nat.* xxx. i appear to have been applied either partially or exclusively to *natron* (s qui-carbonate of soda.) (See Beckman's *History of Inventions and Di coveries*, vol. iv.) The word *saltpetre*, usually applied to nitre, is eviden derived from *sal petræ*, literally signifying rock salt.

Natural History.—This salt occurs in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—In the East Indies, Egypt, Pers Spain, and other parts of the world, large quantities of nitre are found the soil. It would appear to be formed below, and to be brought to t surface of the soil by efflorescence. Some have thought that the nit acid of the salt was formed by the union of the nitrogen and oxygen the atmosphere, while others have supposed the presence of animal m ters necessary to yield, by their decomposition, nitrogen. In so instances the latter opinion is probably correct: but it does not invaria hold good, for in a nitre cave at Ceylon, Dr. Davy (*Account of the In rior of Ceylon*) found nitre without any animal matter. The potash the nitrate is in most cases easily accounted for, being found in some the constituents of the soil, namely, feldspar and mica.

(*b.*) *In the organized kingdom.* This salt has been found in vari plants, as in the roots of *Cissampelos Pareira*, *Geum urbanum*, &c. (D candolle, *Phys. Végét.* p. 387.)

Preparation.—The nitrate of potash consumed in this country imported from India, where it is obtained from natural sources. In so parts of Europe it is procured artificially.

1. *From natural sources.*—The district of Tirhût, in Bengal, is m productive of nitre than any other place in India. It is most abund in those parts containing a redundancy of carbonate of lime. An aver sample of the soil analyzed by Mr. Stevenson (*Journ. of the Asi Society of Bengal*, vol. ii. p. 23) gave the following composition:

Matter insoluble in three Mineral Acids	Silex	50·0
Matter soluble in ditto	Carbonate of Lime	44·3
Matter soluble in Water	Sulphate of Soda	2·7
	Muriate of ditto	1·4
	Nitrate of Lime	0·9
	Nitrate of Potash	0·7
		100·0

"In the month of November the *leonahs*, or native manufacturer saltpetre, commence their operations, by scraping off the surface from mud heaps, mud buildings, waste grounds, &c. where the saltpetre developed itself in a thin white efflorescence, resembling frost rind. T saline earth being collected at the factories, the operator first subject

the process of solution and filtration. This is effected by a large mud
er, lined on the inside with stiff clay." It has a false bottom of
mboo, covered with close wrought grass mats, on which are placed
getable ashes. Upon these the nitrous earth is laid. Water is then
ded to dissolve the saline matters of the earth, and the solution thus
ained, filtering through the mats, drops into the empty space between
real and false bottom, and is conveyed away into an earthen receiver.
its passage through the wood-ashes the carbonate of potash contained
the latter re-acts on the nitrate of lime of the solution, and produces
rate of potash and carbonate of lime. The solution is afterwards
porated in earthen pots, filtered, and put aside to crystallize. The
pure nitre thus procured is termed *dhouah:* it contains from 45 to 70
cent. of pure nitrate of potash. It is re-dissolved and crystallized by
native merchants, who supply the Calcutta bazaars, and when thus
ified is called by the natives *kalmee.* (See Stevenson, *op. cit.*; also
lia Jour. of Med. and Phys. Science, new series, vol. i. p. 10, 1836.)

Saltpetre is imported into this country principally from Calcutta, but
ne comes from Madras. It is brought over in cloth bags which contain
m 150 to 175 lbs. each. Its quality varies considerably. It is always
re or less impure: but the common varieties, which have a dirty
lowish appearance, are termed *rough* or *crude saltpetre,* while the purer
l cleaner looking kinds are called *East India refined.* The loss which
uffers in refining, or in other words the impurities which it contains,
technically designated *refraction.* This varies greatly in different
nples, but is usually between 5 and 15 per cent. (For the methods of
ermining it, consult Dumas, *Traité de Chimie,* t. 2^{me}. p. 762; and
ande's *Manual of Chemistry*, 4th ed. p. 549.)

Nitre is purified by repeated crystallization. When it has been dis-
ved and crystallized once only it is called *singly refined nitre:* when
ce, *doubly refined.* Its purity may be ascertained by testing it with
ate of silver, chloride of barium, and oxalate of ammonia. The
t detects the chlorides, the second the sulphates, and the third the
careous salts.

. *From artificial sources.*—The artificial preparation of nitre is prac-
d in several parts of Europe. The establishments in which it is
ried on are called *artificial Nitrières.* The mode adopted varies,
vever, in different places.

At Appenzel, a canton of Switzerland, nitre is formed from the urine
animals. A hole is dug near to stables, and in this is put a sandy
d of earth, which is kept moistened with the water running from the
bles. In two or three years this earth yields nitre.

n Sweden, where each landed proprietor is compelled to furnish a
tain quantity of nitre, it is prepared as follows:—Decomposing animal
vegetable matters, mixed with cinders, lime, or marl, are placed in
ps (called *nitre beds*) under cover, the mass being occasionally moved,
holes made in it, so that they are exposed to the air. From time to
e they are watered with urine (a liquid containing more nitrogen than
other animal substance.) At the end of two or three years the nitro-
has combined with oxygen, and this with bases to form nitrates. By
viation the salts may be separated, and any nitrate of lime present
y be converted into nitrate of potash by adding wood-ashes, which
tain carbonate of potash.

In Prussia *nitre-walls* are employed instead of nitre-beds. The[y] have two advantages,—they economize land, and they expose a large su[r]face to the air, (Dumas, *op. cit.*)

PROPERTIES.—Nitrate of potash usually crystallizes in six-sid[ed] prisms with diëdral summits. Its primitive form is the right rhomb[ic] prism, and, therefore, it has two axes of double refraction along which [a] ray of light is not split into two.

Double system of rings seen by looking through a slice of nitre (cut perpendicularly [to] the axis of the crystal) placed between two plates of tourmaline (cut paral[lel] to the axis of the crystal).

FIG. 52.

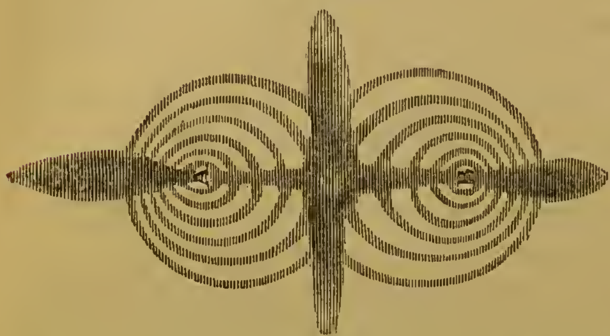


FIG. 53.

Fig. 52 is seen when the plane of the axis of nitre is parallel or perpendicular to [the] plane of polarization.—Fig. 53 is seen when the nitre is turned 45°.

When pure the crystals are transparent and colourless, have a sharp co[ol]ing taste, and undergo no change by exposure to the air. When heat[ed] nitrate of potash fuses, and when cast in moulds forms the *nitrum tabul[a]tum*, or *sal prunelle* of the shops. At a strong red heat it is decompose[d] with the evolution of oxygen and the formation of hyponitrite of potas[h] which when rubbed to powder and mixed with sulphuric acid emits r[ed] fumes (composed of nitrous acid and binoxide of nitrogen.) One hundr[ed] parts of water at 32° dissolve 13·32 parts of this salt, but at 77° th[ey] dissolve 38 parts. During the solution cold is generated. In pure alcoh[ol] nitre is insoluble.

COMPOSITION.—Nitrate of potash has the following composition :—

	Eq.	Eq.Wt.	Per Cent.	Wollaston.			Eq.	Eq.Wt.	Per Ce[nt].
Nitric Acid	1	54	52·9	53·332	or	Nitrogen	1	14	13[…]
Potash	1	48	47·1	46·668		Oxygen	6	48	47[…]
						Potassium	1	40	39[…]
Nitrate of Potash	1	102	100·0	100·000			1	102	100[…]

The crystals contain interstitial water, but no water chemically combin[ed].

CHARACTERISTICS.—This salt is known to be a nitrate by the chara[c]ters already detailed (p. 160) for this class of salts. That its base [is] potash is shewn by the tests before mentioned (p. 274) for this substan[ce].

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—Nitrate of potash di[s]solved in 300 times its weight of water promotes vegetation : but a sol[u]tion containing $\frac{1}{30}$ part of nitre is injurious to the growth of plants (Dav[y], *Agricult. Chemistry*).

(*b.*) *On animals generally.*—Orfila (*Toxicol. Gén.*) found that introduc[ed] into the stomach of dogs it acts as an irritant poison, and is capable [of] producing death, when it is not vomited, in doses of two or three drach[ms]. Its operation is that of a narcotico-acrid poison. When applied to t[he] cellular tissue it produces, according to this experimentalist, local effe[cts] only, and does not become absorbed. But Devergie (*Méd. Lég.*) sta[tes] ı the authority of J. E. M. Smith, that half an ounce applied to the ıigh killed a dog in thirty-six hours. Eight ounces dissolved in a pint 'water, and swallowed, killed a horse in twenty-four hours with all the ·mptoms of violent intestinal irritation, (Moiroud, *Pharm. Vétér.*) Ve-rinarians use nitre as a diuretic and refrigerant in doses of from two to ur drachms.

(*c.*) *On man.*—In *very large doses* (such, for example, as one ounce or ore) nitre has in several instances caused death; but the effects of it e not uniform, since, in other cases, this quantity has not appeared to ıve any very remarkable or obvious effect. For example, Dr. Christison ıew an instance in which one ounce was taken without occasioning any her unpleasant symptom than vomiting; and it was retained on the omach for above a quarter of an hour. In those cases where violent fects followed the ingestion of it, the symptoms were twofold: on the ıe hand, those indicating inflammation of the alimentary canal (such as ıin, vomiting, and purging;) on the other hand, an affection of the ner-›us system (marked by giddiness, convulsions, failure of pulse, tendency fainting, dilated pupil, insensibility, and palsy.) It is probable that e operation of nitre is influenced by the quantity of aqueous liquid in hich the salt was dissolved, and that the more we dilute, the less power-lly does it act as a poison. In no other way can we reconcile the dis-epant statements in regard to the effects produced by an ounce of nitre.

If nitre (or any other neutral alkaline salt) be mixed with dark-coloured nous blood out of the body, it communicates to it a florid or arterial ıe. Now as this salt, when taken into the stomach becomes absorbed, is not unreasonable to suppose that while mixed with the circulating ood it might have an analogous effect. Dr. Stevens (*Observations on e Blood*, p. 298) asserts, that in the last stage of fever, when the blood black, it has this effect. Moreover, he tells us (p. 154) that in a case ıich occurred in America, where a person swallowed an ounce of nitre, mistake, in place of Glauber's salts, the blood when drawn from a in was completely florid, and remained as fluid as if the nitre had been lded to it out of the body. (For some remarks on the effects of nitre the blood, by Mr. Carlyon, see *Med. Gaz.* vol. viii. p. 626; and on tre as a therapeutic agent, by Dr. Hancock, see *Lancet* for 1831-2, l ii. p. 766.)

In *moderate doses* nitre acts as a refrigerant, diuretic, and diaphoretic. s refrigerant properties are best seen when the body is preternaturally ›t, as in febrile disorders. Mr. Alexander (*Essays*, pp. 105, *et. seq.*) in s trials with it, made on himself, experienced a sensation of chilliness ter each dose, but he could not recognise by the thermometer any minution of heat in the external parts of his body. He found in most his experiments that it had a powerful influence over the vascular stem, and surprisingly diminished, in a very short period of time, the ımber of pulsations. Thus on several occasions a drachm of this salt, ithin a few minutes, reduced the frequency of his pulse from 70 to 60 ›ats. Sundelin (*Heilmittell.* Bd. i. S. 59) says nitre diminishes the gasm and plasticity of the blood perhaps by a chemical action on the ıor and fibrin. Diuresis is another, and very generally observed fect. As the nitre can be detected in the urine, its operation as a uretic depends perhaps on the local stimulus which is communicated to e renal vessels while the nitre is passing through them. Like most of the neutral salts of the alkalies, the continued use of it promotes alvin evacuations. Full doses frequently produce pain in the stomach. As diaphoretic it is usually given in combination with emetic tartar.

USES.—It follows from what has been now stated in regard to th physiological effects of nitre, that this substance is indicated when w wish to diminish preternatural heat, and to reduce the force and frequenc of the pulse, as in febrile disorders, inflammatory affections (excep perhaps those of the stomach, bowels, kidneys, and bladder), and hæmor rhages (especially hæmoptysis.) In continued fever it is frequentl given in combination with emetic tartar, and sometimes also wit calomel. It is not often used as a diuretic, because its activity in thi respect is not very great, but it is adapted for those cases which ar accompanied with arterial excitement. In sore throat it is mixed wit white sugar and gradually swallowed. A mixture of nitre and powdere gum has long been a favourite remedy for diminishing the scalding o gonorrhœa. Nitre is rarely employed as an external agent, except as means of producing cold. Thus five ounces of nitrate of potash, wit five ounces of muriate ammonia, dissolved in sixteen ounces of water will reduce the temperature 40° F.; that is, from 50° to 10°, according t Mr. Walker. Hence, therefore, we sometimes employ this mixture placed in a bladder, as an external application (see p. 133.)

On the belief that fever, cholera, and other malignant diseases, wer produced by a deranged state of the blood, and that this derangemen depended on, or consisted in, a diminution or entire loss of the salin parts of the blood, Dr. Stevens employed nitre, chloride of sodium, an other alkaline salts, in the treatment of these diseases (see his *Observa tions*, pp. 296, 298, &c.) Nitre in large doses has been employed in th treatment of scurvy, and with considerable success, according to th statement of Mr. Cameron (*Medico-Chirur. Review*, March 1830, p. 483.)

ADMINISTRATION.—It may be given in doses of from ten grains to hal a drachm in the form of powder mixed with sugar, or in solution. I administered as a refrigerant, it should be dissolved in water and imme diately swallowed, in order that the coldness of the solution may assi the action of the salt. If employed as a diuretic, we ought to give liquid plentifully, and keep the skin cool.

ANTIDOTE.—No chemical antidote is known for this salt. In case o poisoning, therefore, we should remove the poison from the stomach a speedily as possible, and administer tepid emollient drinks. Opiate perhaps may be advantageously administered. The inflammatory symp toms are to be combated by the usual antiphlogistic measures.

Potas'sæ Chlo'ras.—Chlo'rate of Pot'ash.

HISTORY.—Chlorate of potash (also called *oxymuriate* or *hyperoxymu riate of potash*) was first procured by Mr. Higgins, who seems to hav confounded it with nitrate of potash. In 1786 it was distinguished b Berthollet.

PREPARATION.—It is prepared by passing chlorine gas slowly throug a cold solution of carbonate of potash placed in a Woulfe's bottle. Th liquid is allowed to stand for twenty-four hours in a cool place, and i then found to have deposited crystals of chlorate of potash. These ar to be drained, washed with cold water, dissolved in hot water, and re crystallized.

When chlorine gas comes in contact with a solution of carbonate of ›tash, three salts are formed: chloride of potassium, hypochlorite of ›tash, and bicarbonate of potash.

AGENTS.				PRODUCTS.
q. Carbonate Potash 140				2 eq. Bicarb^{te}. Potash 184
ı.Carb^{te}. Potash 140	2 eq. Carb^{c}.A^{d}.	44		
	1 eq. Potash .	48		1 eq. Hypochl^{te}. Pot^{h}. 92
	1 eq. Oxygen.	8	1 eq. *Hypochlor^{s}.A^{d}*.44	
	1 eq. Potassium	40		
ı. Chlo-rine . . 72	1 eq. Chlorine	36		
	1 eq. Chlorine	36		1 eq. Chlor^{de}. Potas^{m}. 76

proportion as the quantity of chlorine increases, the bicarbonate be-mes decomposed: carbonic acid is evolved, and a further quantity of pochlorite of potash and chloride of potassium is produced.

When the solution is strongly charged with hypochlorite, the action the chlorine on the potash is somewhat changed: it abstracts the tassium from the potash, and thereby forms chloride of potassium, iile the oxygen thus set free combines with some hypochlorite of tash, and thereby converts it into the chlorate, the greater part of which stallizes.

AGENTS.			PRODUCTS.
ı. Chlorine		144	4 eq. Chloride Potassium 304
ı. Potash 192	4 eq. Potassium . .	160	
	4 eq. Oxygen . . .	32	
ı. Hypochlorite Potash		92	1 eq. Chlorate Potash . . 124

e residual liquor contains a little chlorate, and a considerable quantity hypochlorite of potash and chloride of potassium (Souberain, *Phar-cie*, t. 2^{me}. p. 430.)

PROPERTIES.—Chlorate of potash crystallizes in nearly rhomboidal tes, the primary form of which is an oblique rhombic prism. Its taste cool, and somewhat similar to nitre. When rubbed in the dark it comes luminous. 100 parts of water at 32° F. dissolve 3·5 parts of orate: at 59° F. 6 parts: at 120° F. 19 parts.

CHARACTERISTICS.—This salt is known to be a chlorate by the follow- characters:—When heated, it fuses, gives out oxygen, and is con-ted into chloride of potassium: when thrown on a red-hot coal, it lagrates—a property, however, common to several other salts. Sul-uric acid gives it an orange red colour, evolves the chlorous acid roxide of chlorine), known by its yellow colour, and great explosive ver when heated. Rubbed with sulphur or phosphorus it explodes lently. Mixed with hydrochloric acid and then with water, it forms a aching liquid. The base of the salt is known by the tests for potash, eady mentioned.

COMPOSITION.—It is an anhydrous salt.

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Chloric Acid	1	76	61·30	61·5083
Potash	1	48	38·70	38·4917
Chlorate of Potash	1	124	100·00	100·0000

IMPURITY.—Chloride of potassium is the usual impurity. This may detected by a solution of nitrate of silver producing the white chloride silver. The pure chlorate potash produces no obvious change in rate of silver.

Physiological Effects. (*a.*) *On animals generally.*—In one series experiments, Dr. O'Shaughnessy (*Lancet* for 1831-2, vol. i. p. 36 injected from 10 to 60 grains of chlorate of potash, dissolved in thr ounces of tepid water, into the cervical vein of a dog: no ill effect w observed: the pulse rose in fulness and frequency, the urine was found a short time to contain traces of the salt, and the blood of the trach veins had a fine scarlet colour. In another series of experiments t animal was stupified by hydrocyanic acid or hydrosulphuric acid ga the brachial vein was opened, and a few drops of excessively dark blo could with difficulty be procured. Half a drachm of the chlorate d solved in water of the temperature of the blood was injected slowly in the jugular vein: the pulsation of the heart almost immediately began return, and in the course of eight minutes scarlet blood issued from t divided brachial veins. In twenty minutes the animal was nearly re vered, and passed urine copiously, which was found to contain t chlorate.

(*b.*) *On man.*—The action of this salt on man requires further inves gation. It appears to be refrigerant and diuretic, analogous to that nitrate of potash. Wöhler and Stehberger have recognized chlorate potash in the urine of patients to whom it had been exhibited, so that does not appear to undergo any chemical change in its passage throu the system. This fact is fatal to the hypothesis of the chemico-physi logists, who fancied that it gave oxygen to the system, and was, ther fore, well adapted for patients affected with scorbutic conditions, whi were supposed to depend on a deficiency of this principle. Excessi doses of the chlorate, like those of the nitrate, would probably produce affection of the nervous system; but I am not acquainted with any sati factory case in proof. Duchateu (Merat and De Lens, *Dict. Mat. Méd* says that eighteen grains taken at thrice caused convulsions and deliriu but the observation is probably erroneous: for others have not exp rienced these effects, in much larger doses. Dr. Stevens (*On the Bloo* p. 155) says chlorate of potash gives a beautiful arterial colour to t venous blood, and reddens the gums much faster than mercury.

Uses.—Chlorate of potash was originally employed as a medicine f supplying oxygen to the system, where a deficiency of that principle w supposed to exist. With this view it was successfully administered b Dr. Garnett (Duncan's *Annals of Medicine*, 1797) in a case of chron scorbutus. Dr. Ferriar also tried it in scurvy with success (*Med. Hi and Reflect.* vol. iii. p. 250). It was subsequently applied in the ven real disease and liver complaints as a substitute for mercurials, who beneficial effects were thought to depend on the oxygen which th communicated to the system (see the reports of Mr. Cruikshank an Dr. Wittman, in Dr. Rollo's *Cases of Diabetes Mellitus*, 2d ed. pp. 504 an 563: also Dr. Chisholm's letter in the same work, *Preface*, p. x). It h also been tried in cases of general debility, on account of its suppos tonic effects, but failed in the hands of Dr. Ferriar (*op. cit.*). In a case dropsy under the care of the latter gentleman it operated successfully a diuretic. More recently, it has been used by Dr. Stevens (*On t Blood*, p. 296) and others, as a remedy for fever, cholera, and oth malignant diseases, which, he supposed, depend on a deficiency of sali matters in the blood, but as it was usually employed in conjunction wi chloride of sodium (see the article on this salt, further on) and carbon soda, it is impossible to determine what share the chlorate had in producing the beneficial effects said to have been obtained by what is called the *saline* treatment of these diseases.

It appears, then, that all the uses of this salt have been founded on certain views of chemical pathology, some of which are now considered untenable. It is very desirable, therefore, that some person, unbiassed by theoretical opinions, would carefully investigate its effects and uses, which I am inclined to think have been much overrated.

ADMINISTRATION.—The usual dose of it is from ten or fifteen grains to half a drachm. Dr. Wittman, in one case, gave 160 grains daily, with a little hydrochloric acid immediately after it, to decompose it: the effects were hot skin, headache, quick, full, and hard pulse, white tongue, and augmentation of urine.

Potas'sæ Car'bonas.—Car'bonate of Pot'ash.

HISTORY.—It is probable that the ancient Greeks, Romans, and Egyptians, were acquainted with this salt. Pliny (*Hist. Nat.* lib. xiv. and xxviii.) describes some of the uses of wood-ashes, and mentions a ley of them (*cineris lixivium*). For a long period carbonate of potash was confounded with carbonate of soda. Geber (*Invent. of Verity*, ch. iv.), in the eighth century, describes the method of procuring it by the combustion of tartar. It has been known by various names; such as, *salt of tartar, mild vegetable alkali, fixed nitre,* and *subcarbonate of potash.*

NATURAL HISTORY.—Reuss (Gairdner, *On Mineral Springs*, p. 18) found carbonate of potash in the waters of the Wuissokow, and in the chalybeate of Twer.

It is formed, during the combustion of inland plants, by the decomposition of the vegetable salts of potash (the acetate, the malate, and the oxalate, but principally the first). Hence it is procured in great abundance from wood-ashes. In some few cases it has been supposed to exist ready formed in plants, as in a fern referred to by Mr. Parkes (*Chemical Essays*, vol. ii. p. 17), the expressed juice of which is employed by the poor weavers of Yorkshire, in the cleansing of cloth at the fulling mills.

PREPARATION.—It is principally obtained from *wood-ashes* (*cineres vegetabilium*, seu *cineres e lignis combustis*). These are procured by burning wood piled in heaps on the ground, sheltered from the wind, or in pits.—[For an account of the proportion and composition of wood-ashes, see Berthier, *Traité des Essais*, t. 1er. p. 259).] The soluble constituents of the ashes are, carbonate, sulphate, phosphate, and silicate of potash, and chlorides of potassium and sodium. The insoluble constituents are, carbonate and subphosphate of lime, alumina, silica, the oxides of iron and manganese, and a dark carbonaceous matter. In America the ashes are lixiviated in barrels with lime, and the solution evaporated in large iron pots or kettles, until the mass has become of a black colour, and of the consistence of brown sugar. In this state it is called by the American manufacturers *black salts* (*cineres clavellati crudi*). The dark colour is said by Dumas to be owing to ulmate of potash.

To convert this substance into the *pot-ash* of commerce (*cineres clavellati calcinati*), it is heated for several hours, until the fusion is complete, and the liquid becomes quiescent. It is then transferred by large iron ladles into iron pots, where it congeals in cakes. These are broken up, packed in tight barrels, and constitute the pot-ashes of commerce. I[ts] colour varies somewhat, but it is usually reddish, in consequence of th[e] presence of sesquioxide of iron.

To make the substance called *pearl-ash* (*potassa impura*, Ph. L.) the mass called black salts, instead of being fused, is transferred from th[e] kettles to a large oven-shaped furnace, so constructed that the flame [is] made to play over the alkaline mass, which in the meantime is stirred b[y] means of an iron rod. The ignition is in this way continued until th[e] combustible impurities are burnt out, and the mass, from being blac[k], becomes dirty bluish white: this is pearl-ash (*United States Dispensatory*). The colouring matter is probably manganesiate of potash.

The following table shows the composition of various kinds of pot-a[sh] and pearl-ash, according to Vauquelin (*Ann. de Chim.* xl. 273):—

Kinds of Potash.	Caustic Hydrate of Potash.	Sulphate of Potash.	Chloride of Potassium.	Insoluble residue.	Carbonic Acid and Water.
American Potash . .	857	154	20	2	119
Russian Potash. . .	772	65	5	56	254
American Pearlash .	754	80	4	6	308
Potash of Trèves . .	720	165	44	24	199
Dantzic Potash . . .	603	152	14	79	304
Potash of Vosges . .	444	148	510	34	16

In this table it will be observed, that the American pot-ash contai[ns] the largest quantity of caustic potash: this arises, probably, from th[e] use of lime in its manufacture. Moreover, pearl-ash contains more ca[r]bonate of potash than pot-ash: this must arise from the absorption [of] carbonic acid during its preparation.—[For the mode of estimating th[e] quantity of alkali present, see Mr. Faraday's *Chemical Manipulation*, a[rt.] *Alkalimetry*.] The pot-ash and pearl-ash employed in this country a[re] principally imported from the British North American colonies, fro[m] Russia, and from the United States of America.

In the Pharmacopœia carbonate of potash is directed to be prepared [as] follows:—Dissolve two pounds of impure carbonate of potash (pearl-as[h]) in a pint and a half of water, and strain; then pour it off into a prop[er] vessel, and evaporate the water, that the liquor may thicken; then stir [it] constantly with a spatula until the salt concretes. In this process th[e] earthy impurities insoluble in water are got rid of. The same authori[ty] also states, that a purer carbonate may be prepared by heating the cry[s]tals of the bicarbonate to redness.

The high price of pearl-ash has occasionally led to the manufacture [of] carbonate of potash from *sal enixum* (bisulphate of potash), by heating [it] in a reverberatory furnace with charcoal. This yields sulphuret of pota[s]sium, in consequence of the carbon deoxidizing the bisulphate. [By] roasting, the sulphuret is decomposed, and converted into the carbona[te] of potash; the sulphur being dissipated, and the potassium combinin[g] with oxygen and carbonic acid.

Properties.—Carbonate of potash (the *salt of tartar* of the shops) [is] usually kept in a granular condition, on account of the difficulty of cry[s]tallizing it. It is white, inodorous, and strongly alkaline to the taste. [It] reacts powerfully as an alkali on turmeric or infusion of red-cabbage. [It] is fusible at a red heat; has a strong affinity for water, so that by exp[osure] re to the air it attracts water, and becomes liquid, forming the *oleum* ·*tari per deliquium.* It is insoluble in alcohol, but is very soluble in ıter; and in the Pharmacopœia is an officinal solution, called *liquor tassæ carbonatis*, composed of twenty ounces of the salt dissolved in ›int of distilled water. The solution is colourless, inodorous, and has a gr. of 1·473.

Pure carbonate of potash may be prepared by the combustion of bitar-te of potash and nitre (forming what is called *white flux*), lixiviating, ıcentrating by evaporation, and crystallizing. The primary form of the ·stal is a rhombic octahedron.

CHARACTERISTICS.—It is known to be a carbonate by its effervescing th the strong acids, and by a solution of it causing a white precipitate luble in acetic acid) with lime water or with chloride of barium. That s a potash salt is determined by the tests for potash already mentioned. om the bicarbonate of potash it is distinguished by its causing a brick-l precipitate with a solution of bichloride of mercury, the precipitate ing percarbonate of mercury. Sulphate of magnesia produces a white ›cipitate with the carbonate of potash, and not with the bicarbonate. ıis test, however, will not recognise the carbonate when mixed with arge quantity of bicarbonate.

COMPOSITION.—Mr. Phillips (*Pharmacopœia*) says, one hundred parts the carbonate of potash of the shops loses about 16 parts of water ıen heated to redness. Hence supposing the carbonate to have been re (which that of commerce never is) its composition would be as lows :—

	Eq.	Eq.Wt.	Per Cent.
Potash	1	48	57·6
Carbonic Acid	1	22	26·4
Water	1½	13·5	16·0
Pure Granulated Carb. Potash	1	83·5	100·0

The pure crystallized salt contains two equivalents of water of crystal-ation, and its equivalent weight, therefore, is 88.

IMPURITIES.—The ordinary impurities in this salt are silicic acid, the lorides, and sulphates. The first is detected by supersaturating with drochloric acid, evaporating, and igniting the residue: the silicic acid insoluble in water. The other impurities are detected by supersatu-ing the salt with nitric acid: if the resulting solution give a white ecipitate with nitrate of silver, the presence of chloride is to be infer-l: if it produce a white precipitate with chloride of barium, a sulphate present.

PHYSIOLOGICAL EFFECTS.—Its effects are in *quality* precisely those of ustic potash already described, but their *intensity* is much less, on count of the presence of carbonic acid, which diminishes the alkaline operties of the base. When it is taken into the stomach in large quan-ies, it acts as a powerfully caustic poison, sometimes inducing death twelve hours, and producing symptoms similar to those caused by the neral acids: at other times, however, the patient recovers from the im-ediate effect of the alkali, but in consequence of the altered condition of alimentary canal the assimilative process cannot be carried on; and er dragging on a miserable existence for a few weeks, the unfortunate fferer dies of absolute starvation. And lastly, in some cases, the caustic eration of the poison is principally confined to the œsophagus, causing icture and death. In one case, related by Sir Charles Bell (*Surgical*

Observations, part i. p. 82), a patient swallowed soap lees: this produced inflammation, which terminated in stricture. She lingered for 20 years and died literally starved. Several other cases have been detailed (Christison, *On Poisons*.) A weak solution of carbonate of potash produces no change in the sanguineous particles drawn from the body: a saturated solution slightly and gradually diminishes their size.

USES.—This salt is employed in medicine in most of the cases already mentioned when describing the uses of caustic potash. For example, as an antacid in dyspeptic affections; as a diuretic; as an antacid in that form of lithiasis which is accompanied with an increased secretion of lithic acid, or the lithates; in those forms of inflammation in which there is a tendency to the formation of false membranes; in gout, &c. Mixed with cochineal it is a popular remedy for hooping-cough. Externally, it has been applied in the form of a solution to wounds; as an injection in gonorrhœa; as a collyrium in some affections of the cornea, &c. Lastly, it is sometimes employed in the manufacture of the common effervescing draught, made with either the citric or tartaric acid. Twenty grains of carbonate of potash are saturated by about 17 grains of the citric acid of commerce, by 18 grains of tartaric acid, or by ʒiv. of lemon juice.

ADMINISTRATION.—It may be given either in the solid or liquid state. In the solid state it is given in doses of from gr. x. to ʒss. The doses of the *liquor potassæ carbonatis* of the Pharmacopœia is from ten minims to a fluidrachm.

ANTIDOTES.—When swallowed as a poison, the antidotes are oils or acids, as already mentioned for the caustic potash.

Potas'sæ Bicar'bonas.—Bicar'bonate of Pot'ash.

HISTORY.—This salt, formerly called *carbonate of potash* or *aerated kali*, was first prepared by Cartheuser in 1752.

PREPARATION. (*a.*) *Process of the Pharmacopœia.*—In the London Pharmacopœia we are directed to pass carbonic acid (generated by the action of equal weights of sulphuric acid and water in powdered chalk) through a solution of six pounds of the carbonate in a gallon of distilled water, to saturation. Apply a gentle heat, so that whatever crystals have formed may be again dissolved. Then set the solution aside that crystals may be formed, which are to be dried.

In this process, each equivalent of carbonate of potash unites with an additional equivalent of carbonic acid, and thereby forms the bicarbonate. The silicic acid is separated partly while the carbonic acid is passing through the solution, and partly during the crystallization of the bicarbonate.

(*b.*) *Cartheuser's Process.*—In the *Pharmacopée Raisonnée* of MM. Henry and Guibourt the following directions are given for performing this process:—Dissolve 500 parts of (pure) carbonate of potash in 1000 parts of distilled water, and filter: place the solution in a porcelain capsule in a salt-water bath, and gradually add 300 parts of pulverized carbonate of ammonia: slightly agitate the liquor until only a feeble disengagement of ammonia is perceived, then filter over a heated vessel and put aside to cool. The proportions employed by Geiger (*Handbuch d. Pharm.*) are somewhat different: they are, a pound of carbonate of potash, sixteen ounces of water, and six ounces of carbonate of ammonia. Mr. Brande (*Manual of Chemistry*) says Cartheuser's process is more expensive than that of the Pharmacopœia.

n this process the volatility of the ammonia, joined to the affinity of carbonate of potash for more carbonic acid, causes the decomposition he sesquicarbonate of ammonia: the ammonia with a small portion of bonic acid is disengaged, while the remaining acid converts the carate into the bicarbonate of potash.

ROPERTIES.—It is a crystalline, colourless solid, the primary form of se crystal is, according to Mr. Brooke, a right oblique-angled prism. inodorous, has an alkaline taste, and re-acts very feebly as an alkali egetable colours. It is soluble in four times its weight of water, at F., but is insoluble in alcohol. When exposed to the air it unders no change. When exposed to a red heat it gives out half its carbo- acid, and becomes the carbonate.

HARACTERISTICS.—The presence of carbonic acid and potash in this is known by the tests for these substances before mentioned. From carbonate of potash it is best distinguished by a solution of loride of mercury, which causes a slight white precipitate with it: reas with the carbonate it causes a copious brick-dust precipitate. hate of magnesia will not recognise the freedom of bicarbonate from onate, as I have before stated (p. 301.)

OMPOSITION.—The composition of this salt is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Berard.
Potash	1	48	47·58	48·92
Carbonic Acid	2	44	43·60	42·01
Water	1	9	8·82	9·07
Crystallized Bicarbonate Potash	1	101	100·00	100·00

MPURITIES.—The presence of chlorides and sulphates may be recog- d in the way described when speaking of carbonate of potash. hloride of mercury may be employed to detect any carbonate of ash, with which it would form a brick-dust coloured precipitate.

HYSIOLOGICAL EFFECTS.—The effects of this salt are similar to those he carbonate of potash, except that its local action is much less getic, in consequence of the additional equivalent of carbonic acid; e the alkaline effect on the system is equally energetic, so that it is an edingly eligible preparation in lithiasis and other cases where we t its constitutional, and not its local, action.

SES.—It may be employed for the same purposes that we use caustic sh (vide *potash*), except that of acting as an escharotic. Thus it is l as an antacid, to modify the quality of the urine, in plastic inflam- ion, in glandular diseases, affections of the urinary organs, &c. But nost frequent use is that for making effervescing draughts, with either c or tartaric acid. The proportions are as follows:—20 grains of rbonate of potash will saturate about 14 grains of the citric acid of merce, 15 grains of tartaric acid, or ℥iijss. of lemon juice. In the s, a preparation, called *lemon and kali*, is kept: it is composed of ır, dry citric acid, and the bicarbonate of potash. It is used as an mporaneous effervescing draught. As it abstracts water from the sphere, it must be kept in a well-stopped bottle.

here there is great irritability of stomach, I believe the effervescing ght, made with bicarbonate of potash and citric acid, to be more acious than that made with carbonate of soda and tartaric acid, the lting citrate of potash being, in my opinion, a much milder preparation than the tartrate of soda. The citrate promotes slightly the secretion of the alimentary canal, the cutaneous transpiration, and the renal secretion: and like other vegetable salts of potash, renders the urine alkaline.

Administration.—This salt may be given in doses of from gr. x. to gr. xv. or to the extent of half a drachm, or even a drachm.

Liquor Potassæ Effervescens (Ph. L.)—The effervescing solution of (bicarbonate of) potash is ordered to be prepared by dissolving a drachm of bicarbonate of potash in a pint of water, and passing into the solution carbonic acid compressed by force, more than sufficient for saturation. The solution is to be kept in a well-stopped vessel. This preparation has been introduced as an agreeable form for exhibiting carbonate of potash, without diminishing its constitutional operation.

Potas'sæ Ace'tas.—Ac'etate of Pot'ash.

History.—It appears to have been first clearly described by Raymond Lully in the thirteenth century, and has been known by several appellations, such as *terra foliata tartari*, *diuretic salt*, &c.

Natural History.—Geiger (*Handbuch der Pharmacie*) says this salt is found in some mineral springs. It probably exists in most plants which, by incineration, yield carbonate of potash. The sap of the elm and of most trees, Winter's bark, linseed, senna leaves, the rhizome of ginger, &c. are said to contain it.

Preparation.—It is prepared by adding a pound of carbonate of potash to twenty-six fluidounces of acetic acid (Ph. L.) mixed with twelve fluidounces of distilled water, or sufficient acid to saturate the carbonate. Evaporate the strained liquor in a sand-bath, the heat being cautiously applied until the salt is dried.

In this process the acid unites with the potash of the carbonate, and disengages carbonic acid.

Properties.—It is usually met with as a colourless, white solid, with a foliated texture (which is given to it by fusion and cooling), odourless, but having a pungent saline taste, and a soapy feel. It is exceedingly deliquescent, and, therefore, ought to be preserved in a well-stopped bottle. It is very soluble both in water and alcohol; indeed, in water, it is one of the most soluble salts we are acquainted with. At 60°, 100 parts of the salt will dissolve in 102 parts of water. When heated, it fuses and is decomposed into *pyroacetic spirit*, and *carbonate of potash*. One equivalent of this spirit contains the elements of one equivalent of acetic acid, minus those of one equivalent of carbonic acid.

Characteristics.—(See the tests for the *acetates*, p. 222, and for *potash*, p. 274).

Composition.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Wenzel.
Potash	1	48	48·5	50·15
Acetic Acid (dry)	1	51	51·5	49·85
Acetate of Potash	1	99	100·0	100·00

Purity.—It should be white and perfectly neutral. Frequently, however, it reacts as an alkali, owing to a slight excess of potash. The presence of chlorides may be detected by nitrate of silver; of sulphates by chloride of barium; of metals, by hydrosulphuric acid or ferrocyanide of potassium.

PHYSIOLOGICAL EFFECTS.—Two or three drachms cause purging, which sometimes accompanied with griping. In smaller doses, more especially largely diluted, this salt acts as a mild diaphoretic. In its passage to kidneys it becomes decomposed, and converted into the carbonate potash, which may be detected in the urine. Probably the pulmonary cretions of those who employ it also become impregnated with this t, since it has been said that in persons with delicate lungs it acts as irritant to these organs.

USES.—In this country it is rarely employed, except as a diuretic in opsical complaints. On the continent, however, it is administered in ious other diseases, as an alterative or resolvent, in scirrhus of the orus, chlorosis, and visceral and glandular enlargements. It may employed, in the lithic acid diathesis, to render the urine alka-e. It is of course exceedingly improper where phosphatic deposits observed in the urine.

ADMINISTRATION.—It is given as a diuretic in doses of from a scruple a drachm and a half, dissolved in some mild diluent. In larger doses, two or three drachms, it acts as a purgative.

Potas'sæ Bitar'tras.—Bitar'trate of Pot'ash.

HISTORY.—In its impure form, as a deposit from wine, it must have n known at a very early period. "It is called *tartar*," says Paracel-, "because it produces oil, water, tincture, and salt, which burn the ient as *hell* does." Scheele, in 1769, first explained its nature. Its onymes are *cream of tartar*, *supertartrate of potash*, and *acidulous trate of potash.*

NATURAL HISTORY.—It is a constituent of many vegetables: thus it is nd in grapes, tamarinds, *Cetraria islandica*, &c.

PRODUCTION.—All the bitartrate of commerce is obtained during the ous fermentation. It exists in solution in grape juice; but being slightly soluble in a mixture of alcohol and water, it deposits ng fermentation (that is, when alcohol is produced), and forms a st on the sides of the cask. In this state it is known in commerce er the name of *crude tartar* (*tartarus crudus*), or *argol*, and which is ned *white* or *red* (*tartarus albus* vel *tartarus ruber*), according as it is ained from white or red wine.

Argol, or *crude tartar*, occurs in crystalline cakes of a reddish colour, is composed of the bitartrate of potash, tartrate of lime (and some-es racemate of potash), colouring and extractive matter, &c.

t Montpelier, bitartrate of potash is procured thus:—Argol is boiled water, and the solution allowed to cool, by which a deposit of crystals btained; these are washed with cold water, and dissolved in boiling er, containing charcoal and alumina (clay); the latter substances being ployed to remove the colouring matter with which they precipitate. clear liquor is allowed to cool slowly, by which crystals of the rtrate are formed. These constitute the *tartarus depuratus* or *crys- tartari* of the older chemists. If a hot saturated solution of tartar be ed, the surface of the liquid becomes coated by a layer of very fine tals of bitartrate: hence this crust was called *cream of tartar* (*cremor ari.*)

PROPERTIES.—As met with in commerce, this salt forms a white crystalline mass, without odour, but having an acidulous and gritty taste. The primary form of the crystals is a right rhombic prism. It is unaltered by exposure to the air; but when heated, it decomposes, swells up, evolves various volatile products, gives out an odour of caromel and is converted into *black flux* (*fluor niger*),—a compound of charcoal and carbonate of potash. If the bitartrate be deflagrated with nitrate of potash, the residue is *white flux* (*fluor albus*), or carbonate of potash. Bitartrate of potash is very slightly soluble in water, and is insoluble in alcohol.

CHARACTERISTICS.—One character of this salt is derived from the phenomena attending its conversion into black flux, as above mentioned. If black flux be digested in water we obtain a solution of carbonate of potash, known by the properties before mentioned (p. 301.) Another character of the bitartrate is its slight solubility in water, and the solution reddening litmus. The addition of caustic potash increases its solubility, whereas alcohol diminishes it. Acetate of lead added to a solution of the bitartrate forms a copious white precipitate; lime water has the same effect. Mixed with alkaline carbonates it produces effervescence. Boracic acid, or borax, very much increases the solubility of this salt in water, forming what has been termed *soluble cream of tartar* (*cremor tartari solubilis*), or *tartarus boraxatus* of some writers.

COMPOSITION.—Crystallized bitartrate of potash has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Potash	1	48	25·3	24·80
Tartaric Acid	2	132	70·0	70·45
Water	1	9	4·7	4·75
Crystallized Bitar^{te}. Potash	1	189	100·0	100·00

IMPURITY.—Bitartrate of potash usually contains from 2 to 5 per cent of tartrate of lime, and hence a little carbonate of lime may be detected in black flux. This is of no material consequence in a medicinal point of view. If the powdered bitartrate be adulterated with either alum or bisulphate of potash, the fraud may be detected by chloride of barium which causes a white precipitate (sulphate of baryta) insoluble in nitric acid.

PHYSIOLOGICAL EFFECTS.—When taken in *small doses*, diluted with water, it acts as a refrigerant and diuretic: in *larger doses* (as two or three drachms) it purges, and frequently creates flatulence and griping. By continued use it disorders the digestive functions, and causes emaciation, most probably from defective nutrition. In *excessive doses* it produces inflammation of the stomach and intestines. A fatal case has been recorded by Mr. Tyson (*Med. Gaz.* vol. xxi. p. 177.) A man, to relieve the effects of drunkenness, swallowed four or five table-spoonfuls of cream of tartar. It caused violent vomiting and purging, and other symptoms of gastro-enteritis, and pain in the loins. The thighs and legs appeared paralyzed. He died on the third day. On a post-mortem examination the stomach and intestines were found inflamed.

USES.—Bitartrate of potash is frequently employed in the form of *imperial* or *cream of tartar whey*, as a *refrigerant* drink in febrile and inflammatory diseases. It allays thirst, diminishes preternatural heat d reduces vascular action. As a *diuretic* in dropsical complaints it is ed in the same way. As a *purgative* it is not usually exhibited alone, t, in general, with jalap, sulphur, senna, or some other purgative. us, in dropsical complaints, a very valuable hydragogue cathartic is a xture of jalap and bitartrate of potash. In skin diseases and affections the rectum (as piles, stricture, and prolapsus) a very useful purgative un electuary composed of sulphur, bitartrate of potash, and confection senna. An effervescing aperient may be prepared by mixing three ichms of the bitartrate with two and a half drachms of carbonate of la: the resulting salt is the potash-tartrate of soda. As a *tooth-powder*, artrate of potash is sometimes used on account of its gritty qualities: very good dentrifice consists of equal parts of bitartrate, powdered tany root, and myrrh.

ADMINISTRATION.—As a hydragogue cathartic the dose is from four to ht drachms: as an aperient, one or two drachms: as a diuretic, in eated doses of a scruple to a drachm. *Imperial* (*tisana imperialis*) is ned by adding boiling water to cream of tartar, and flavouring with on-peel and sugar. It may be taken, *ad libitum*, as a refrigerant ık in febrile complaints. *Cream of tartar whey* (*serum lactis tartaıtum*) is made by adding about two drachms of bitartrate to a pint of k. It may be diluted with warm water, and taken in dropsical comints. The *compound powder of jalap* (*pulvis jalapæ compositus*) of the ıdon Pharmacopœia is composed of three ounces of jalap, six ounces he bitartrate, and two drachms of ginger: the dose is from a scruple drachm in dropsical complaints.

Potas'sæ Tar'tras.—Tar'trate of Pot'ash.

HISTORY.—This salt was known to Lemery. It has been termed *arized tartar*, *tartarized kali*, *soluble tartar*, or *vegetable salt*.

PREPARATION.—It is readily prepared by saturating the bitartrate with carbonate of potash. The proportions employed in the London rmacopœia are sixteen ounces (or as much as may be sufficient) of onate of potash dissolved in six pints of boiling water, and three nds of powdered bitartrate of potash. After boiling, strain, and orate until a pellicle forms; then set aside to crystallize.

ı this process the excess of acid in the bitartrate is saturated by the sh of the carbonate: the carbonic acid escapes.

PROPERTIES.—It is usually met with in the shops in a granular state, it ought to be crystallized. The primary form of the crystals is a t oblique-angled prism. To the taste this salt is saline, and somet bitter. It deliquesces when exposed to the air, and is soluble in wn weight of water at 50°; the solution decomposes by keeping.

CHARACTERISTICS.—When heated to redness, it is decomposed, leaving residue charcoal and carbonate of potash. A solution of the tartrate uces a white precipitate with solutions of acetate of lead, nitrate of r, and chloride of calcium; the precipitates being soluble in nitric When heated, the salt evolves the odour of caromel. If an excess ny strong acid (as the sulphuric) be added to a solution of this salt, obtain crystals of the bitartrate. Hence acids, and most acidulous , are incompatible with it: as also are tamarinds. The tartrate is readily distinguished from the bitartrate by its deliquescent property, it greater solubility, and its want of acidity.

Composition.—The following is the composition of this salt:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Potash	1	48	42·1	41·31
Tartaric Acid.	1	66	57·9	58·69
Tartrate of Potash	1	114	100·0	100·00

Impurity.—It may contain excess of acid or base, either of which easily recognised; the one by litmus, the other by turmeric. The sulphates may be detected by chloride of barium throwing down a whi precipitate insoluble in nitric acid.

Physiological Effects.—This salt is a gentle purgative, analogous its action to the sulphate of potash, from which it differs in being mild in its operation, and partially digestible; for, like the other vegetable sal of the alkalies, it is decomposed in the system, and converted into t carbonate, in which state it is found in the urine.

It is said to have the power of preventing the griping of other mo active cathartics; as senna and scammony; but, from my own perso observations, I doubt the correctness of this statement.

Uses.—It is employed as a mild purgative in dyspepsia, at the com mencement of diarrhœa, in some liver complaints, &c. Sometimes it used as an adjunct to other more active purgatives: as the infusion senna.

Administration.—It may be given in doses of from two to thr drachms to half an ounce, or even an ounce.

Order 11.—Compounds of Sodium.

So'dii Chlo'ridum.—Chlo'ride of So'dium.

History.—As this salt is a necessary and indispensable seasoning our food, it doubtless must have been known to, and employed by, t first individuals of our race. The earliest notice of it occurs in writings of Moses, (*Gen.* xix. 26; *Lev.* ii. 13) and Homer (*Iliad*, lib. 214). It has received various names, such as *common salt*, *culinary sa* and *muriate* or *hydrochlorate of soda*.

Natural History.—It occurs in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—An enormous quantity of this salt contained in the waters of the ocean. At an average calculation water contains 2·5 per cent. of chloride of sodium (*vide* various analy of this fluid in Thomson's *System of Chemistry*, 6th ed. vol. iii. p. 1 It is found also in great abundance in mineral waters (Gairdner, *Mineral Springs*, p. 12). It has not hitherto been found in the old stratified rocks (De la Beche, *Researches in Theoret. Geol.* p. 31), bu met with in all the later formations. Thus Mr. Featherstonhaugh (*P Mag.* N. S. vol. v. p. 139; vol. vi. p. 75; and vol. vii. p. 198) states t salt or brine springs occur in certain parts of the United States, in *old transition slate rocks.* Salt springs occur in various parts of Engla in the *coal measures* (Bakewell, *Introd. to Geology*, 4th ed. p. 252). T rock salt of Cheshire, and the brine springs of Worcestershire, occur e *old red sandstone group* (*Trans. Geol. Society*, vol. i. p. 38, and vol. ii. 94). The salt of Ischel, in the Austrian Alps, belongs to the *oolitic oup* (Sedgwick and Murchison, *Phil. Mag.* N. S. vol. viii. p. 102), as es also that found in the lias in Switzerland (Bakewell, *op. cit.* p. 253). he immense mass or bed of salt near Cardona in Spain, and which has en described by Dr. Traill (*Trans. Geolog. Society*, vol. iii. p. 404) curs in the *cretaceous group* (De la Beche, *op. cit.* p. 293). The salt posit of Wieliczka, near Cracow, belongs to the *supracetaceous group* e la Beche, p. 270). Lastly, in the Crimea, salt is said to be daily accuulating in the inland lakes.

(*b.*) *In the organized kingdom.*—It is found in plants which grow by e sea side, in the blood and urine of man, &c.

Preparation.—The salt consumed in this country is procured by the aporation of the water of brine springs. The salt districts are Northch, Middlewich, and Nantwich, in Cheshire; Shirleywich, in Staffordire; and Droitwich, in Worcestershire. In Cheshire the rock salt (called so *fossil salt, sal fossilis* or *sal gemmæ*) constitutes two beds which vary in ickness from 4 to 130 feet, and are separated by a bed of clay, 10 or 12 et thick; the uppermost bed of salt being 30 or more feet from the surce of the earth. It is for the most part of a reddish colour, but is also et with in transparent colourless masses. It is called in commerce *ussia rock*, and is largely exported for purification. Brine springs are et with both above and below the level of the beds of rock salt.

The brine is pumped up into cisterns or reservoirs, from which it is awn when wanted into large, oblong, wrought-iron evaporating pans, hich are usually worked with four or more fires. If the brine be not mpletely saturated with chloride of sodium, a little rock salt is added it. By the evaporation of the water the salt deposits in crystals. The purities separate in the form of a scum (which is removed by a skiming dish), and of a sediment called *pan-scale*, or *pan-scratch*. As all parts the pan are not equally heated, the crystallization of the salt takes ace in different parts at different times, and consequently in the same n the grains or crystals vary considerably in size. The small-grained lt is formed by the strongest heat, and constitutes the *butter*, *stoved*, *mp*, or *basket salt* of commerce: while the larger crystals, forming the *y* and *fishery salts* of commerce, are deposited in the coolest part of the n. (For further information on the manufacture of common salt, consult ikin's *Dictionary of Chemistry*, vol. ii. p. 118; Holland's *Agricultural rvey of Cheshire*; Mr. Furnival's *Wharton and Marston Patent Salt efineries*, 1836; Dr. Brownrigg's *Art of making Common Salt*, 1748.)

In some parts of the world chloride of sodium is obtained from seaater: but the mode of extracting it varies according to circumstances. warm countries it is procured by solar evaporation, and is then called *y salt*. In cold countries congelation is resorted to as a means of ncentrating sea water; for when a weak saline solution is exposed to eat cold, it separates into two parts; one almost pure water, which eezes, and the other which remains liquid, and contains the larger prortion of salt. Another method of concentration is by *graduating uses*: these are skeletons of houses, in which the water is pumped up, d allowed to fall on heaps of brushwood, thorns, &c., by which it is vided and agitated with the air, and evaporation promoted. The furer concentration is effected by heat.

Properties.—It crystallizes in colourless cubes, or more rarely in regular octahedrons. In the salt pans the little cubes are frequently so aggregated as to form hollow, four-sided pyramids, whose sides have some resemblance to a series of steps: these are technically called *hoppers*. The specific weight of salt is 2·17. The taste is purely saline. When free from all foreign matters, chloride of sodium is permanent in the air, but ordinary salt is slightly deliquescent, owing to the presence of small quantities of chloride of magnesium. When heated it decrepitates (more especially the coarse-grained or bay salt), at a red heat fuses, and at a still higher temperature volatilizes. Rock salt is transcalent or diathermanous: that is, it transmits radiant heat much more readily than many other transparent bodies, as glass. It is soluble in water, and slightly so in alcohol. Hot and even boiling water dissolves very little more salt than cold water. At 60° it requires about twice and a half its weight of water to dissolve it.

Characteristics.—Its characters as a soda salt are the following:—It produces no precipitate with the hydrosulphurets, ferrocyanides, phosphates, or carbonates. From the salts of potash it is distinguished by causing no precipitate with perchloric or tartaric acid, or with chloride of platinum, and by the yellow tinge which it communicates to the flame of alcohol. As a chloride it is known by nitrate of silver throwing down a white precipitate, soluble in ammonia, but insoluble in nitric acid. Lastly, chloride of sodium is odourless, and devoid of bleaching properties.

Composition.—Pure chloride of sodium has the following composition:

	Eq.	Eq.Wt.	Per Cent.	Ure.
Sodium	1	24	40	39·98
Chlorine	1	36	60	60·02
Chloride of Sodium	1	60	100	100·00

The crystals contain no water in chemical combination with them, but a little is frequently mechanically lodged between their plates.

Impurities.—The commercial salt of this country is sufficiently pure for all dietetical and therapeutical purposes; and its low price is a sufficient guarantee against its adulteration. In France, however, serious accidents have happened in consequence of the use of sophisticated salt (Christison's *Treatise on Poisons*, 3d ed. p. 604, and Devergie, *Méd. Lég.* t. ii. p. 876.)

Physiological Effects. (*a.*) *On vegetables.*—In minute quantities chloride of sodium is injurious to very few, if any, plants, and to some it appears to be beneficial. Used moderately it is a most excellent manure to certain soils. In large quantities it is injurious, though unequally so to all plants. (Davy, *Agricult. Chem.*, and Decandolle, *Phys. Vég.* pp. 126[?] and 1343.)

(*b.*) *On animals.* To marine animals common salt is a necessary constituent of their drink. It is relished by most land animals. "The eagerness with which many quadrupeds and birds press towards salt springs and lakes, situated in inland districts, for the purpose of tasting their contents, indicates," says Dr. Fleming, (*Philosophy of Zoology*, vol. i p. 316) "a constitutional fondness for salt." In the *Ruminantia* the salutary effects of salt are especially observed. "They contribute power lly," observes Moiroud (*Pharmac. Vétérin.* p. 410), "to prevent, in ese animals, the influence of rainy seasons and wet pasturage, as ell as of damaged fodder. Given to animals intended for fattening, it ves more consistence to the fat and more taste to the meat." It appears be offensive and injurious to many of the lower animals: hence when bbed on meat, it prevents the attack of insects, and when applied to the in of leeches causes vomiting.

(*c.*) *On man.*—Chloride of sodium serves some important and essential es in the animal economy. It is employed, on account of its agreeable ste, by the people of all nations, from the most refined to the most bar-rous; but the quantity taken varies with different individuals, inasmuch some have a much greater relish for it than others. It is, I think, not probable, that this unequal appetite for salt, in different individuals, is licative of different wants of the system for this necessary substance;— salt must serve some more important function than that of merely grati-ng the palate. It is an invariable constituent of the healthy blood. Dr. evens (*On the Blood*) has shown that the red colour of the blood pends on the saline matters contained in it, for without these this fluid black. Some of the properties of the sanguineous fluid, such as its idity, its stimulating qualities, and its power of self-preservation, are obably more or less connected with its saline constituents. The free drochloric acid found in the stomach, and which is so necessary to gestion, is probably derived from the salt taken in with the food, is also perhaps the soda of the blood. The chloride of sodium found some of the secretions, as the bile and tears, probably serves some portant purposes.

It is said that persons who take little or no salt with their food are ry subject to intestinal worms. Dr. Paris (*Pharmacologia*) tells us at Lord Somerville, in his address to the Board of Agriculture, states at the ancient laws of Holland "ordained men to be kept on bread one *unmixed with salt*, as the severest punishment that could be flicted upon them in their moist climate; the effect was horrible: these etched criminals are said to have been *devoured by worms* engendered their own stomachs." Mr. Marshall (*Med. and Phys. Jour.* vol. xxxix.) lls us of a lady who had a natural aversion to salt: she was most eadfully affected with worms during the whole of her life.

Considered in a therapeutical point of view it is an irritant in its local eration. Thus applied to the skin and the mucous membranes it uses redness. Taken into the stomach in large quantity (as in the dose a table-spoonful or more) it excites vomiting, and when thrown into the rge intestines produces purging. In moderate quantities it promotes e appetite, and assists digestion and assimilation. If used too freely it casions thirst. The long-continued employment of salted provisions casions scurvy: of the correctness of this statement there cannot exist, think, a shadow of doubt, notwithstanding the bold denial given to it Dr. Stevens (*op. cit.* p. 262); a denial the more remarkable, since Dr. evens admits he has never seen a single case of the disease! His inion is evidently founded on hypothetical grounds, and is in direct position to the best medical testimony we possess.

In some diseases the moderate use of salt produces the effects of a tonic. acts as a stimulant to the mucous membranes, the absorbent vessels, and glands. Occasionally it seems to merit the designation of an alterative or resolvent.

Properly diluted and injected into the veins, in cholera, it acts as a powerful stimulant and restorative; the pulse, which was before imperceptible, usually becomes almost immediately restored, and, in some cases, reaction and recovery follow. A solution of common salt produces no change in the size and form of the sanguineous particles out of the body (Müller's *Physiology*). Dr. Macleod injected a solution of common salt into the jugular vein of a rabbit which had been asphyxied, but without restoring or producing resuscitation (*Med. Gaz.* vol. ix. p. 358).

Uses.—The following are some of the most important therapeutical uses of chloride of sodium.

As *a vomit*, it has been recommended in malignant cholera, in preference to other emetics (Searle, *Med. Gaz.* vol. viii. p. 538; Sir D. Barry, *Med. Gaz.* vol. ix. pp. 321 and 407; Brailoff and Isenbeck, *ibid*, p. 490*). In narcotic poisoning, in the absence of the stomach-pump and the ordinary emetic substances, it may also be employed. The dose of it is one or two table-spoonfuls in a tumblerful of water. A tea-spoonful of flour of mustard assists its action. As a *purgative* it is seldom employed except in the form of enema. One or two table-spoonfuls of common salt dissolved in a pint of gruel form a very useful clyster for promoting evacuations from the bowels.

It has been used in some diseases with the view of *restoring the saline qualities of the blood*. Dr. Stevens (*op. cit.*) has shewn that the red colour of the blood depends on the presence of its saline constituents, and that when deprived of these, this fluid is black. Now, in cholera, the blood is remarkably black, incapable of coagulating, and contains more albumen and hematosine, but less water and saline parts, than natural; while the enormous discharges from the bowels consist of a weak solution of albumen containing the salts of the blood (Dr. O'Shaughnessy, *Report on the Chemical Pathology of the Malignant Cholera*, 1832). The obvious indications, therefore, in the treatment of this disease, are to restore the water and saline matters to the blood. Hence originated what has been called the *saline treatment* of cholera. This, at first, consisted in the exhibition of certain alkaline salts by the mouth, and in the form of enemata. The following are formulæ which have been recommended:—

Take of Carbonate of Soda . . half a drachm.
Chloride of Sodium . a scruple.
Chlorate of Potash . . 7 grains.

Dissolve in half a tumblerful of water. This to be repeated at intervals of from 15 minutes to an hour, according to circumstances (Dr. Stevens, *op. cit.* p. 459).

Take of Phosphate Soda . . . . . . 10 grains.
Chloride of Sodium . . . . 10 grains.
Carbonate of Soda . . . . 5 grains.
Sulphate of Soda . . . . . 10 grains.

Dissolve in six ounces of water. The mixture to be repeated every second hour (Dr. O'Shaughnessy, *op. cit.* p. 54).

This plan, however, was followed by that of injecting saline solutions into the veins: which was, I believe, first practised by Dr. Latta (*Med. Gaz.* vol. x. p. 257.) The quantity of saline solution which has been in some cases injected is enormous, and almost incredible. In one case "120 ounces were injected at once, and repeated to the amount of 330 ounces in 12 hours. In another, 376 ounces were thrown into the veins between Sunday at 11 o'clock A.M. and Tuesday at 4 P. M.; that is, in the course of 53 hours, upwards of 31 pounds. The solution that was used isisted of two drachms of muriate and two scruples of carbonate of a to sixty ounces of water. It was at the temperature of 108° F. or)° F." (*Med. Gaz.* vol. x. p. 257.) In another series of cases 40 lbs e injected in 20 hours; 132 ounces in the first 2 hours; 8 lbs. in half hour! (*Med. Gaz.* vol. x. pp. 379-80.) The *immediate* effects of se injections, in a large majority of cases, were most astonishing: oration of pulse, improvement in the respiration, voice, and general earance, return of consciousness, and a feeling of comfort. In many ances, however, these effects were only temporary, and were followed collapse and death. In some, injurious consequences resulted, as ebitis (*Med. Gaz.* vol. x. p. 453), drowsiness, (*ibid.* p. 447), &c. The orts as to the ultimate benefit of the saline treatment in cholera are so tradictory, that it is exceedingly difficult to offer the student a correct impartial estimate of its value. That it failed in a large proportion ases, after an extensive trial, and greatly disappointed some of its unchest supporters, cannot be doubted. (*Med. Gaz.* vol. x. p. 717.) Griffin (*Recollections of Cholera*, in *Med. Gaz.* vol. xxii. p. 319) states all the published cases of injection which he can find recorded unt to 282, of which 221 died, while 61 only recovered: but he ks that the average recoveries from collapse by this method of treat-t "far exceeded the amount of any other treatment in the same dis- and under the same circumstances."

ommon salt has been employed as an *anthelmintic.* For this pur- it is exhibited in large doses by the mouth, or, when the worms are ged in the rectum, a strong solution is administered in the form of na. When leeches have crept into the rectum, or have been acci-ally swallowed, a solution of salt should be immediately used. As a iical antidote chloride of sodium may be administered in poisoning nitrate of silver. As an *alterative and tonic* it is useful in scrofula glandular diseases. As an *astringent* in hæmorrhages, dysentery, diarrhœa, it has been administered in combination with lime juice mon juice (*Memoir of the late Dr. Wright*, p. 322).

s an *external application* salt has been used for various purposes. s, a saturated solution of salt, applied with friction, is employed, as a ter-irritant and discutient, in glandular enlargements and chronic ases of the joint; as a stimulant, it is rubbed on to the chest in ing and asphyxia. A solution of salt is employed for baths (cold warm), affusion, the douche, &c. Its action is more stimulant and than simple water, and the reaction or glow more rapidly and cer-y takes place. Consequently, the salt-water bath may be used for a er period, without causing exhaustion, than the pure water bath. It popular opinion, which is probably well founded, that patients are likely to take cold after the salt-water bath than after the common r bath.

DMINISTRATION.—As a tonic and alterative, the dose of salt is from grains to a drachm. As an emetic, from two to three table-spoonfuls e or six ounces of warm water. As a cathartic, from half an ounce ounce. In the form of clyster, it is used to the extent of two or three table-spoonfuls. A solution of one part of salt in forty parts ater will form a bath of about the same strength as sea water.

So'dæ Hypochlo'ris.—Hypochlo'rite of So'da.

History.—The disinfecting power of a solution of this substance w discovered by Labarraque about 1820 (Alcock, *Essay on the Use of t Chlorurets*, p. vi). In the London Pharmacopœia this solution is call *liquor sodæ chlorinatæ;* in the French Codex, *hypochloris sodicus aq solutus.* It is commonly known in the shops under the name of *chlori of soda, liqueur de Labarraque*, or *Labarraque's soda disinfecting liqui* Other synonymes for it are *chloruret of the oxide of sodium*, and *oxym riate of soda.*

Preparation.—There are two methods in use for preparing a soluti of hypochlorite of soda.

(*a.*) *Process of the Pharmacopœia.*—Dissolve a pound of carbonate soda in two pints of water; then put four ounces of chloride of sodiu and three ounces of binoxide of manganese, rubbed to powder, into retort; and add to them four ounces of sulphuric acid previously mix with three fluidounces of water, and cooled. Heat the mixture, and pa the chlorine, first through five fluidounces of water, and afterwar through the above prescribed solution of carbonate of soda.

When chlorine gas comes in contact with a solution of carbonate soda, three salts are formed: chloride of sodium, hypochlorite of so and bicarbonate of soda.

REAGENTS.				PRODUCTS.
2 eq. Carbonate Soda 108				2 eq. Bicarb^{te}. Soda . 1
2 eq. Carb^{te}. Soda 108	2 eq. Carb^{c}. A^{d}.	44		
	1 eq. Soda . .	32		1 eq. Hypochl^{te}. Soda
	1 eq. Oxygen.	8	1 eq. *Hypochlors. A^{d}*. 44	
	1 eq. Sodium .	24		
2 eq. Chlorine . . 72	1 eq. Chlorine	36		
	1 eq. Chlorine	36		1 eq. Chlor^{de}. Sodium

The essential and characteristic properties of this solution depend the hypochlorite of soda. The changes which take place in the ma facture of chlorine have been already explained (p. 105).

(*b.*) *Process of the French Codex.*—Diffuse one part of dry chloride lime (hypochlorite of lime) through 30 parts of water. Then add t parts of crystallized carbonate of soda, previously dissolved in 15 parts water. Filter the mixture. In this process a double decompositio effected; hypochlorite of soda is formed in solution, while carbonate lime precipitates. This process is more easy of execution than t previous one. By using the proportions here directed the solution much weaker than that prepared by the process of the London Pharm copœia.

Properties.—The solution of hypochlorite of soda (*liquor so chlorinatæ* of the London Pharmacopœia) has a yellowish colour, astringent taste, and an odour of chlorine. It destroys the colour vegetable substances; as litmus, turmeric, and sulphate of indi Previous to bleaching them, it reacts as an alkali on turmeric paper, a infusion of red cabbage. By evaporation, crystals are obtained, which re-solution in water re-produce the disinfecting liquid. By exposure the air, the solution undergoes decomposition, and crystals of carbon of soda are formed.

Characteristics.—The following are the essential characters of the *[liq]uor sodæ chlorinatæ*, Ph. L.:—It decolorizes sulphate of indigo. On addition of hydrochloric acid it evolves chlorine and carbonic acid. [S]olution of nitrate of silver throws down a white precipitate (chloride [of s]ilver) soluble in ammonia, but insoluble in nitric acid. Lime water [cau]ses a white precipitate (carbonate of lime). Oxalate of ammonia [occ]asions no precipitate, shewing the absence of lime. Chloride of [pla]tinum produces no yellow precipitate, proving the absence of potash [and] ammonia. That the base of the solution is soda may be shewn in [tw]o ways: evaporated to dryness, we obtain a residuum which renders [the] outer cone of the flame of a candle, or the flame of a spirit lamp, [yel]low: saturated with hydrochloric acid and evaporated to dryness, [com]mon salt is procured: this may be recognized by the characters before [men]tioned (p. 310).

Composition.—Some chemists regard the *liquor sodæ chlorinatæ*, Ph. L. [as] a mixture of chloride of soda and bicarbonate of soda. But the view [usu]ally taken of it is that it consists of hypochlorite of soda, chloride of [sod]ium, and bicarbonate of soda.

Physiological Effects. (*a.*) *On animals.*—A solution of chloride of [sod]a acts as a local irritant, more or less powerfully according to the [deg]ree of its concentration. From the experiments of Segalas (*Journ. Chim. Med.* t. 1er. p. 271) it appears that besides the irritant operation, [by] its direct and sympathetic action on the organic solids, it exercises [an] evident influence over the blood, and, in consequence, over the whole [eco]nomy, by means of absorption. In an experiment referred to by Dr. [Chr]istison, (*Treatise on Poisons*, 3d ed. p. 221) two ounces of Labar[aq]ue's solution introduced into the peritoneum of a dog excited palpita[tion], oppressed breathing, constant restlessness, and death in ten minutes.

(*b.*) *On man.*—I am unacquainted with any experiments made to [dete]rmine the physiological effects of chloride of soda on man. That it [wou]ld, *in large doses*, act as a powerful local irritant, and, if swallowed, [give] rise to symptoms of gastro-enteritis, cannot, I think, be doubted. [Mér]at and de Lens (*Dict. Mat. Méd.* t. ii. p. 257) state that the imme[diat]e consequence of, and predominating symptoms produced by, a glass[ful o]f *eau de javelle* (a solution of chloride of potash) was general rigidity, [whi]ch gave way to demulcent drinks. This observation agrees with one [mad]e by Segalas (Christison, *op. cit.* p. 221) in his experiments on dogs, [nam]ely, that chloride of soda caused tetanic spasms. It is probable, [ther]efore, that the chlorides (hypochlorites) of the alkalies exercise a [spec]ific influence over the nervous system.

[C]hloride of soda, in *moderate or small doses*, has been denominated [stim]ulant, tonic, astringent, antiseptic, and febrifuge. But these terms [give] no real explanation of the nature of those organic changes produced [by t]his remedial agent, whereby we obtain such benefit from its employ[men]t in various diseases. In fever I have seen dampness of the skin [follo]w its use. Increased secretion of urine is a common effect of it. In [fever]s it improves the qualities of the evacuations. Under the conti[nued] employment of it, glandular enlargements and chronic mucous [disc]harges have disappeared, from which circumstance chloride of soda [has] been denominated alterative and resolvent. All these effects depend [prob]ably on the alteration which the chloride gives rise to in the condi[tion] of the blood, and the change thereby produced in the action of the different organs. We must not overlook the important fact that th solution of chloride of soda used in medicine contains bicarbonate soda, to which perhaps in many cases its beneficial effects are, in part least, to be referred.

USES.—The solution of chloride of soda is employed as a *disinfectan antiseptic*, and *antidote* (in cases of poisoning by the hydrosulphuret and hydrosulphuric and hydrocyanic acids.) But for most of the purposes the chloride of lime is employed instead of chloride of sod since its properties are analogous, and being manufactured on a ve extensive scale for the use of bleachers, it can be obtained more conv niently and cheaply. On this account, therefore, and to avoid repe tion, I must refer to the article HYPOCHLORITE OF LIME for informati respecting the above uses of chloride (hypochlorite) of soda. I wou remark, however, that in several cases where I have carefully tried a compared the two chlorides (hypochlorites) I give the decided preferen to the chloride of soda. As an antiseptic, Labarraque also preferred t latter preparation, on the ground that by the process of disinfection becomes chloride of sodium, which is not a deliquescent salt; wher the chloride of calcium generated by chloride (hypochlorite) of lim attracts water from the atmosphere, and thereby furnishes one of t conditions (viz. moisture) necessary to the putrefactive process. Henc in his opinion, while chloride of lime will serve equally well for me disinfection, chloride of soda is preferable where we wish at the sa time to prevent a renewal of putrefaction.

Chloride of soda is employed internally in all diseases commo termed *putrid* or *malignant*, as typhus fever, scarlatina maligna, &c. is indicated where there are great prostration of strength, fetid evac tions, and a dry and furred tongue. In such cases I have seen it essential service, improving the quality of the secretions, producing moist state of the skin, preventing collapse, and altogether acting m beneficially. It may be administered both by the mouth and t rectum.

There are many other diseases in which the solution of chloride soda has been administered internally with apparent success; but which a more extended experience of its effects is required to enable to place confidence in the results. I refer now to the employment of t substance as a substitute for the disulphate of quinia, in intermitte recommended by Lalesque and Gouzée (*Brit. and For. Med. Rev.* Ap 1838); to its use in the treatment of secondary syphilis, as practised Dr. Scott (*Lond. Med. Rep.* N. S. vol. ii. 1826, p. 139), and by Cazeno (*Journ. de Chim. Méd.* t. iv. p. 140): to its administration in chro skin diseases, and as a substitute for chlorine in bilious disorders by Darling (*Lond. Med. Rep.* N. S. vol. ii.); in scrofula, by Godier (*Jou Gén. de Méd.* 1829); and in plague, by Neljoubin (Richter, *ausf. A neim.* Suppl.-Bd. p. 539.) In some of these cases (as in syphilis a scrofula) the benefit obtained may have resulted from the bicarbonate soda present in the chloride of the shops.

As a *local* remedy, we employ chloride of soda in all cases atten with fetid discharges, not merely as a disinfectant and antiseptic—t is, as a chemical agent destroying fetor, and preventing the putrefact of dead matters (as gangrenous parts, the discharges from wounds a ulcers, &c.) though in these respects it is most valuable—but as a me stopping or relieving morbid action by an impression produced on the ing tissues. It frequently puts a stop to the further progress of gan-ne; promotes the separation of the dead from the living parts; proves the quality of the secretions; and, at the same time, diminishes ir quantity, when this is excessive. We apply it to ulcers of all kinds ether common, phagedenic, cancerous, syphilitic, or scrofulous) en attended with foul discharges or a disposition to slough. We ploy it with the greatest benefit in affections of the mucous surfaces. us it is used as a gargle to check ptyalism and ulceration of the uth, whether arising from mercury or other causes. In scarlatina ligna we apply it to check ulceration and sloughing of the throat. In yza and ozæna it has been injected into the nostrils with considerable efit. In fetid and excessive discharges from the vagina, and neck of uterus or bladder, it is employed as an injection with, at least, tem-rary relief. It has also been applied in some skin diseases, as tinea itis, eczema, scabies, prurigo pudendi muliebris, &c. The above are ty a few of the cases in which chloride of soda has been used with st marked benefit. In conclusion, I may justly add, that there are , if any, remedies the uses of which, as local agents, are so valuable d extensive, as the chlorides of soda and lime.

ADMINISTRATION.—The *liquor sodæ chlorinatæ*, Ph. L. may be admi-tered internally in doses of twenty drops or more, diluted with three or r ounces of some mild aqueous liquid. When used as a gargle, it uld be diluted with eight or ten parts of water: as an injection into vagina, it is to be mixed with from fifteen to thirty parts of water: a wash, its strength must vary according to circumstances. In some ughing ulcers I have used it mixed with its own volume of water, t in most cases it should, at the commencement of its use, be largely uted.

ANTIDOTE.—(See CALCIS HYPOCHLORIS.)

So'dæ Sul'phas.—Sul'phate of So'da.

HISTORY.—Sulphate of soda (also called *natron vitriolatum*, *Glauber's t*, *sal catharticus Glauberi*, or *sal mirabile Glauberi*) was discovered in 58 by Glauber.

NATURAL HISTORY.—It occurs in both kingdoms of nature. As an lorescence, the hydrous sulphate of soda is met with in various parts the world. In the anhydrous state, mixed with a minute portion of rbonate of soda, it constitutes the mineral called *Thenardite*. Sul-ate of soda is a constituent of many mineral waters; as those of eltenham, Leamington, and Spital. It is found in the ashes of some nts which grow by the sea-shore; as the *Tamarix gallica*. Lastly, it found in some of the animal fluids; as the blood and urine.

PREPARATION.—It is a product of several chemical processes. In the armacopœia it is directed to be prepared from the salt which remains er the distillation of hydrochloric acid. This salt consists of sulphate th some bisulphate of soda. It is to be dissolved in water, and to the lution carbonate of soda is to be added, to saturate the excess of acid the bisulphate. The liquid is then to be boiled down, strained, and stallized.

In consequence of the enormous consumption of sulphate of soda ; the manufacture of carbonate of soda, makers of the latter article a obliged to procure sulphate purposely, by the addition of sulphuric aci to chloride of sodium.—[For the theory of this process, see p. 149.]

Properties.—The primitive form of the ordinary crystallized sulpha of soda is the oblique rhombic prism. To the taste this salt is coolin and bitterish saline. By exposure to the air it effloresces. When heate it undergoes the watery fusion, gives out its water of crystallization, an thereby becomes a white solid, and at a red heat it again becomes liqui One part of it dissolves in three parts of water at 60°, or one part o water at 212°. It is insoluble in alcohol.

Characteristics.—Its constituents, sulphuric acid and soda, may b detected by the tests for these substances before mentioned (pp. 265 an 310). From the bisulphate of soda it is distinguished by its not redden ing litmus, and by its less solubility. Crystals of anhydrous sulphate o soda are distinguished by their form being the rhombic octahedron.

Composition.—The ordinary crystals of sulphate of soda have th following composition :—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Wenze
Soda	1	32	19·75	19·24	19·
Sulphuric Acid	1	40	24·69	24·76	24·
Water	10	90	55·56	56·00	55·
Ordinary Crystals of Sulphte. of Soda	1	162	100·00	100·00	99·

Purity.—The crystallized sulphate of soda of the shops is usuall sufficiently pure for medical purposes. The presence of chlorides in i may be detected by nitrate of silver.

Physiological Effects.—It is a mild but efficient cooling laxativ or purgative salt, promoting secretion and exhalation from the mucou membrane of the stomach and bowels, without causing inflammation o fever.

Uses.—It may be employed as a common purgative, either alone o added to other purgatives. It is applicable in fevers and inflammator affections, where we want to evacuate the bowels without increasing o causing febrile disorder.

Administration.—The usual dose of it is from six to eight drachms When dried, so as to expel the water of crystallization, three and a hal drachms act as an efficient purgative.

So'dæ Bibo'ras.—Bibo'rate of So'da.

History.—Pliny (*Hist. Nat.* lib. xxxiii) describes a substance unde the name of *chrysocolla*, which has been supposed by some to be biborat of soda. The term *bauracon* or *baurach* (from which our word *borax* i derived) first occurs in the writings of the Arabians. By some of the authors (as Mesue and Avicenna) it was applied to nitre (Beckmann *Hist. of Invent. and Discov.* vol. iv. p. 559): it is not improbable, how ever, that Geber (*Search of Perfection*, ch. iii.) used it to indicate ou borax. By modern chemists the salt has been termed *biborate, borate,* o *sub-borate of soda.*

ɴATURAL HISTORY.—Borax is a substance peculiar to the mineral gdom. It has been found in some mineral waters; as those of San stituta, in Ischia (Gairdner, *On Mineral Springs*, p. 414). It occurs in the waters of certain lakes, especially those of Thibet and Persia.

ᴾREPARATION.—Borax is obtained in two ways:—1st, by refining ve borax; 2dly, by saturating native boracic acid with soda.

ɑ.) *By refining native or crude borax.*—About fifteen days' journey th from Teeshoo Lomboo, in Thibet, is a lake, said to be about uty miles in circumference, and supplied by brackish springs rising n the bottom of the lake itself. In consequence of its high situation, ing a part of the year this lake is frozen over. The water of it conıs, in solution, both common salt and borax. The latter crystallizes the edges and shallows of the lake, and is taken up in large masses, ch are broken and dried.

t is imported, usually from Calcutta, under the name of *tincal* (a d derived from *tincana*, the Sanscrit name for borax; Royle's *Essay Hindoo Medicine*, p. 97) or *crude borax* (*borax cruda* seu *nativa*), he form of flattened six-sided prisms, coloured with a greasy unctuous stance, said, by Vauquelin, to be a fatty matter, saponified by soda; colour is yellowish, bluish, or greenish. Mojon states that the enish grey matter which surrounds some kinds of rough borax, conıs native boron. Various methods have been contrived for refining ax; some calcine it, to destroy the fatty matter, others wash it with an lline solution (soda or lime), and then dissolve and crystallize. The duct is called *refined borax* (*borax depurata* seu *purificata*).

b.) *By saturating native boracic acid.*—In the year 1776, Messrs. efer and Mascagni discovered boracic acid in the Lagoni of Tuscany, state of efflorescence, and also in solution in the waters with which soil is impregnated. From the soil is constantly evolved aqueous our, impregnated with boracic and hydrosulphuric acids; formed, as supposed, by the action of water on sulphuret of boron contained he interior of the earth,—by which part of the water is decomposed, oxygen of which acidifies the boron, while the hydrogen forms rosulphuric acid with the sulphur, and the heat evolved causes the ation of some aqueous vapour. By washing the mud surrounding *fumaroles*, or craters, decanting the liquor, and evaporating, *rough Tuscany boracic acid* is obtained. To form borax from this, a solution he carbonate of soda is saturated with the rough acid: effervescence s place, and borax is formed.

ᴾROPERTIES.— It occurs in large, colourless, transparent crystals, ose primary form is the oblique rhombic prism. In commerce we uently meet with it in irregular shaped masses. Its taste is saline, ling, and somewhat alkaline. It reacts on turmeric paper like an ali. By exposure to the air it effloresces slowly and slightly. When ted it melts in its water of crystallization, swells up, and forms a t, white, porous substance, called *calcined borax* (*borax usta* seu *inata*). At a higher temperature it fuses into a transparent glass *ss of borax*), which is anhydrous borax. It is soluble in twelve parts old, or in two parts of hot water.

ᶜHARACTERISTICS.—Borax may be recognized by the following chaers: it reddens turmeric paper; it fuses before the blowpipe into a glass, which may be readily tinged by various metallic solutions,—thu rose red by chloride of gold, and blue by solutions of cobalt; if a fe drops of sulphuric acid be added to powdered borax, and then spirit wine, the latter will, when fired, burn with a green-coloured flam lastly, if to a strong hot solution of borax, sulphuric acid be adde boracic acid will be deposited in crystals, as the liquid cools. The te now mentioned for the most part only prove the salt to be a borate: th nature of the base is determinable by the tests for soda before describ (p. 310).

COMPOSITION.—Chemists are not agreed as to the precise atomic co stitution of borax, in consequence of a difference of opinion as to th equivalent of boron. In the following table the first column shows th number of equivalents according to Berzelius, Dumas, and Turner,— the second, according to L. Gmelin, Brande, and Phillips.

	Eq.	Eq.	Eq.Wt.	Per Cent.	Berzelius.	L. Gmel
Soda	1	1	32	16·666	16·31	17
Boracic Acid	2	1	70	36·458	36·59	35
Water	10	10	90	46·875	47·10	46
Crystallized Borax	1	1	192	99·999	100·00	100

By a particular management of the crystallizing process, Payen ha obtained borax in permanent octahedral crystals, containing only fi equivalents of water. It is termed *octahedral borax*, in contra-distincti to the ordinary kind, which is called *prismatic borax*. Octahedral bor offers several advantages to the arts over the prismatic variety (Guibou *Hist. des Drog.* t. i. p. 191, ed. 3me.)

PHYSIOLOGICAL EFFECTS.—The effects of borax have been imperfect ascertained. Its *local* action is that of a mild irritant: applied to sor it excites smarting, and taken into the stomach, in large doses, excit vomiting.

The *constitutional effects* are probably those of a mild refrigerant a diuretic. Wöhler and Stehberger detected it in the urine, so that passes out of the system unchanged.

By some writers it is regarded as an agent exercising a speci influence over the uterus; promoting menstruation, alleviating the pa which sometimes attends this process, facilitating parturition, diminis ing the pain of accouchement, and favouring the expulsion of t placenta and lochia (Vogt's *Pharmakodynamik*). Further evidenc however, is wanting to enable us either to admit or deny the suppos uterine influence of borax. Some recent English writers seem to ent tain no doubt as to its promoting uterine contractions (Dr. Copland, *Di of Pract. Med.* art. *Abortion*, and *Brit. and For. Med. Rev.* for July 183 page 86).

Borax has also been regarded as producing the effects of alkalies the system; principally, I believe, from an erroneous notion that it was subsalt (Vogt, *op. cit.* and Sundelin, *Heilmittellehre*). When Hombe asserted that boracic acid was a sedative, borax was supposed to posse similar properties.

USES.—As a *local agent*, borax is employed, as a detergent, in aphth and ulceration of the mouth. In some skin diseases it has been us ith benefit: as pityriasis versicolor (called also *liver spots* or *chloasma*). solution of it in rose-water is employed as a cosmetic. In gonorrhœa d leucorrhœa an aqueous solution has been occasionally used, as an jection, with success. Lastly, in the form of ointment it has been plied to inflamed and painful hæmorrhoidal tumors.

Internally it has been used to diminish the secretion of uric acid; to t as a diuretic in dropsical cases; and to influence the uterus in the ses before mentioned. To promote uterine contractions, Dr. Copland commends it in conjunction with ergot of rye.

ADMINISTRATION.—The dose of it is from half a drachm to a drachm. a detergent in aphtha it may be used in powder, mixed with sugar or th honey. The *MELLITE OF BORAX* (*mel boracis*, Ph. L.) consists a drachm of powdered borax mixed with an ounce of clarified honey; s the most eligible form for the employment of borax in the aphtha of ldren.

So'dæ Phos'phas.—Phos'phate of So'da.

HISTORY.—This salt was long known before its true nature was underod. In 1737 Hellot found it in the urine. It has been known by various nes, such as *alcali minerale* and *sal mirabile perlatum*. In the shops s sold as *tasteless purging salts*. Dr. Turner calls it *triphosphate of a and basic water*. It is sometimes termed the *rhombic phosphate soda*.

NATURAL HISTORY.—It has been found, in small quantities, in some eral waters (Gairdner, *On Mineral Springs*, p. 19). It exists in many mal fluids, especially the urine of man.

PREPARATION.—It is procured as follows:—carbonate of soda is added the impure solution of phosphoric acid, obtained by digesting bone- in sulphuric acid (*vide* p. 250) to saturation: the liquid is then red, evaporated, and put aside to crystallize. A slight excess of soda motes the formation of fine crystals.

PROPERTIES.—The primary form of the crystals of this salt is the que rhombic prism. The crystals are transparent, but by exposure he air effloresce and become opaque. Their taste is cooling saline. y react feebly on vegetable colours like alkalies. When heated, they ergo the watery fusion, give out water, and form a white mass which been called *pyrophosphate of soda*: at a red heat this melts into a nsparent glass, called *metaphosphate of soda*. The crystals of phosphate soda require, for their solution, four times their weight of cold or e their weight of hot water: they are nearly insoluble in alcohol.

CHARACTERISTICS.—The presence of soda in this salt is known by the s for this base before mentioned (p. 310). The phosphoric acid in it ecognised as follows: a solution of the phosphate throws down a te precipitate with acetate lead, as well as with chloride of barium: precipitate in both cases is a phosphate, and dissolves in nitric l without effervescence: with nitrate of silver, the phosphate of a occasions a yellow precipitate soluble both in nitric acid and nonia: pyrophosphate of soda, obtained by heating the phosphate, luces a white precipitate with nitrate of silver: hydrosulphuric acid, well as the hydrosulphates, occasion no change in a solution of sphate of soda. Phosphate of lead fused upon charcoal, in the outer ne of the blowpipe, becomes distinctly crystalline upon cooling.

Composition.—Some difference of opinion exists as to the atomi constitution of this salt, as is obvious from the following table:—

	Brande and Phillips. Eq.	Eq.Wt.	PerCt.	Graham and Turner. Eq.	Eq.Wt.	PerCent.	Berzelius. (Experiment.)
Soda	1	32	18·2	2	62·6	17·20	17·67
Phosphoric Acid	1	36	20·5	1	71·4	19·94	20·33
Water	14	108	61·3	25	225·0	62·84	62·00
Crystallized Phosphate Soda	1	176	100·0	1	359·0	99·98	100·00

According to Mr. Graham, one of the twenty-five equivalents of wate performs the function of a base to the acid.

Physiological Effects.—In doses of an ounce, or an ounce and half, it acts as a mild antiphlogistic purgative, like sulphate of soda. I small and continued doses it has been used with the view of altering th composition of the blood, and of promoting the deposit of phosphate o lime in the bones.

Uses.—As a purgative it is employed in the diseases of children an delicate persons, in preference to other saline substances, on accou of its slight taste and mild action on the stomach. It is well adapted f febrile and inflammatory disorders.

It is one of the substances which have been employed in cholera, t restore to the blood its deficient saline matters (Dr. O'Shaughnessy, *Repor on the Chemical Pathology of the Malignant Cholera*, p. 54). On accou of the phosphoric acid which it contains it has been supposed to b particularly applicable in those diseases in which there is a deficiency o phosphate of lime in the bones. It has also been administered i diabetes.

Administration.—As a purgative it is given in doses of from six t twelve drachms. It is best taken in broth or soup. As an alterative th dose is one or two scruples three or four times a day.

So'dæ Car'bonas.—Car'bonate of So'da.

History.—This salt, as well as the sesquicarbonate of soda, was pr bably known to the ancients under the term of *νίτρον*, or *nitrum* (vi *Potassæ Nitras*, p. 292; also *Sodæ Sesquicarbonas*). The *salt-alkali*, *sagimen vitri* of Geber (*Invent. of Verity*, ch. iv., and *Search of Perfe tion*, ch. iii.) was a carbonate of soda: the word *sagimen* is a corrupti of the Hindee term *sajjiloon*, (Dr. Royle, *Essay on Hindoo Medicin* p. 41). In modern times this salt has had various appellations, such *mild mineral* or *fossil alkali*, *aërated mineral alkali*, *subcarbonate of soa* and *natrum carbonicum*.

Natural History.—It is found in crystals, or in the form of an effl rescent powder, in several parts of the world. According to Klapro (quoted by Dr. Thomson, in his *Outlines of Mineralogy*, vol. i. p. 9 it occurs at Debrezin, in Hungary, and Montenuovo, near Napl Beudant (quoted by Necker in his *Règne Minéral*, t. 2^{me}. p. 667) h analyzed three native carbonates of soda: one from Lac Blanc, in Hu gary; a second from Egypt; and a third from Vesuvius. Carbonate so is a constituent of some mineral waters, which are, in consequen termed *alkaline*, or, when they also contain a large excess of carbo acid, *acidulo-alkaline* (see p. 148).

Preparation.—It may be procured from *barilla*, from *kelp*, or fro *sulphate of soda*.

1. *From barilla.*—The substance called *barilla* is an ash usually
ained by the combustion of plants belonging to the order *Chenopo-
ceæ*; as the Salsolas, Salicornias, and Chenopodiums. These are cul-
ited on the coasts, and when ripe are cut, dried, and burned in heaps:
resulting ash is barilla. It is a hard greyish or bluish mass, not deli-
scent, having an alkaline acrid taste, and a peculiar odour. It con-
s of carbonate and sulphate of soda, sulphuret and chloride of sodium,
onate of lime, alumina, silica, oxide of iron, and carbonaceous matter
ch has escaped combustion. The carbonate of soda is produced by
decomposition of the oxalate and other organic salts of soda con-
ed in the plants before combustion. Several varieties of barilla are
wn in the market: they are distinguished by the names of the places
whence they are imported; namely, the Grand Canary and Teneriffe
nds, Alicant, Sicily, Carthagena, and the East Indies. *Canary barilla*
rocured from *Salsola Kali* (Loudon, *Encyclop. of Agricult.*); *Alicant
lla* (*soda hispanica*, *s. alicantina*) is obtained from *Salsola sativa*,
nopodium setigerum, and other species (Lagasca, quoted in Decan-
e's *Phys. Vég.* p. 388). It yields from 25 to 40 per cent. of carbonate
oda. *Sicily barilla* is procured principally from *Salsola sativa:* it fur-
es, according to Fée (*Cours d'Hist. Nat.* t. 2nd. p. 488), 55 per cent. of
onate of soda. Of the *French barillas* two only deserve notice;
ely, that of Narbonne, obtained from *Salicornia herbacea*, and which
ls 14 or 15 per cent. of carbonate; and that of Aiguemortes, called
iquette, and which contains from 3 to 8 per cent. only of alkaline
onate.

arbonate of soda is procured from barilla by dissolving it in water,
ing the solution, evaporating, and crystallizing. The importation of
la has very much fallen off of late years, in consequence of the
ction of carbonate of soda from sulphate of soda. In 1827 the quan-
mported was 326,239 cwts. (*A General Statement of the Imports
Exports*, printed by order of the House of Commons, 24th Feb.
); whereas, in 1837, it was only 16,760 cwts. (*Trade List*, Jan. 9,
).

From kelp.—Kelp (called by the French *Varec* or *Normandy Soda*)
ocured by the combustion of cryptogamic plants of the order *Algaceæ*.
rding to Dr. Greville (*Algæ Britannicæ*, p. xxi.) the species most
d for this purpose are *Fucus vesiculosus*, *nodosus* and *serratus*, *Lami-
digitata* and *bulbosa*, *Himanthalia lorea*, and *Chorda Filum*. These
urned in coffers of stone or in kilns. About 24 tons of sea-weed are
red to produce one ton of kelp (Macculloch's *Western Islands*, vol. i.
3). The resulting ash is kelp. As met with in commerce, it con-
of hard, dark grey or bluish masses, having an acrid caustic taste,
omposed of chloride of sodium, about five per cent. of carbonate of
(formed by the decomposition of the oxalate and other organic salts
la), sulphates of soda and potash, chloride of potassium, iodide of
sium or sodium, and insoluble and colouring matters. By diges-
n a small quantity of water, filtering and evaporating the solution,
als of carbonate of soda may be procured. But as this salt can be
ured at a lower price and of finer quality from artificial soda, kelp is
of little value as a source of soda. In the Orkney Islands, about
0 persons were, a few years since, occupied in the manufacture of
(Greville, *op. cit.*)

3. *From sulphate of soda.*—The principal manufactories are situated i the northern parts of the kingdom, and are conducted on a most extensi scale. The process adopted varies in some of its details in differen places.

The sulphate of soda employed is, in part, obtained from manufacture of chloride of lime, who procure a considerable quantity in the proce for generating chlorine. But the greater part of it is made expressly b adding sulphuric acid to common salt (chloride of sodium). Th hydrochloric acid which is evolved is allowed to escape into th atmosphere, and is most injurious to animal and vegetable life, as I ha before stated (*vide* p. 150). In the report of a trial at Lancast March 21, 1838, the Queen *v.* Airey, in the *Times* newspaper, is contain a very humorous account of the unpleasant effects of this gas. For th sake of economy, manufacturers of carbonate of soda usually make the own sulphuric acid.

The sulphate of soda is usually decomposed by mixing it with cha and some carbonaceous matter (small coal, charcoal, or sawdust), an heating the mixture in a reverberatory furnace. The proportions us by Leblanc (Dumas, *Traité de Chimie*, t. 2^{me}. p. 475) are 1000 parts dry sulphate of soda, 1000 of chalk, and 550 of charcoal. In a large ma nufactory in the neighbourhood of London the proportions of the ingr dients employed are nearly 2 parts sulphate, 1 part chalk, and 1 pa small coal. The product of this operation has a dark grey or blacki appearance, and is called *English barilla* or *ball alkali*. By lixiviating wi water and evaporating the resulting solution, a blackish crystalline mass obtained, which, when roasted, is called *soda-ash*. This is digested in wat the solution evaporated, and the carbonate of soda afterwards crystalliz in iron pans. For other modes of proceeding I must refer to the *Tra de Chimie* of Dumas, or Brande's *Manual of Chemistry*, and Dunca *Edinburgh Dispensatory*.

The *theory* of the process is the following: the sulphuric acid the sulphate is deprived of oxygen by the carbonaceous matter (c or sawdust), while its sulphur is partly burnt and escapes as s phurous acid, and partly combines with the calcium of the chalk to fo sulphuret of calcium. The soda unites with carbonic acid produced the decomposition of the chalk, as well as by the combustion of carb To purify the impure carbonate of soda of the shops, it is ordered, in t Pharmacopœia, to be dissolved, strained, and re-crystallized.

Properties.—Carbonate of soda usually forms large crystals, the p mitive form of which is, according to Mr. Brooke, the oblique rhom prism. They are transparent, and have a cooling alkaline taste. exposure to the air they effloresce. When heated they undergo watery fusion and give out their water of crystallization: at a red heat, whole of the water is expelled, and when the resulting anhydrous car nate has been rubbed to powder it constitutes the *sodæ carbonas exsicca* Ph. L.: 54 grains of which are equivalent to 144 grains of the crys lized salt. Carbonate of soda is insoluble in alcohol. It dissolves twice its weight of water at 60°, and in less than its own weight at 212 The solution reacts as an alkali on vegetable colours.

Characteristics.—As a carbonate it is known by the tests for class of salts already stated (vide p. 301.) From the bicarbonates i distinguished by the brick-red precipitate (percarbonate of mercu ich it throws down with bichloride of mercury. Sulphate of magnesia ıses a white precipitate with it. As a soda salt it is recognised by the ts for this basic substance already stated (p. 310.)

Composition.—The perfect crystals of the ordinary carbonate of soda commerce have the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Klaproth.
Soda	1	32	22·25	22
Carbonic Acid	1	22	15·25	16
Water	10	90	62·5	62
Crystallized Carbonate of Soda	1	144	100·00	100

Impurity.—The ordinary impurities of this salt are sulphates and orides. These are detected as follows:—Supersaturate with nitric acid, l then add, to separate portions of the solution, chloride of barium and rate of silver: if the first occasion a white precipitate, it indicates the sence of a sulphate—if the second also produce a white precipitate, ıble in ammonia, it shews the presence of a chloride.

Physiological Effects.—Carbonate of soda is less acrid, and has a der and less unpleasant taste, than carbonate of potash; but in other pects the effects of these two salts on both vegetables and animals are same.

Uses.—Carbonate of soda is used in the same cases as carbonate of ash, over which it has the advantage of a less disagreeable taste. ırcroy imagined that as soda is contained in animals in larger protion than potash it was a better agent for medicinal use. Experience, vever, has not confirmed this opinion, but has proved the reverse; for h Sir G. Blane (*Trans. of a Society for the improvement of Med. and rurg. Knowledge*, iii. 347) and Mr. Brande (*Quart. Journ. of Science*, . vi. p. 205) state that they obtained beneficial effects, in calculous ıplaints, from the use of potash, where soda failed to give any relief. G. Blane accounted for this by assuming that soda becomes applied the purposes of the economy before it reaches the kidneys, whereas ash is carried to these organs in order to be thrown out of the tem.

Administration.—Crystallized carbonate of soda is exhibited in doses from ten grains to half a drachm or a drachm, or five grains to a uple of the dried carbonate, which may be given either in the form of vder or pills.

t is sometimes employed in the manufacture of the effervescing ught. A scruple of the crystallized salt saturates about $9\frac{1}{4}$ grains the ordinary crystals of citric acid, $10\frac{1}{2}$ grains of crystallized tartaric d, or $2\frac{1}{2}$ fluidrachms of lemon juice.

Antidotes.—(*Vide* art. Potassa, p. 279).

So'dæ Sesquicar'bonas.—Sesquicar'bonate of So'da.

In the province of Sukena, near Tripoli, is found a substance which the icans call *Trona*—a word from which are probably derived the terms ιον, *nitrum*, and *natron* (vide Potassæ Nitras and Sodæ Carbonas). t the analyses of Klaproth (*Beitrage*, iii. 83), Phillips (*Quart. Journ. Science*, vol. vii. 297), and Beudant (quoted by Necker, *Règne Minéral*,

ii. 668) show that the quantity of carbonic acid which it contains i larger than the carbonate, and less than the bicarbonate: hence Mr Phillips denominated the salt a sesquicarbonate. From the analysis o MM. Mariano de Rivero and Bossingault (*Ann. de Chim.* xxix. 110) i appears that the substance termed *Urao*, and which occurs at the bottom of a lake at Lagunillas, near Merida, in South America, has a simila composition.—[For an account of this lake, see *Quart. Journ. of Science* vol. i. p. 188.]

The white powder sold in the shops of this country for making *soda powders*, and which is denominated *carbonate, bicarbonate*, or *sesquicarbonate of soda*, is a compound of soda and carbonic acid; the quantit of the latter constituent being greater than that of the carbonate, bu less than that of the bicarbonate. Hence in the Pharmacopœia this sal is denominated *sodæ sesquicarbonas*, and its composition has been sup posed to be identical with the *trona* of Africa and the *urao* of Sout America. It is distinguished from the ordinary carbonate of soda b its not causing a white precipitate with a cold solution of sulphate o magnesia.

The so-called sesquicarbonate of soda of the shops, usually, if no invariably, contains carbonate and bicarbonate of soda; these may b detected as follows:—Wash with a small quantity of distilled water, an filter: the solution contains carbonate of soda (known by its throwin down a brick-dust red precipitate on the addition of bichloride of mer cury)—while there remains on the filter bicarbonate of soda (recognize by its causing a white precipitate, or a slight milkiness or opalescenc with bichloride of mercury.)* The relative proportions of carbonate an bicarbonate of soda are not constant—a fact which will explain the fol lowing remark made by Mr. Phillips (*Transl. of the Pharm.* 3rd. ed 1838):—"I am informed by Mr. Everitt that bicarbonate of soda is no not unfrequently to be met with; and very commonly, instead of mer sesquicarbonate, a mixture of this salt and a large proportion of bicar bonate may be obtained from those who manufacture on a large scale. (For further information respecting the *sodæ sesquicarbonas*, Ph. L., se SODÆ BICARBONAS.)

The composition of native crystallized sesquicarbonate of soda is a follows:—

	Eq.	Eq.Wt.	Per Cent.	Klaproth. *Trona.*	Boussingault *Urao.*
Soda	1	32	38·55	37·0	38·62
Carbonic Acid	$1\frac{1}{2}$	33	39·76	38·0	40·13
Water	2	18	21·69	22·5	21·24
Sulphate Soda	—	—	—	2·5	—
Native Sesquicarbonate Soda	1	83	100·00	100·0	99·99

* I have been recently informed by Mr. Scanlan that the salt called *Ammoniæ Sesquicarbonas* (vide p. 173) is resolved, by washing with water, into two salts, the ca bonate of ammonia, which dissolves, and a mass of crystals of bicarbonate of ammon having the form of the lump of sesquicarbonate employed. Mr. Scanlan has al obligingly furnished me with illustrative specimens of the above results. The crysta of what he has sent me as bicarbonate of ammonia have, however, a slight odour ammonia; but he tells me, that when first prepared they were odourless. Dr. Dalt (*Mem. of the Lit. & Phil. Soc. of Manchester*, 2nd Ser. vol. iii. p. 18) seems to ha been aware that the salt now called sesquicarbonate of ammonia was a mixture two salts.

So'dæ Bicar'bonas.—Bicar'bonate of So'da.

History.—This salt was discovered by Valentine Rose. In some orks it is termed *natron carbonicum perfecte saturatum seu acidulum.* ixed or combined with carbonate of soda it constitutes the *sodæ sesqui-rbonas* of the Pharmacopœia—the *carbonate* or *bicarbonate of soda* or e shops.

Natural History.—It is a constituent of the mineral waters called *idulo-alkaline,* as those of Carlsbad and Seltzer.

Preparation.—There are several methods of procuring it. Of these I all briefly notice three.

1. *Process of the Pharmacopœia.*—The substance called in the London armacopœia *sodæ sesquicarbonas* is ordered to be prepared as follows:—ssolve seven pounds of carbonate of soda in a gallon of distilled ater, and strain: then pass carbonic acid into the solution to satura-n, that the salt may subside. Dry this with a gentle heat, wrapped d pressed in cloth. According to Mr. Brande (*Manual of Chem.*) 0 lbs. of carbonate should be dissolved in 13 gallons of water, and car-nic acid thrown into the solution in a proper apparatus. About 50 s. of bicarbonate fall: and when separated should be dried in an draulic press, and afterwards by exposure to heat not exceeding 100° F. fresh portion of carbonate is dissolved in the mother liquor, and the eration repeated as before.

The carbonic acid used in this process is usually procured artificially the action of dilute sulphuric acid on carbonate of lime. In some untries, however, it is obtained from natural sources, as at Vichy, ere it is collected from the mineral waters. (For a description and etch of the apparatus used in the collection of the gas by D'Arcet, see *ct. de l'Indust.* 3me. t. p. 61.)

2. *Smith's process.*—This consists in placing the ordinary carbonate soda in a box, and surrounding it by an atmosphere of carbonic acid s under pressure. As the bicarbonate combines with much less water crystallization than is contained in the carbonate, a considerable por-n of water is liberated, which, saturated with part of the salt, is allowed drain off: when the gas ceases to be absorbed, the salt is taken out d dried. On examination it is found to have retained the original m of the pieces; but they have become of a porous and loose texture, esenting the appearance of numerous crystalline grains, aggregated gether, and having a snow-white colour. (*Journ. of the Philadelphia Col-e of Pharm.* vol. i. quoted by Dr. Bache in the *United States Dispen-ory.* For a sketch of the apparatus employed by Souberain in per-ming Smith's process, see his *Nouv. Traité de Pharm.* t. 2me. p. 341.)

3. *Process by sesquicarbonate of ammonia.*—This is the process ected to be followed in the London Pharmacopœia for 1809. Sesqui-bonate of ammonia is to be added to a solution of carbonate of soda, l a heat of about 100° F. applied to drive off the ammonia: the solu-n is then to be set aside to crystallize. The proportions employed in Pharmacopœia of 1809 were a pound of carbonate of soda, three nces of sesquicarbonate of ammonia, and a pint of distilled water. inckler (*Lehrb. d. Pharm. Chemie.* 1er. Th. S. 292) directs 4 parts of stallized carbonate of soda, $1\frac{1}{2}$ parts of sesquicarbonate of ammonia,

and 10 parts of water. The proportions ordered by MM. Henry and Guibourt (*Pharm. Raisonnée*, t. 2nd. p. 409, éd. 2me.) are 6 parts of the crystallized carbonate of soda, 2 parts of sesquicarbonate of ammonia, and 4 parts of water.

Properties.—Bicarbonate of soda usually occurs in the form of a white crystalline mass. The perfect crystals are, according to Dr. Thomson (*Chem. of Inorg. Bodies*, vol. ii. p. 54), oblique rectangular prisms. The taste of this salt, and its reaction on vegetable colours, are slightly alkaline. By exposure to the air it effloresces superficially. When heated it evolves carbonic acid and water, and becomes the anhydrous carbonate. It dissolves in 13 parts according to Rose, or 8 parts according to Berthollet, of cold water. By heat the solution loses first one-quarter, and subsequently one-half of its carbonic acid.

Characteristics.—To recognize the carbonic acid and soda of this salt, the tests are the same as before described (vide p. 324) for the carbonate of soda. From the latter salt the bicarbonate of soda is distinguished by its causing neither a brick-red precipitate with the bichloride of mercury, nor a white precipitate with the sulphate of magnesia. The sodaic powder of the shops (*sodæ sesquicarbonas*, Ph. L.) being a mixture of carbonate and bicarbonate produces a red precipitate with bichloride of mercury, but no precipitate with sulphate of magnesia; and when washed with a small quantity of cold distilled water, leaves a white powder (bicarbonate of soda), which, when dissolved in water, gives a white precipitate or slight opalescence to a solution of bichloride of mercury.

Composition.—Crystallized bicarbonate of soda has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Rose.	Berthollet.	Bérard.
Soda	1	32	34·04	37	31·75	29·85
Carbonic Acid	2	44	46·80	49	44·40	49·95
Water	2	18	19·14	14	23·85	20·20
Cryst^d. Bicarb. Soda	1	94	99·98	100	100·00	100·00

According to Dr. Thomson's analysis (*First Principles of Chemistry*, vol. ii. p. 268), this salt contains only one equivalent of water of crystallization.

Purity.—When quite pure, this salt occasions no precipitate with chloride of platinum, perchloric acid, or tartaric acid, by which its freedom from potash is demonstrated. When supersaturated with pure nitric acid, it gives no precipitate with either chloride of barium or nitrate of silver, by which the absence of sulphates and chlorides is shewn. Lastly, it occasions a white precipitate with bichloride of mercury, by which the freedom from a simple or mono-carbonate is shewn.

Physiological Effects.—The effects of this salt are analogous to those of bicarbonate of potash, than which it is regarded as having a somewhat less disagreeable taste and a slighter local action. It is of course less caustic and irritant than the sesquicarbonate, and still more so than the carbonate of soda. Its remote or constitutional effects are analogous to those of the caustic alkalies. (Vide Potassa, p. 275.)

Uses.—It is employed as an *antacid* in those forms of dyspepsia which are attended with an inordinate quantity of acid in the stomach; as a *lithontriptic* in those kinds of lithiasis which are accompanied with an essive secretion of uric acid and the urates; as a *resolvent* or *altera-* in certain forms of inflammation, in glandular affections, in syphilis, scrofula; and as a *diuretic* in some dropsical complaints. (For fur- particulars regarding these uses of bicarbonate of soda, vide POTASSA, 277, *et seq.*)

The principal consumption of bicarbonate of soda (*sodæ sesquicarbo-* Ph. L.) is in the preparation of the effervescing draught, soda-pow-, and Seidlitz powders: in these the bicarbonate is mixed with a etable acid (either citric or tartaric, usually the latter.) Taken in a e of effervescence, a solution of this kind is an agreeable and refreshing ık for allaying thirst, checking sickness, and diminishing febrile heat, have before mentioned (p. 193.) The resulting soda-salt (tartrate or ıte) undergoes partial digestion in its passage through the system, and ound in the urine in the state of carbonate. Hence, therefore, these rvescing preparations may be employed as diuretics and lithontriptics, ead of the simple carbonate or bicarbonate of soda, than which they more agreeable. On the other hand they are highly objectionable, are to be carefully avoided, in the treatment of phosphatic deposits in urine. Alluding to these cases Dr. Prout (*Inquiry into the Nature Treatment of Affections of the Urinary Organs*, 2d ed. p. 145) erves, "were I required to name the remedy calculated to do the most chief, I should name the common saline draught, formed of potash or ı, and *some vegetable acid.*"

DMINISTRATION.—The dose of this salt is from ten grains to a drachm. he preparation of effervescing draughts, a scruple of the powder sold ıe shops as bicarbonate of soda (*sodæ sesquicarbonas*, Ph. L.) usually ıires about 18 grains of crystallised tartaric acid, or about 17 grains he ordinary crystals of citric acid, or four drachms of lemon juice, to rate it.

. *SODAIC POWDERS.*—These consist of half a drachm of bicarbonate oda, contained in a blue paper, and 25 grains of tartaric acid, in a e paper. When taken they should be dissolved in half a pint of er. The flavour of the solution is improved by adding to the water, re dissolving the acid, one or two drachms of simple syrup, and er half a drachm of the tincture of orange-peel, or two or three drops ıe essence of lemon. The *pulvis aërophorus e natro carbonico acidulo* ıe Prussian Pharmacopœia consists of a drachm of the bicarbonate, scruples of tartaric acid, and the like quantity of white sugar. *ger-beer powders* are made in the same way as sodaic powders, except five grains of powdered ginger and a drachm of white sugar are ed with the bicarbonate of soda.

SEIDLITZ POWDERS.—These consist of two drachms of tartarized ı and two scruples of bicarbonate of soda contained in a blue paper, 30 grains of powdered tartaric acid in a white paper. These are to be n dissolved in half a pint of water, while the liquid is in a state of vescence. These form an agreeable and mild aperient. Why they called *Seidlitz* powders I cannot divine, as they have no analogy to litz water.

SODA WATER, properly so called: Liquor sodæ effervescens, Ph. L. he greater part of the liquid sold in the shops as *bottle-soda water*, *soda water from the fountain* or *pump*, is merely a solution of car-c acid in common water, effected by pressure, and, therefore, has no claim to the denomination of *soda* water (*vide* p. 191). Some fe makers, however, prepare it by condensing carbonic acid in a solution carbonate or bicarbonate of soda: this is *soda water properly so called* formulæ for which are given in all the British Pharmacopœias, as well in the French Codex; but which I conceive are quite unnecessary, this liquid can be prepared extemporaneously by adding bicarbonate soda to the ordinary bottle-soda water. Thus, half a drachm of bica bonate of soda and half a pint of bottle-soda water, will form a soluti of the same strength as the *liquor sodæ effervescens* of the London Pha macopœia, which is directed to be prepared by dissolving a drachm sesquicarbonate of soda in a pint of distilled water, and forcing into an excess of compressed carbonic acid gas. The *aqua carbonatis sod acidula* (Ph. Dublin) is of the same strength: the *aqua super-carbonat sodæ* (Ph. Edinb.) contains 96 grains of carbonate of soda to a pound water.

A fraudulent imitation of soda water is said to have been practised b adding a few drops of sulphuric acid to a solution of carbonate of sod in water, and instantly corking the bottle. The fraud may be detect by chloride of barium, which throws down a white precipitate insolub in nitric acid.

Soda water properly so called (*liquor sodæ effervescens*, Ph. L.) employed in the same cases as bicarbonate of soda. The addition quantity of carbonic acid contained in it, renders it more agreeable an not less effectual, as an alkaline agent, in its operation on the syste generally. It is employed to counteract or prevent the inordinate secr tion of uric acid and the urates; but both this and soda water powde are highly injurious in phosphatic deposits,—in the latter case, howeve carbonic acid water (ordinary bottle-soda water) may be used (*vi* p. 198).

Potas'sæ So'dio-Tar'tras.—So'dio-Tar'trate of Pot'ash.

History.—This salt was discovered by Seignette, an apothecary Rochelle, in 1672, and hence it is frequently termed *Seignette's salt* *Sel de Seignette* (Beckmann's *Hist. of Invent.* vol. iv. p. 616). He call it *alkaline salt*, *sal polychrest*, and *Rochelle salt* (*sal rupellensis*). T distinguish it from the sal polychrest (sulphate of potash) of other write it is sometimes denominated *sal polychrestum Seignetti*. Its other nam are, *tartarized soda* (*soda tartarizata* seu *natron tartarizatum*), or t *tartrate of potash and soda*. In the Pharmacopœia it is termed *soda potassio-tartras*.

Preparation.—The following are the directions for preparing th salt in the London Pharmacopœia:—Dissolve 12 ounces of carbonate soda in four pints of boiling water, and add, gradually, 16 ounces powdered bitartrate of potash. Strain the liquor; then apply a gen heat until a pellicle floats, and set aside, that crystals may be forme The liquor being poured off, dry these. Again evaporate the liquor, th it may yield crystals.

In this process the excess of acid in the bitartrate of potash is sat rated by the soda of the carbonate, while the carbonic acid of the latt is disengaged.

Properties.—This salt is met with in large, transparent, and reg ly-shaped crystals, whose primary form is the right rhombic prism: ; curiously enough, the crystals are frequently produced in halves. eir taste is mildly saline and bitter. Exposed to the air they slightly oresce. When heated they undergo the watery fusion, evolve their ter of crystallization, and are decomposed: the residue consists of ircoal and the carbonates of potash and soda. They are readily ible in cold, and still more so in hot water.

HARACTERISTICS.—This salt may be recognised by the shape and of the crystals. Sulphuric acid added to the aqueous solution throws vn small crystals of bitartrate of potash; perchloric acid throws down chlorate of potash: the chlorides of barium and calcium occasion ite precipitates, soluble in excess of water, and composed of soda, aric acid, and, in the one case, baryta, in the other lime: chloride platinum produces a yellow precipitate of the platinum-chloride of assium. Nitrate of silver occasions a white precipitate (tartrate of er), soluble in excess of water. When heated, potash-tartrate of a is decomposed, evolves various volatile substances, and gives out odour of caromel. If the residuum be digested in hydrochloric acid, obtain a solution of the chlorides of sodium and potassium: the oride of potassium may be precipitated by chloride of platinum, ing chloride of sodium in solution, which may be detected by the s already mentioned for this salt (p. 310).

OMPOSITION.—The composition of this salt is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Schulze.			Eq.	Eq. Wt.
la	1	32	10·6	13·3	or	Tartrate Potash	1	114
tash	1	48	15·6	14·3		Tartrate Soda	1	98
rtaric Acid	2	132	43·7	41·3		Water	10	90
ter	10	90	29·8	31·1				
rstl^d^.Sodio-Tart^e^. of Potash	1	302	99·7	100·0			1	302

Thomson (*First Principles*, ii. 440) says, that when the crystals are from all adhering moisture they contain only eight equivalents of er of crystallization, and their atomic weight is then 284.

HYSIOLOGICAL EFFECTS.—It is a mild, laxative, cooling salt, very logous in its effects to the tartrate of potash. Sundelin (*Heilmittell.*) s it is uncertain as a purgative, sometimes failing, at others acting slowly, but strongly, and with violent abdominal pain. He thinks ay be completely replaced in practice by a mixture of magnesia and hate of magnesia. Like the other vegetable alkaline salts, it under- s partial decomposition in the system, and is converted into the car- ate, in which state it is found in the urine. Hence its use should be fully avoided in persons suffering with phosphatic deposits in the e.

JSES.—It is commonly employed as a mild aperient for females and r delicate persons. It may be used with advantage by those who subject to excessive secretion of uric acid or the urates.

DMINISTRATION.—It is given in doses of from half an ounce to an ce. It should be exhibited largely diluted with water. A very con- ient mode of exhibition is in combination with bicarbonate of soda tartaric acid in an effervescing condition (*vide* SEIDLITZ POWDERS, 29).

So'dæ Ace'tas.—Ac'etate of So'da.

History.—This salt was first described by Baron, in 1747 (Thomson's *Chemist. of Inorg. Bod.* vol. ii. p. 464): but according to Dulk (*die Preuss. Pharm. übers. u. erläut.*) its real discoverer was F. Meyer, in 1677. It was formerly called *terra foliata tartari crystallisata*, or *terra foliata mineralis*.

Preparation.—It may be readily procured by saturating carbonate of soda by distilled vinegar (as directed in the Dublin Pharmacopœia), evaporating the solution and crystallizing. In this process the acetic acid expels the carbonic acid with effervescence.

On the large scale acetate of soda is obtained by manufacturers of pyroligneous acid by the following process:—Rough or impure pyroligneous acid is saturated with either slacked lime or chalk. In this way there is formed an impure acetate of lime (commonly termed pyrolignate of lime). To the clear solution is added sulphate of soda. Double decomposition takes place: sulphate of lime precipitates, and acetate of soda remains in solution. The clear liquid is then evaporated and crystallized. The impure acetate of soda thus procured is purified by drying, solution in water, re-crystallization, fusion in an iron pot, expulsion of the water of crystallization by heat, incipient carbonization to decompose the impurities of the salt, re-solution, and re-crystallization.

Properties.—The primary form of the crystals of this salt is the oblique rhombic prism. Geiger (*Handb. d. Pharm.* 1 Bd. 150, 3 Aufl.) says that a saturated solution of this salt does not readily crystallize when cooled in a tall glass vessel unless some pointed or angular body be introduced. Its taste is cooling, saline, and bitterish. Exposed to the air, at ordinary temperatures, the crystals undergo little change; but in dry and warm air they effloresce and become anhydrous. When heated they first undergo the watery fusion, then give out their water of crystallization, and afterwards undergo the igneous fusion. At a red heat they are decomposed, and give, as a residue, a mixture of charcoal and carbonate of soda. They are soluble in about 3 parts of cold water; and are slightly soluble in alcohol.

Characteristics.—As an acetate it is recognized by the tests before mentioned (p. 222) for this class of salts. That the base is soda is shewn by the characters already described (p. 310) for the soda salts.

Composition.—The following is the composition of this salt:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Soda	1	32	23·36	22·94
Acetic acid	1	51	37·22	36·95
Water	6	54	39·41	40·11
Crystallized Acetate of Soda	1	137	99·99	100·00

Purity.—It should be white and perfectly neutral to test-paper (litmus and turmeric.) The presence of sulphuric acid may be recognized by chloride of barium, which occasions, with this acid, a white precipitate insoluble in nitric acid. If nitrate of silver cause a white precipitate insoluble in both water and nitric acid, but soluble in ammonia

; presence of a chloride is to be inferred. Potash may be recognised the before-mentioned tests for this base (p. 274), as well as by the liquescence of the suspected acetate.

Physiological Effects.—Acetate of soda operates on the body like etate of potash, but is probably somewhat milder in its action.

Uses.—It is rarely employed for medicinal purposes. It may, how- er, be used as a substitute for acetate of potash, over which it has the vantage of not being deliquescent.

In pharmacy and the arts it is largely employed in the manufacture of etic acid (vide p. 221), and on this account has been introduced into ; Pharmacopœia, as the officinal source of this acid.

Administration.—The dose of it, as a diuretic, is from a scruple to o drachms.

Sa'po.—Soap.

History.—The Hebrew word *borith*, translated in our version of the ble (*Jer.* ii. 22, and *Mal.* iii. 2), soap, is, by most commentators sup- sed to refer to a plant, or to the alkaline ashes of some plant. Pliny, 10 (*Hist. Nat.* xxviii.) mentions soap, says it is made of tallow and ashes, cribes its invention to the Galls, and adds, that the Germans employed th thick and liquid soap (hard and soft soap?) In the excavations ide at Pompeii, a complete soap-boiler's shop was discovered, with the ap still perfect, though it must have been manufactured for more than 00 years (Parkes, *Chem. Essays*, ii. 5, 2nd. ed.)

Natural History.—Soap is always an artificial product, unless the ontaneous formation of *adipocire*, from dead animal matter, be consi- rred an exception to this statement. This substance appears, from the alysis of Chevreul, to consist of a small quantity of ammonia, of potash, d lime united to much margaric acid, and a very little oleic acid.

Preparation.—The manufacture of soap varies according to the qua- y of this substance intended to be produced.

The soaps employed in medicine are those which contain, as their se, potash, soda, ammonia, lime, or oxide of lead: the three first are lled *soluble*—the two latter *insoluble soaps*. Of these five, two only quire notice at present, viz. those which contain either soda or potash: d for an account of the three other soaps I must refer to the articles nimentum Ammoniæ (p. 176), Linimentum Calcis, and Emplastrum umbi.

1. *Of Soda Soap* (*sapo sodaicus: s. natrinus: s. durus: s. spissus* of iny?) The quality of this kind of soap varies according to the kind of ty or resinous matter used in its manufacture.

(*a.*) *Olive oil soda soap* (*sapo ex olivæ oleo et sodâ confectus*, Ph. L. *po durus*, Ph. Dub. *Sapo Hispanicus.*)—This is made by boiling ive oil with a solution of caustic soda (prepared by the action of lime barilla or some other impure carbonate of soda) till the soap separates, promote which common salt is sometimes added. It is then suffered congeal, and afterwards remelted in water to remove any adhering kali. When sufficiently cold it is run into *frames* (wooden troughs ith moveable bottoms), and after it has acquired sufficient firmness, is it into long cakes or bars by means of a wire. (For further details, nsult Aikin's *Dict. of Chemistry*, art. *Soap.*)

There are two varieties of olive oil soda soap—one *white* (*sapo albus*)

—another, *marbled* or *mottled*. The soap sold in the shops as *Castile soap* (*sapo castiliensis*) is of the latter kind: "the marbled appearance which it presents is produced by the addition of sulphate of iron to a part of the alkaline ley, after the soap is fully boiled, which gives the blue colour; and the stirring in red oxide of iron, when the soap is almost made, gives the red colour." (Thomson's *London Dispensatory*.) The marbling, or mottling, therefore, is an impurity.

(*b.*) *Almond oil soda soap* (*sapo amygdalinus.* Fr. Codex.)—This is the medicinal soap (*savon médicinal*) of the French; directions for preparing which are contained in the French Codex.

(*c.*) *Animal oil soda soap* (*sapo sebaceus*, Geiger: *sapo vulgaris*, United States Ph.)—Of this two kinds are in common use in this country. The best is that called *white curd soap*, and which is prepared from pure or white tallow and soda: when scented it constitutes *Windsor soap*. The *common* or *domestic soap*, usually termed *mottled soap*, is made with refuse kitchen grease (commonly called *kitchen stuff*.)

(*d.*) *Resin soda soap.*—This is the *common yellow soap* of the shops, and is the commonest of the hard soaps of this country. It owes its peculiar properties to the admixture of resin and palm oil with animal fat.

Besides the above, there are many other varieties of hard soap, termed *fancy soaps*, sold by perfumers. The patent *silica soap* consists of the usual kinds of soaps to which precipitated silica is added.

2. *Of Potash Soap.* (*sapo potassicus: s. kalinus: s. mollis: s. liquidus*, Pliny?)—This kind of soap is made with caustic potash instead of caustic soda.

(*a.*) *Olive oil potash soap* (*sapo mollis,—sapo, ex olivæ oleo et potassâ confectus*, Ph. L.)—No soap of this kind is made or known in London. I am informed by Messrs. Rowe, of Brentford (the most extensive manufacturers of soap in the neighbourhood of the metropolis), that they are unacquainted with it. On inquiry I find that a *white soft soap*, made by Mr. Taylor, 13, Newington Causeway, is used at Apothecaries' Hall, in the preparation of *Ung. Sulph. Co.* Ph. L.; but I have been unable to procure a sample of it. Mr. Taylor tells me it is only made to order, as there is very little demand for it, the principal consumption being at Apothecaries' Hall. He also informed me, that it was made from three fatty substances (olive oil, tallow, and some other oil), and two alkalies (potash and soda)—that it is white, and has the consistence of butter, but by keeping becomes harder.

(*b.*) *Animal oil potash soap.*—This is the *common soft soap* of the shops, and which is made with fish oil (whale or cod), tallow and potash. (For particulars respecting its manufacture consult Ure's *Dict. of Chem.*, art. *soap*.)

Theory of Saponification.—Soaps are to be regarded as alkaline salts, formed by the action of alkaline bases on fatty or resinous bodies. At one time it was supposed that they were mere compounds of fat or resin and of alkali; but it is now known that in the process of saponification, the organic constituents (*stearine*, *margarine*, and *olein*) of vegetable and animal fats undergo certain chemical changes by which acids (*stearic*, *margaric*, and *oleic*) are produced, which, combining with the bases, form the salts (*stearates*, *margarates*, and *oleates*) commonly termed *soaps;* and at the same time a sweet substance (*glycerine*) is generated. Thus it appears that, by the influence of an alkali, one equivat or 564 parts of stearine are converted into one equivalent or 527 ts of anhydrous stearic acid, and one equivalent or 37 parts of anhy-us glycerine; the stearic acid unites with the alkali to form soap. e following diagram illustrates these changes:—

GENTS.			RESULTS.
q. ine 564	73 eq. Carbon 438	70 eq. Carb. 420	1 eq. Anhyd. Stearic Acid = 527
		3 eq. Carb. 18	
	70 eq. Hydrog. 70	67 eq. Hydr. 67	
		3 eq. Hydr. 3	
	7 eq. Oxygen 56	5 eq. Oxyg. 40	
		2 eq. Oxyg. 16	1 eq. Anhyd. Glycerine = 37

n the conversion of resin into soap the phenomena are different. ins consist of one or more acids, which combine with alkalies to form nous salts or soaps. Thus ordinary yellow resin (or rosin) consists two acids, called respectively pinic and silvic acids; and a soda p made of this substance would, therefore, be a mixture of pinate and ate of soda.

ROPERTIES.—The consistence, colour, odour, and sp. gr. of soap y in the different kinds. The taste of all is slightly alkaline. All alkaline soaps are soluble both in water and alcohol. The substance ed *transparent soap* is prepared by evaporating an alcoholic solution ure soap. When heated soap fuses, swells up, and is decomposed, ing a residuum of charcoal and alkaline carbonate. Most of the acids ompose soap: they unite with the alkaline base and separate the fatty ls. The earthy salts (as sulphate of lime, sulphate of magnesia, alum,) also decompose soap: the fatty acids unite with the earth to form nsoluble earthy soap, while the alkali of the soap combines with the l of the salt. The *hardness* of sea, spring, and well water, depends on earthy salts (principally sulphate of lime) which decompose soap: ce tincture of soap may be used as a test of the hardness or softness ommon waters. The metallic salts also decompose soap, and give to metalline soaps.

live oil soda soap may be either white or marbled, as before stated. en pure it has very little odour. It is hard, but in the fresh state may asily worked or kneaded between the fingers: by keeping in warm t becomes dry and pulverizable. It should not feel greasy, have a id odour, communicate an oily stain to paper, nor be covered with a ne efflorescence; but should dissolve completely and readily in both er and alcohol. The marbling, as I have before stated, is an impurity.

nimal oil potash soap (*common soft soap*) is of a brownish or yel-sh colour; transparent, but interspersed with white specks, owing to admixture of tallow.

HARACTERISTICS.—Soap may be partly recognised by its physical erties, especially by its feel, which is so well known that it is usually d *soapy*. The solubility of soap in water and alcohol is an impor-character, as well as its detergent quality, which depends on its er of rendering fatty and other matters soluble in water. The effect eat on it also deserves notice: if the carbonaceous residuum be sted in weak hydrochloric acid, and the solution filtered and concen-d by evaporation, the nature of the alkaline base may be ascertained pplying the tests for potash and soda before mentioned (pp. 274 and). Lastly, the action of acids and earthy and metallic salts on a tion of soap, as already noticed, serves to recognise soap.

Composition.—The following is the composition of several varieti of soap:—

OLIVE OIL SODA SOAP.					
Marseilles white.			Marseilles Marbled.	Foreign Castile, very dry.	London-made Castile, very dry.
Soda	10·24	6	6	9·0	10·5
Stearic acid	9·20	60	64	76·5	75·2
Oleic acid	59.20				
Water..............	21·36	34	30	14·5	14·3
Olive oil soda soap..	100·00	100	100	100.0	100·0
	(Braconnot.)	(D'Arcet.)	(Thenard)	(Ure.)	(Ure.)

ANIMAL OIL POTASH SOAP	
Glasgow soft soap.	
Potash.................	
Fatty acids.............	4
Water	4
Animal oil potash soap ..	10
	(U

For analyses of other kinds of soap I must refer the student to Ur *Dict. of Chemistry*, and Gmelin's *Handb. d. Chemie*. The atomic co stitution of soap cannot be determined with accuracy, on account of t great variation in the quantity of water. The relative proportion of ac and base appear to be nearly one equivalent of the fatty acid to two the alkali. Thus, olive oil soda soap may be regarded as a compound one equivalent or 518 parts of oleic acid, and two equivalents or 64 pa of soda, exclusive of the water and the small quantity of stearate (margarate) of soda present.

Purity.—The adulterations of soap are excess of water, lime, gypsu or pipe-clay. The first may be known by the consistence of the soa and the great loss of weight which this substance undergoes in dry ai The other impurities may be detected by alcohol, which leaves the undissolved.

Physiological Effects. (*a.*) *On vegetables.*—Soap, used as a manu appears to promote vegetation (Decandolle, *Physiol. Végét.* p. 1343).

(*b.*) *On animals.*—It does not appear to be poisonous to anima Veterinarians employ it as a diuretic, and, in large doses, as a purgative

(*c.*) *On man.*—Soap acts very much like the alkalies (*vide* Potass. p. 275). Its local operation, however, is much less energetic than eith the caustic or even the carbonated alkalies. Hence it may be admini tered in considerable doses without causing irritation or inflammatio When swallowed it very readily palls the appetite and disturbs the dige tive functions, and in these qualities it is more powerful than the alkali Perhaps these effects depend on the fatty acids which must be disengag in the stomach, in consequence of the union of the alkali of the so with the free acids of the gastric juice. Probably the fatty acids becon more or less completely digested, for soap acts on the general system li the alkalies; it promotes the secretion of urine, and communicates alk line properties to this fluid. In large doses, soap acts as a purgati I knew an idiot who had frequently eaten large lumps of soap without a ill effects; and I have heard of a pound of it being swallowed for wager!

Uses.—As an *antacid*, soap is employed in poisoning by the mine acids: it should be administered in the form of a strong solution, whi effectually neutralizes the acid without acting as an irritant. So also those forms of dyspepsia which are attended with an excessive formati of acid, soap may be usefully employed to neutralize it. External pa burnt with the strong mineral acids, or with phosphorus, should washed with a solution of soap. As a *lithontriptic*, soap has been us in those forms of lithiasis in which uric acid or the urates preva A mixture of soap and lime-water was once considered a most power lvent for urinary calculi. The Hon. Horace Walpole (*Philosophical* *·ansactions*, xlvii. 43 & 472) gained great relief from it. By the tion of lime-water on soap, an insoluble calcareous soap and a solu-)n of caustic soda are formed. As a *purgative*, soap is rarely exhi-ted alone: in combination with rhubarb it may be employed with nsiderable benefit in habitual constipation and disordered conditions the biliary functions. In the form of enema, a strong solution of soap sometimes used with great relief to dissolve hardened fæces, and lieve obstinate constipation. As a *resolvent* or *alterative*, soap was ce much esteemed in enlargements and various chronic disorders of e viscera and glands; and as the alkalies have been found useful in e same diseases, any good effects which may have been obtained by ap are probably referrible to its alkaline base.

Externally, soap is frequently employed on account of its detergent, pricating, and discutient qualities. Thus, in tinea capitis, scabies, and rious other skin diseases, ablution night and morning with soap-water eatly contributes to the cure. On account of its lubricating qualities, ap is a most convenient adjunct to liniments. The uses of the lini-nt, cerate, and plaster of soap, are noticed below.

Lastly, soap is useful in pharmacy to render other medicines more uble, or to give a proper consistence to various substances for the iking of pills. Thus it is a constituent of various pills (e. g. *pil. rhei np.*, *pil. sap. comp.*, and *pil. scillæ comp.*) In some cases it acts as adjuvans, assisting and promoting the operation of other medicines; a *corrigens*, correcting their operation; and as a *constituans*, imparting agreeable or convenient form. The addition of soap to aloes or tract of jalap is cited by Dr. Paris (*Pharmacologia*) as an instance in ich soap fulfils all three of these objects.

Administration.—The usual dose of soap, taken in a pilular form, is m five grains to half a drachm. In cases of poisoning by the mineral ds, half a pint of a strong solution of soap should be instantly admi-tered.

1. *Linimentum Saponis*, Ph. L. & D. (soap, ℥iii.; camphor, ℥i.; rit of rosemary, f. ℥xvi.): *Tinctura Saponis Camphorata*, Ph. Ed. & U.S. ap, ℥iv.; camphor, ℥ii.; oil rosemary, f. ℥ss.; alcohol, f. ℥xxxii.) Drug-ts frequently substitute soft soap (animal oil potash soap) for the olive soda soap of the Pharmacopœia. *Soap liniment* or *opodeldoc* is used a stimulant and discutient, as well as, on account of its lubricating alities, in local pains, sprains, bruises, rheumatism, &c. When mixed h three-fourths of its volume of tincture of opium, it constitutes the odyne liniment (*linimentum saponis cum opio*, vel *linimentum anodynum*) the Dublin Pharmacopœia.

2. *Ceratum Saponis*, Ph. L. (soap, ℥x.; wax, ℥xiiss.; oxide of lead, wdered, ℥xv.; olive oil, Oj.; vinegar, Cj.)—The subacetate of lead, med by boiling oxide of lead with vinegar, is decomposed by the soap, soda of which combines with the acetic acid of the subacetate, while fatty acids (oleic and margaric) unite with the lead. The wax and oil ve to give consistence to the preparation. *Soap cerate* is used as a ld cooling dressing for scrofulous swellings, and other local inflamma-ns, as well as for fractured limbs: in the latter case its principal use as a mechanical support.

3. *Emplastrum Saponis*, Ph. L. & Dub. (soap, lb. ss.; lead plaster lb. iii.) This quantity of soap is said to be too much by one half. This plaster, spread on leather, is employed as a discutient and mechanica support. When two parts of it are mixed with three parts of resinou plaster (*emplastrum resinæ*, Ph. L.), it constitutes the *emplastrum saponi compositum*, vel *emplastrum adhærens*, Ph. D., and which, when spread by a machine on linen, is sold in the shops by the name of *adhesiv plaster* (Dr. Duncan, *Edinb. Dispensatory*).

Order 12. Compounds of Barium.

Bary tæ Car bonas.—Car'bonate of Bary ta.

History.—The earthy base called *baryta* was discovered in 1774 b Scheele. It was at first termed *terra ponderosa.* In 1783 Dr. Witherin recognised the native carbonate of baryta, which has been called, after it discoverer, *Witherite.*

Natural History.—*Witherite* occurs in the lead mines of the nort of England (as those of Anglesark, in Lancashire), and in various oth localities. The mineral called *baryto-calcite* (a compound of carbona of baryta and carbonate of lime) is found at Alston Moor, Cumberlan —[For some curious anecdotes respecting its discovery at the latt place, consult Parkes's *Chem. Essays*, vol. i. p. 324].

Preparation.—The native carbonate of baryta is sufficiently pure f the preparation of the other barytic salts, and is the kind meant in t Pharmacopœia. Absolutely pure carbonate may be prepared by t addition of a pure alkaline carbonate to a solution of some barytic sal as the sulphuret (obtained from the decomposition of the sulphate some carbonaceous matter), or the chloride; or it may be obtained igniting (or boiling in water) finely powdered sulphate of baryta wi three parts of carbonate of potash, and washing away the resulting su phate of potash; or by decomposing sulphate of baryta by carbonate ammonia.

Properties.—Native carbonate of baryta occurs massive, stalacti and crystallized: the primary form of the crystals is the right rectangul prism. The sp. gr. of this mineral is 4·3. Heated before the blowpi it melts into a white enamel, with the evolution of much light and t loss of carbonic acid. Artificially prepared, carbonate is a fine, tastele odourless powder. It is almost insoluble in both hot and cold wat 4,304 parts of cold, or 2,304 parts of hot water, being required to dissol one part of carbonate. It is more soluble in carbonic acid water.

Characteristics.—It dissolves with effervescence in hydrochlo acid, forming a solution of chloride of barium: the evolved gas, wh collected, is found to be carbonic acid (*vide* p. 190). The hydrochlo solution is not precipitated by ammonia, the hydrosulphurets, or t ferrocyanides; but the soluble sulphates, phosphates, and carbonat throw down white precipitates, which are, respectively, sulphate, pho phate, oxalate, and carbonate of baryta: sulphate of baryta is insolu in both water and nitric acid. The salt (chloride of barium) obtain by the evaporation of the hydrochloric solution, tinges the flame alcohol greenish yellow.

Composition.—The following is the composition of this salt:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius.	Berard.
Baryta	1	77	77·7	77·9	78
Carbonic Acid	1	22	22·2	22·1	22
Carbonate Baryta	1	99	99·9	100·0	100

Purity.—It should be white, odourless, and tasteless. Neither caustic ammonia nor hydrosulphuric acid should produce any precipitate or change of colour in the hydrochloric solution, by which the absence of alumina and metallic matter may be inferred. If excess of sulphuric acid be added to this solution, no precipitate should be occasioned by the subsequent addition of carbonate of soda, by which the absence of lime is shown.

Physiological Effects. (*a.*) *On vegetables.*—Germination does not take place in carbonate of baryta. (Vogel, in Decand. *Phys. Végét.* p. 1341.)

(*b.*) *On animals.*—Cows and fowls have been destroyed by swallowing the native carbonate. (Parkes, *Chem. Essays*, vol. i. p. 330.) Orfila (*Toxicol. Gén.*) says a drachm of the powder killed a dog in six hours; but C. G. Gmelin (*Versuche über d. Wirk. des Baryts*, &c. p. 8) gave two drachms to a dog: vomiting took place, and the animal was well the next day. A drachm killed a rabbit in three hours. When applied to a wound it has proved fatal. (Campbell, quoted by Christison, *Treatise on Poisons*, 3d ed. p. 532.) From the above experiments carbonate of baryta appears to act as an acro-narcotic poison: when swallowed it causes vomiting, inflames the alimentary tube, becomes absorbed, and acts specifically on the nervous system, causing convulsions, paralysis, and insensibility.

(*c.*) *On man.*—Only one case illustrating its action on the human subject has been published. (Dr. Wilson, *Med. Gaz.* vol. xiv. p. 487.) A young woman swallowed half a tea-cupful of the powdered carbonate: in two hours she had dimness of sight, double vision, ringing in the ears, pain in the head, and throbbing in the temples, a sensation of distension and weight at the epigastrium, distension of stomach, and palpitation. Subsequently she had pains in the legs and keees, and cramps in the calves. A day or two after the cramps became more severe. These symptoms slightly modified continued for a long time.

Uses.—Carbonate of baryta is employed in the preparation of the chloride of barium. It is not administered as a medicine.

Antidote.—(Vide Barii Chloridum.)

Ba'rii Chlo'ridum.—Chlo'ride of Ba'rium.

History.—This compound was discovered by Scheele in 1775. It was at first termed *terra ponderosa salita*, and afterwards *muriate of barytes*.

Preparation. 1. *From the native carbonate of baryta.*—The following are the directions given in the London Pharmacopœia:—Add ten ounces of carbonate of baryta, broken in small pieces, to half a pint of hydrochloric acid mixed with two pints of distilled water. Apply heat, and when the effervescence has finished, strain and boil down, that crystals may be formed.

In this process one equivalent or 37 parts of hydrochloric acid react on one equivalent or 99 parts of carbonate of baryta: the products are one equivalent or 22 parts of carbonic acid, which escape; one equivalent or 9 parts of water, and one equivalent or 105 parts of chloride of barium.

REAGENTS.				RESULTS.	
1 eq. Carb. Baryta, 99.	1 eq. Carb. Acid		22	1 eq. Carb. Acid	[illegible]
	1 eq. Baryta 77	1 eq. Oxyg.	8	1 eq. Water	[illegible]
		1 eq. Barm.	69		
1 eq. Hydrochlc. Acid 37.	1 eq. Hydrogen		1		
	1 eq. Chlorine		36	1 eq. Chloride Barm.	10[illegible]

2. *From the native sulphate of baryta.*—As a sulphate of baryta can be obtained in greater abundance and cheaper than the carbonate, manufacturers usually prepare the chloride, as well as other salts, of barium from it. There are several modes of proceeding, but the most common one is the following:—Make finely powdered sulphate into a paste with about an equal volume (or a sixth part of its weight) of flour (or charcoal); and expose it in a covered crucible to an intense heat for two hours. The carbon combines with the oxygen of the sulphuric acid and of the baryta, and forms carbonic oxide, which escapes. The residue digested in water forms a solution of sulphuret of barium. To the filtered liquor add hydrochloric acid, which causes the evolution of hydrosulphuric acid gas: filter the solution, evaporate, and crystallize. By re-solution, evaporation and a second crystallization, the crystals may be obtained very pure and fine. Or sulphate of baryta may be decomposed by igniting it with chloride of calcium.

Properties.—Chloride of barium crystallizes in right rhombic plates or tables, sometimes in double eight-sided pyramids: the primary form of the crystals is the right rhombic prism. To the taste this salt is disagreeable and bitter. Its sp. gr. is 2·825. In dry warm air the crystals effloresce, but in the ordinary states of the air they undergo no change. When heated they decrepitate, lose their water of crystallization, and at a red heat fuse. At a white heat, according to Planiava, this salt volatilizes. It is soluble in both cold and hot water: 100 parts of water at 60° dissolve 43·5 of the crystallized salt,—at 222°, 78 parts. It is slightly soluble in ordinary rectified spirit, but is said to be insoluble in pure alcohol.

Characteristics.—That it is a chloride is readily known by nitrate of silver (vide p. 105.) The tests by which the nature of the base can be determined have been before mentioned (p. 338.)

Composition.—The crystals of chloride of barium have the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Phillips.
Barium	1	69	56·09	85·201	85·5
Chlorine	1	36	29·26		
Water	2	18	14·63	14·799	14·5
Cryst. Chlor. Barium	1	123	99·98	100·000	100·0

Purity.—The crystals should be colourless, neutral to test paper, permanent in the ordinary states of the air, (if they become moist or deliquesce, the presence of chloride of calcium, or chloride of strontium, may be suspected), and their aqueous solution should undergo no alteration of colour by the addition of ferrocyanide of potassium, hydrosulphuric acid ucture of nutgalls, or caustic ammonia, by which the absence of metallic atter (as iron, lead, or copper), may be inferred. If excess of sulphuric :id be added, the filtered solution should be completely volatile when :ated, and should occasion no precipitate on the addition of carbonate 'soda, by which the absence of lime or magnesia is proved.

Physiological Effects. (*a.*) *On vegetables.*—This salt is poisonous plants. (Marcet, quoted by Decandolle, *Phys. Végét.*)

(*b.*) *On animals.*—The action of chloride of barium on animals is, ac- rding to Sir B. Brodie (*Phil. Trans.* 1812, p. 205), analogous to that of senic. Locally it operates as an irritant. After absorption it affects the rvous system, the organs of circulation, and the stomach. Its action the nervous system is manifested by staggering, convulsions, paralysis, d insensibility; on the circulating system, by palpitations, with feeble d intermittent pulse; on the stomach, by vomiting from its application a wound. According to Sir B. Brodie the affection of the stomach is ghter than that caused by arsenic. (See also the experiments of Orfila the *Toxicol. Génér.*, and of C. G. Gmelin in his *Versuche über die Wir- ngen*, &c.)

(*c.*) *On man.*—Administered in *small doses*, it at first produces no ry obvious effects. In some cases the appetite appears to be improved. on we observe an increased secretion of urine, tendency to sweating, d not unfrequently loose stools. With no other obvious symptoms in these, glandular swellings or enlargements sometimes become softer d smaller, from which we infer that the absorbent system is stimulated greater activity. If we persevere in the use of gradually increased ses, the appetite becomes disordered, nausea and vomiting, with not frequently griping and purging, come on: a febrile state, with dry igue, is produced, the nervous system becomes affected, and the patient nplains of giddiness and muscular weakness. Sometimes, according Schwilgue (*Traité de Mat. Méd.* vol. i. p. 441, 3^{me}. ed.) under the ntinued use of it, catarrhal discharges from the eye, nose, ear, &c. take ce; inflamed or suppurating lymphatic glands evince signs of an gmented excitation, wounds assume a more healthy appearance, and, some cases, cicatrize.

In *large medicinal doses* very unpleasant effects have been occasionally served from its use; such as vomiting, purging, sometimes griping, ntracted pulse, giddiness, and great muscular debility, almost amount- ; to paralysis, with trembling. (See an illustrative case in *Medical mmentaries*, xix. 267.)

In *excessive* or *poisonous doses* (as an ounce) the affection of the ner- is system is more obvious. In one recorded case the symptoms were ivulsions, pain in the head, deafness, and, within an hour, death. (*Journn. Science*, vol. ix. p. 382.)

In conclusion, it may be observed, that considered medicinally chloride barium is most analogous to, though more powerful than, chloride of cal- m, and is applicable in the same cases: regarded toxicologically it may compared to arsenic, but it acts less energetically on the stomach, and re rapidly on the nervous system, and causes death in a shorter time.

Uses.—The principal medicinal use of chloride of barium is in the atment of *scrofula*, for which it was introduced into medicine by Dr. awford in 1790 (*Med. Commentaries*, Dec. 2d, vol. iv. p. 433, and *d. Communications*, vol. ii.), and was subsequently employed by Hufeland (*Erfahr. üb. d. Gebr. u. d. Kräfte d. salzs. Schwererde*, Berl. 1794 and *Vollst. Darstell. d. med. Kräfte u. d. Gebr. d. salzs. Schwererde*, Berl. 1794), with great benefit. The latter writer has employed it in all the forms of this disease, but especially in excited and inflamed conditions, (particularly of delicate and sensible parts, as of the lungs and eyes in painful ulcers, indurations which are disposed to inflame, and cutaneous affections. It has also been administered as a resolvent, deobstruent, or alterative, in some other diseases: for example, *scirrhus* and *cancer*, *cutaneous diseases*, *bronchocele*, &c. As a local application, solution of it has been used as a wash in herpetic eruptions, and as collyrium in scrofulous ophthalmia.

In pharmacy and chemistry it is extensively employed as a test for sulphuric acid and the sulphates.

Administration.—It is used in the form of aqueous solution. The *Liquor Barii Chloridi*, Ph. L. consists of a drachm of the salt dissolved in an ounce of distilled water. The dose is ten drops gradually and cautiously increased until nausea or giddiness are experienced. The officinal solutions of the Edinburgh and Dublin Pharmacopœias are about $2\frac{1}{2}$ times stronger. Common water, and all liquids containing carbonates, phosphates, or sulphates, are incompatible with it.

Antidotes.—The antidotes for the barytic salts are the sulphates which form therewith an insoluble sulphate of baryta. Hence sulphate of soda, sulphate of magnesia, or well or spring water (which contains sulphate of lime) should be copiously administered. Of course the poison should be removed from the stomach as speedily as possible. To appease any unpleasant symptoms caused by the continued use of large medicinal doses, opiates may be employed.

Order 13. Compounds of Calcium.

Calx.—Lime.

History.—Lime, and the mode of obtaining it by burning the carbonate, were known in the most remote periods of antiquity. Hippocrates (*Popularium*, ii. sect. 5) employed this earth in medicine. Dr. Black in 175[illegible] first explained the nature of the process for making it. In 1808 Davy shewed that this substance was a metallic oxide, and hence it has been termed the *oxide of calcium*. To distinguish it from the hydrate of lime it is termed *caustic* or *quicklime* (*calx viva*), or *burned lime* (*calx usta.*)

Natural History.—It occurs in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—In the mineral kingdom lime is found in the form of carbonate, sulphate, phosphate, silicate, arseniate, tungstate, borate, and titanate. Its base, calcium, occurs in combination with fluorine. "Lime is also disseminated through sea water though in small quantities; so that calcium is widely distributed in land and water, being principally abundant in the central and higher parts of the fossiliferous rocks, and widely dispersed, in small quantities, throughout the more ancient rocks, and in the waters of the ocean." (De la Beche, *Research. in Theor. Geol.* p. 21.)

(*b.*) *In the organized kingdom.*—In vegetables, lime (or calcium) is an invariable ingredient, except, it is said, in the case of *Salsola Kali.* (De Candolle, *Phys. Végét.* p. 382.) It is found combined with carbonic, su uric, phosphoric, nitric, and various organic acids (as oxalic, malic, tric, tartaric, and kinic): calcium occurs in combination with chlorine. animals lime is found principally as carbonate and phosphate.

PREPARATION.—For use in the arts lime is usually obtained by burning e carbonate with coals, coak, or other fuel, in a kind of wind furnace lled a *kiln* (vide Loudon's *Encycl. of Agricult.* 3d ed. p. 625; and ray's *Operative Chemist.*) In the Dublin, Edinburgh, and United ates Pharmacopœias, the officinal lime is the lime of commerce: but as is contains various impurities, the London Pharmacopœia directs lime be prepared by exposing chalk to a very strong fire during an hour, which the carbonic acid is expelled. White Carrara marble yields e purest lime.

PROPERTIES.—Lime (commonly termed *quicklime*) when pure is a white, greyish white solid, having a sp. gr. of 2·3. It has an acrid, alkaline ste, and reacts powerfully on vegetable colours as an alkali. It is diffi-lt of fusion: but by the oxy-hydrogen flame it may be both fused and latilized. Exposed to the air it attracts water and carbonic acid. If small portion of water be thrown on lime, part of it combines with the ne, and thereby causes the evolution of a considerable degree of heat, by hich another portion of the water is vaporized. The lime swells up, acks, and subsequently falls to powder: in this state it is called *slacked ne* (*calx extincta*), or the *hydrate of lime.* By heat the water may be ain expelled.

Lime dissolves in water, forming *lime-water* or *aqua calcis.* It is pre-ared by first slacking lime and then adding more water: the proportions aployed by the London College are half a pound of lime to three gallons water. The solution should be kept in stopped glass vessels with the dissolved lime, and when used the clear liquor poured off. The solu-lity of lime in water is very remarkable; cold water dissolving more an hot. According to Mr. Phillips,

A pint of Water at	32° dissolves	13·25 grains	of lime.
Ditto . .	60° . . .	11·6	ditto.
Ditto . .	212° . . .	6·7	ditto.

that water at 32° dissolves nearly twice as much lime as water at 212°. ime water is colourless and transparent, but by exposure to the air comes covered with a film of carbonate of lime, which precipitating to e bottom of the vessel is succeeded by another. Its taste is unplea-nt and alkaline, and it has an alkaline reaction on vegetable colours. hen a cold saturated solution of lime is heated, small crystals of drate of lime are deposited: the same are also produced by evaporat-g lime water in the exhausted receiver of the air-pump.

CHARACTERISTICS.—Lime water is recognized by its action on turme-c paper and on the infusion of red cabbage; by the milkiness produced it on the addition of carbonic acid or a soluble carbonate, and by the hite precipitate on the addition of a solution of oxalic acid or an oxalate. ulphuric acid affords no precipitate with lime water. Solutions of the lcareous salts are known by the following characters:—The hydro-ulphurets, ferrocyanides, and, if the solution be dilute, the sulphates, casion neither a precipitate nor a change of colour: the soluble car-onates, phosphates, and oxalates, produce white precipitates. The lcareous salts (especially chloride of calcium) give an orange tinge to e flame of alcohol.

Composition.—The following is the composition of lime and its hydrate:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Calcium	1	20	71·42	71·91
Oxygen	1	8	28·57	28·09
Lime	1	28	99·99	100·00

	Eq.	Eq. Wt.	Per Cent.
Lime	1	28	75·67
Water	1	9	24·32
Hydrate of Lime	1	37	99·9

Purity.—The lime used in the arts is never absolutely pure, but usually contains variable quantities of carbonate of lime, silica, alumina, and oxide of iron, and sometimes magnesia.

Physiological Effects. (*a.*) *On vegetables.*—Quicklime is poisonous to plants. Notwithstanding this, however, it is sometimes used as a manure, its efficacy depending on its decomposing and rendering soluble the vegetable matter of the soil, during which the lime attracts carbonic acid and becomes innocuous. (Davy, *Agricult. Chemistry.*)

(*b.*) *On animals.*—On dogs, Orfila (*Toxicol. Gén.*) found that quicklime acted as a caustic poison, but not very energetically; and that it occasions death by producing inflammation of the texture with which it comes in contact.

(*c.*) *On man.*—Quicklime is an escharotic. Its chemical action on the tissues is analogous to that of the fixed alkalies, to which must be added its powerful affinity for water. Its use in promoting the decomposition of the bodies of persons who have died of contagious diseases, or on the field of battle, and its employment by the tanner to separate the cuticle and hair from skins, sufficiently establish its causticity. Its escharotic and irritant action is well seen in the ophthalmia produced by the lodgment of small particles of lime in the eye.

When applied to suppurating or mucous surfaces, lime water checks or stops secretion, and produces dryness of the part: hence it is termed a desiccant.

When administered internally, it neutralizes the free acid of the gastric juice, diminishes the secretions of the gastro-intestinal membrane, and thereby occasions thirst and constipation. It frequently gives rise to uneasiness of stomach, disordered digestion, and not unfrequently to vomiting. After its absorption it increases the secretion of urine, and diminishes the excessive formation or deposition of uric acid and the urates. With this exception, it does not, as the alkalies, promote the action of the different secreting organs, but, on the other hand, diminishes it, and has in consequence been termed an astringent. But it does not possess the corrugating action of the astringent vegetables, or of many of the metallic salts: it is rather a drying remedy, and might be more correctly termed a *desiccant* than astringent. In this respect lime differs from the alkalies, but is analogous to the oxide of zinc. Vogt (*Pharmak.*) considers it to be intermediate between the two. Weickard and others have ascribed to lime an antispasmodic property; and if this be true, its relation to zinc is still further proved.

A power of exciting and changing the mode of action of the absorbent vessels and glands has been ascribed to lime water, and probably with foundation. At any rate, under the use of it, glandular enlargements have become softer and smaller. Sundelin (*Heilmittell.*) says that the excessive use of lime does not, as in the case of the alkalies, bring about a scorbutic diathesis, but a general drying and constriction, analogous to that caused by zinc.

ime in large doses acts as a poison: the symptoms in one case were st, burning in the mouth, burning pain in the belly, obstinate constiion, and death in nine days. (Christison.)

Jses.—Quicklime has been employed as a *caustic*, but alone is now ly resorted to. It is sometimes applied in the form of *potassa cum e*, and is a constituent of the ordinary depilatories. As an *antidote*, water, in conjunction with milk, was recommended by Navier *ntre-poison de l'arsenic*, &c. 1777, quoted by Richter, *ausf. Arzn.*) in soning by arsenious acid. In the absence of more appropriate antis, lime water may be administered in poisoning by the common eral and oxalic acids. As a *lithontriptic* it possessed at one time siderable celebrity, partly from its being one of the active ingredients Miss Joanna Stephens' *Receipt for the Stone and Gravel*, as well as experiments and reports of professional men. As this lady had uired no slight fame by her mode of treatment, a great desire was ifested to know the nature of her remedies, and she therefore offered iscover them on the payment of a suitable reward. A committee of essional men was appointed to examine the efficacy of her treatment, her medicines were given to patients known to have calculi. The ort made by the committee, as to the effects, was so favourable, that liament was induced to grant a reward of £5000, a notice of which eared in the *London Gazette* of March 18, 1739! (D'Escherny, *A atise of the Causes and Symptoms of the Stone*, 1755.) The essential s of her remedies were lime (prepared by calcining egg-shells and ls), soap, and some aromatic bitters; viz. camomile flowers, sweet fenparsley, and burdock leaves, &c. That the patients submitted to treatt obtained relief by the remedies employed cannot, I think, be doubted, no cure was effected; that is, no calculus was dissolved, for in the lder of each of the four persons whose cure was certified by the ees, the stone was found after their death (Alston's *Lect. on the Mat. l.* vol. i. p. 268). Notwithstanding the favourable reports to the rary (Chevallier, *Med. Gaz.* vol. xx. p. 460), it appears to me that rational ground of hope can now be entertained that lime water is ble of dissolving urinary calculi in the kidneys or bladder: but e is abundant evidence to prove that patients afflicted with the uric diathesis have sometimes experienced extraordinary benefit from se (Van Swieten's *Commentaries upon Boerhaave's Aphorisms*, vol. xvi. 99). Its mode of action is analogous to that of the alkalies (*vide* 9 & 279). Chevallier (*Med. Gaz.* vol. xx. p. 584) accounts for its acy in the treatment of gravel and stone by the circumstance of the bination of the lime with uric acid forming a very soluble salt, viz. e of lime; and he even thinks that lime water may be useful in phosic calculi, either by depriving them of a portion of the uric acid h they contain, and thus rendering them less dense; by decomposing ammoniacal salt which enters into the composition of some; or by g on the animal matter which holds the molecules of these calculi ther. As an *antacid* in dyspepsia accompanied by acidity of stoh, it is sometimes useful. "Mixed with an equal measure of milk, h completely covers its offensive taste, it is one of the best remedies ur possession for nausea and vomiting dependent on irritability of ach. We have found a diet, exclusively of lime water and milk, to nore effectual than any other plan of treatment in dyspepsia, accompanied with vomiting of food. In this case one part of the solution to two or three of milk, is usually sufficient" (*United States Dispensatory*). In the dyspepsia of gouty and rheumatic subjects, and which is usually accompanied with a copious secretion of uric acid by the kidneys, I have seen lime water serviceable. As a *dessicant* or *astringent*, it is useful as a wash for ulcers attended with excessive secretion. In some scrofulous ulcers in which I have employed it, its power of checking secretion has been astonishing. In diarrhœa, when the mucous discharge is great, and the inflammatory symptoms have subsided, lime water is useful as an astringent. As an injection in leucorrhœa and gleet it sometimes succeeds where other remedies have failed. The internal use of lime water has also been serviceable in checking secretion from various other parts, as from the bronchial membranes, the bladder, &c.

Besides the above, lime water has been employed for various other purposes. Thus as an antispasmodic, in hypochondriasis and hysteria with habitual excessive sensibility of the nervous system, it has been found useful by Weickard (Richter's *ausf. Arzneim.* iii. 585). It has also been given as an alterative in glandular enlargements and venereal affections, and to promote the deposit of bone earth in diseases accompanied with a deficiency of this substance. In skin diseases (tinea capitis, scabies, prurigo, &c.) it has been applied as a wash.

Administration.—From half an ounce to three or four ounces may be taken three times a day. As already mentioned, it may be conveniently administered in combination with milk.

Linimentum Calcis, Ph. Dub. & U. S.; *Oleum Lini cum Calce*, Ph. Ed. *Calcareous soap* or *oleo-margarate of lime* (lime water, linseed or olive oil āā. equal parts).—This compound has been celebrated as an application to burns and scalds. From being used at the Carron Iron works, in cases of burns, it is called *Carron oil*. It is almost invariably prepared with linseed oil, though in the Dublin Pharmacopœia olive oil is ordered. Turpentine may be sometimes advantageously added to it.

Cal'cii Chlo'ridum.—Chlo'ride of Cal'cium.

History.—This salt, obtained in the decomposition of sal ammoniac by lime, was known, according to Dulk (*Die Preuss. Pharm. übersetzt*, &c. ii. 293) in the fifteenth century to the two Hollands, who called it *fixed sal ammoniac* (*sal ammoniacum fixum*). Its composition was not understood until the eighteenth century, when it was ascertained by Bergman, Kirwan, and Wenzel. It is commonly termed *muriate of lime*.

Natural History.—It is found, in small quantity, in sea and many mineral and well waters. It has also been detected, in a few instances in vegetables: thus Pallas recognised it in the root of *Aconitum Lycoctonum*.

Preparation.—It is readily prepared by dissolving carbonate of lime in hydrochloric acid. The proportions ordered in the London Pharmacopœia are, five ounces of chalk, half a pint of hydrochloric acid, and the like quantity of water. When the effervescence has finished, the filtered solution is ordered to be evaporated to dryness, and the resid

;ed in a crucible. While in the liquid state it is to be poured on a :an flat stone, and when cold broken into small pieces, and preserved a well-stopped vessel.

In this process one equivalent or 37 parts of hydrochloric acid react one equivalent or 50 parts of carbonate of lime, and produce one uivalent or 22 parts of carbonic acid, which escapes in a gaseous form, e equivalent or 9 parts of water, and one equivalent or 56 parts of loride of calcium. By the subsequent evaporation and fusion, both water used and that formed are expelled, leaving anhydrous chloride calcium.

REAGENTS.		RESULTS.
1 eq. Carbon^{te}. of Lime . . 50	1 eq. Carbon.A^{d}. 22	1 eq. Carb^{c}. Acid . 22
	1 eq. Oxygen . . 8	1 eq. Water 9
	1 eq. Calcium . 20	
1 eq. Hydrochl^{c}. Acid . . 37	1 eq. Hydr. . . 1	
	1 eq. Chlor. . . 36	1 eq. Chlor^{de}.Calc^{m}. 56

Chloride of calcium is a secondary product in the manufacture of the drated sesquicarbonate of ammonia (p. 174).

Properties.—Anhydrous chloride of calcium is a white translucent id, of a crystalline texture. Its taste is bitter and acrid saline. It is ible, but not volatile. It deliquesces in the air, and becomes what has en called *oil of lime* (*oleum calcis*). When put into water it evolves at, and readily dissolves in a quarter of its weight of this fluid at ° F., or in a much less quantity of hot water. By evaporation the solu- n yields striated crystals (*hydrated chloride of calcium*), having the m of regular six-sided prisms, and which, therefore, belong to the ombohedic system (p. 61). These crystals undergo the watery fusion ıen heated, are deliquescent, readily dissolve in water with the produc- n of great cold, and when mixed with ice or snow form a powerful gorific mixture. Both anhydrous and hydrous chloride of calcium are ıdily soluble in alcohol.

Characteristics.—This salt is known to be a chloride by the tests this class of salts before mentioned (p. 105). The nature of its base ascertained by the tests for lime (p. 343).

Composition.—The composition of this salt is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Ure.
ılcium	1	20	35·71	36·7
ılorine	1	36	64·28	63·3
ıloride Calcium	1	56	99·99	100·0

	Eq.	Eq.Wt.
Chloride Calcium	1	56
Water	6	54
Cry^{t}.Chl^{de}.Calc^{m}.	1	110

Purity.—Chloride of calcium, when pure, is colourless, evolves no ımonia when mixed with lime, and undergoes no change of colour nor es any precipitate with caustic ammonia, chloride of barium, hydro- lphuric acid, or ferrocyanide of potassium.

Physiological Effects. (*a.*) *On animals.*—Three drachms and a lf given to a dog caused quick breathing and snorting, with convulsive t vain efforts to vomit, a profuse secretion of saliva, and death in six urs. The mucous membrane of the stomach and small intestines was ry blood-shot, and in many places almost black, and converted o a gelatinous mass (Beddoes, *Duncan's Annals of Medicine*, vol. i. ıstr. ii. 208).

(*b.*) *On man.*—In *small doses* it promotes the secretions of mucus, urin and perspiration. By continued use it appears to exercise a specif influence over the lymphatic vessels and glands, the activity of which increases; for under its use glandular and other swellings and indur tions have become smaller and softer, and ultimately disappeared alt gether. In *larger doses* it excites nausea, vomiting, and sometimes pur ing; causes tenderness in the præcordium, quickens the pulse, an occasions faintness, weakness, anxiety, trembling, and giddiness. I *excessive doses* the disorder of the nervous system is manifested b failure and trembling of the limbs, giddiness, small contracted puls cold sweats, convulsions, paralysis, insensibility, and death (Vogt, *Pha makodyn*). Considered in reference to other medicines, it has the close resemblance in its operation to chloride of barium. Hufeland (quot by Wibmer, *die Wirkung*, &c.) says its operation is more irritant th the last mentioned substance, and that its use requires greater caution,— a statement which is directly opposed to the experience of Dr. Wo (*Ed. Med. and Surg. Journ.* i. 147), and of most other practitioners.

Uses.—It has been principally employed in scrofulous affections, esp cially those attended with glandular enlargements. Beddoes (*op. cit* gave it to nearly a hundred patients, and he tells us there are few of t common forms of scrofula in which he has not had successful experien of it. Dr. Wood (*op. cit.*) tried it on an extensive scale, and wi decided benefit. It has been found most efficacious in the treatment tabes mesenterica, checking purging, diminishing the hectic fever, alla ing the inordinate appetite, and ultimately restoring the patient to perfe health. It has also been recommended in chronic arthritic complaint in bronchocele, in some chronic affections of the brain (as paralysis and in other cases where the object was to excite the action of the ab sorbents.

Occasionally, though rarely, it has been employed externally. Th a bath containing two or three ounces of it, either alone or with chlori of sodium, has been used in scrofula (Vogt, *Pharmakodyn.*)

In pharmacy chloride of calcium is used in the rectification of spir (p. 197), on account of its strong affinity for water. In chemistry it employed in the drying of gases, and in the crystallized state, mix with half or two-thirds of its weight of ice or snow, for producing a intense degree of cold.

Administration.—Chloride of calcium is always used in the form aqueous solution. The *Liquor Calcii Chloridi*, Ph. L. consists four ounces of the chloride dissolved in twelve fluidounces of distill water. The dose of it is forty or fifty minims, gradually increased un slight nausea is produced.

Cal'cis Hypochlo'ris.—Hypochlo'rite of Lime.

History.—In 1798, Mr. Tennant, of Glasgow, took out a patent f the manufacture of this substance as a bleaching powder, which in co sequence was long known as *Tennant's bleaching powder*. According the views entertained of its composition, it has been successively term *oxymuriate of lime*, *chloride of lime* or *chloruret of the oxide of calciu chlorite of lime* (Berzelius), and *chlorinated lime* (*calx chlorinata*, Ph. L

'REPARATION.—It is prepared by conveying chlorine gas into a vessel hamber containing slacked lime. On the large scale the gas is gene-d in large, nearly spherical, leaden vessels heated by steam. The edients employed are binoxide of manganese, chloride of sodium, diluted sulphuric acid. The gas is washed by passing it through er, and is then conveyed by a leaden tube into the combination room, re the slacked lime is placed in shelves or trays, piled over one her to the height of five or six feet, cross bars below each, keeping about an inch asunder, that the gas may have free room to cir-te. The combination m is built of siliceous sandstone, and is ished with windows, to allow the operator to judge how the impreg-on is going on. Four days are usually required, at the ordinary rate orking, for making good marketable chloride of lime (Ure, *Quart. n. of Science*, xiii. 1). At Mr. Tennant's manufactory at Glasgow, lime is placed in shallow boxes at the bottom of the combination nbers, and is agitated during the process by iron rakes, the handles hich pass through boxes filled with lime, which serves as a valve *erican Journ. of Science*, vol. x. No. 2, Feb. 1826, and Dumas' *Traité himie*, ii. 806). The theory of the process will be noticed when ribing the composition of this substance.

ROPERTIES.—Chloride of lime, as met with in commerce, is a white rownish white powder, having a feeble odour of chlorine, and a strong r and acrid taste. Exposed to the air it evolves chlorine, and at-s carbonic acid, and is thereby converted into a mixture of carbonate ne and chloride of calcium, the latter of which deliquesces. Digested ater the chloride or hypochlorite of lime dissolves, as well as any ride of calcium present, and a small portion of caustic lime: any car-te and the excess of caustic lime remain undissolved. The solution, h has a slight yellow colour, first reacts on vegetable colours as an i, and afterwards bleaches them. Its bleaching and disinfecting pro-es depend on the oxidizement of the colouring or infectious matter: if cid be employed in the process, chlorine is evolved, which produces gen at the expense of the elements of water, as before mentioned 07): if, on the contrary, no acid be used, Balard (*Researches*, in or's *Scientific Memoirs*, vol. i. p. 269) supposes that both the hypo-ous acid and lime give out their oxygen, and thereby become chlo-of calcium. When chloride of lime is heated it evolves first chlorine subsequently oxygen.

HARACTERISTICS.—Its smell and bleaching properties are most cha-ristic of it. The acids (as sulphuric or hydrochloric) separate chlo-from it. An aqueous solution of it throws down white precipitates nitrate of silver, the alkaline carbonates, and with oxalic acid or the ites. The supernatant liquor from which chloride of silver has thrown down by nitrate of silver possesses a decolorizing property.

OMPOSITION.—Chemists are not agreed as to the nature of the sub-e called chloride of lime. By most English chemists (Dalton, nson, Brande, Turner, and Phillips), it is supposed that when chlo-omes in contact with slacked lime combination takes place, and that ime undergoes no decomposition By others (Berzelius, Soubeiran, Balard), however, it is supposed that part of the lime is decomposed; portion of the chlorine uniting with the calcium to form chloride of um; and another with the oxygen to become hypochlorous (*chlorous*, Berzelius) acid, which combines with the undecomposed lime: so that th so-called chloride of lime is, according to this view, a mixture of chlorid of calcium and hypochlorite (or rather a tris-hypochlorite) of lime an water. The following diagram illustrates the formation of these com pounds according to the latter theory:—

REAGENTS.			RESULTS.
2 eq. Chlorine, 72.	1 eq. Chlor...36		1 eq. Chloride Calcium = 56.
	1 eq. Chlor. ..36		
4 eq. Hydrate of Lime 144	1 eq. Calcium 20		
	1 eq. Oxyg.... 8	1 *eq. Hypochl^s. Acid* 44	
	3 eq. Lime ..84		1 eq. Tris-hypochlorite Lime 128
	4 eq. Water ..36		4 eq. Water 36

Chloride Lime of

When chloride of lime comes in contact with water, the tris-hypochlori deposits two equivalents of hydrate of lime, while one equivalent of th chloride of calcium and one equivalent of the neutral hypochlorite lime are dissolved.

The following table shews the composition of the so-called chloride lime according to Soubeiran (*Nouv. Traité de Pharm.* ii. 365); Philli (*Transl.* 3d ed.); and Ure, (*op. cit.*)

SOUBEIRAN.	Eq.	Eq.Wt.	PHILLIPS.	Eq.	Eq.Wt.	URE.	*Ure's.*	*Comm*
Chloride of Calcium	1	56	Bihydrated Chloride of Lime	1	82	Chlorine....	40·31	..
Tris-hypochlorite of Lime	1	128	Lime	1	28	Lime	45·40	..
Water..................	4	36				Water	14·28	..
Dry Chloruret of Lime ..	1	220	Chlorinated Lime	1	110	Chloride of Lime	99·99	..

CHLOROMETRY —The chloride of lime of commerce varies in the qua tity of hypochlorite which it contains, and hence some chlorometric process is necessary in order to ascertain its goodness. The two prin pal methods are, to determine the quantity of chlorine gas which evolves on the addition of hydrochloric acid (Ure, *Quart. Journ. of S ence*, xiii. 21) and to observe what quantity of sulphate of indigo it capable of decolorizing (Gay Lussac, in Alcock's *Essay*, p. 136.) I Ure says 10 grains of good bleaching powder should yield 3 or 4 cu inches of chlorine.

PHYSIOLOGICAL EFFECTS.—The effects of chloride (hypochlorite) lime on the system have not as yet been accurately ascertained. local action is that of an irritant and caustic. A solution of it applied suppurating and mucous surfaces is a powerful desiccant, probably part at least from the uncombined lime in solution. When the secreti are excessive and extremely fetid, it not only diminishes their quant but much improves their quality; so that considered in reference to su purating and mucous surfaces, it is not only a desiccant, but, in mor conditions of these parts, a promoter of healthy secretion. Applied the form of ointment (composed of a drachm of chloride to an ounce fatty matter) to scrofulous swellings, Cima (Configliachi and Brugnatel *Giornale di Fisica*, 1825, quoted by Dierbach, *d. neust. Entd. in d. M Med.* 1828, 2^te. Abt. 597), found that it provoked suppuration, cau strong redness, promoted the suppurating process, and dispersed the s rounding hardness.

Taken internally in *small doses* (as from 3 to 6 grains dissolved in or two ounces of water) it sometimes causes pain and heat in the stoma occasionally, according to Cima, purging. Under the continued use t, hard and enlarged absorbent glands have become softer and smaller, a which circumstance it has been supposed to exercise a specific uence over, and promote the healthy action of, the lymphatic system. ring its employment, Cima says he did not find it necessary to give gatives. Dr. Reid (*Trans. of the Associat. of Fellows and Licentiates he College of Physicians in Ireland*, vol. v. 1828), gave it in the epide- fever which raged in Ireland in 1826, and he tells that it rendered tongue cleaner, abated the delirium, and promoted the cutaneous ctions. In dysentery it soon put a stop to the bloody evacuations, umbilical pain, and the tenesmus.

am not acquainted with any facts respecting the effects of chloride of *in large or poisonous doses.* Analogy would lead us to expect that ould produce the combined effects of a caustic, and of an agent spe- cally affecting the nervous system.

Uses.—The chlorides (hypochlorites) of lime and soda are extensively ployed as disinfectants and antiseptics. I have already stated (p 107) chlorine gas stands unrivalled for its power of destroying putrid urs and checking putrefaction, and where uninhabited chambers or dings are to be purified, fumigations with this gas should be adopted. its powerful action on the organs of respiration precludes its use in abited places, and, in such cases, the alkaline chlorides (chloride of , on account of its cheapness) are to be substituted. When these stances are in contact with organic matter, it is supposed the hypo- orite gives out oxygen, and is converted into a metallic chloride: the gen being the effective disinfecting and antiseptic agent. When, ever, the solution of the chloride (hypochlorite) is exposed to the air, onic acid is attracted by the lime, and hypochlorous acid set free: is decomposed by the calcium of the chloride, lime is formed, which bines with carbonic acid of the air, and chlorine (from both the hypo- orous acid and chloride of calcium) is disengaged, and furnishes gen to the putrefying matter at the expense of some water, with the rogen of which it combines. Hence these chlorides (hypochlorites) n exposed to the air evolve chlorine so slowly and in such moderate ntities, as not to produce any noxious effects, though their action on anic matters is very powerful. Their most obvious effect is that of roying the unpleasant odour of putrid matter. Their action on rosulphuric acid, ammonia, and hydrosulphate of ammonia (substances ved by decomposing animal matters) can be readily and easily de- nstrated. Other odorous principles given out by putrid matters are, he experience of most persons, admitted to be destroyed by the line chlorides, though Piorry (*Journ. Chim. Méd.* ii. 601) has asserted are only overpowered by the stronger smell of the chlorine.

The alkaline chlorides (hypochlorites) possess another valuable pro- y—that of stopping or checking the putrefactive process; and hence are called antiseptics. For various facts in proof of this I must to the late Mr. Alcock's *Essay on the Uses of the Chlorurets.*

These two properties, viz. that of destroying offensive odours and that reventing putrefaction, render the alkaline chlorides most valuable its to the medical practitioner. We apply them to gangrenous s, to ulcers of all kinds attended with foul secretions, to compound fractures accompanied with offensive discharges, to the uterus in variou diseases of this viscus attended with fetid evacuations; in a word, w apply them in all cases accompanied with offensive and fetid odour As I have before remarked with respect to chloride of soda (p. 316) thei efficacy is not confined to an action on dead parts, or on the discharge from wounds and ulcers: they are of the greatest benefit to living part in which they induce more healthy action, and the consequent secretio of less offensive matters. Furthermore, in the sick chamber, many oth occasions present themselves on which the power of the chlorides t destroy offensive odours will be found of the highest value: as to countera the unpleasant smell of dressings or bandages, of the urine in various di eases of the bladder, of the alvine evacuations, &c. In typhus fever, handkerchief dipped in a weak solution of an alkaline chloride, and su pended in the sick chamber, will be often of considerable service both t the patient and the attendants.

The power of the chlorides (hypochlorites) to destroy infection o contagion, and to prevent the propagation of epidemic diseases, less obviously and satisfactorily ascertained than their capability destroying odour. Various statements have been made by Labarraqu and others (vide Alcock's *Essay*, p. 55, *et seq.*) in order to prove th disinfecting power of the chlorides with respect to typhus and oth infectious fevers. But, without denying the utility of these agents i destroying bad smells in the sick chamber, and in promoting the rec very of the patient by their influence over the general system, I ma observe that I have met with no facts which are satisfactory to my min as to the chemical powers of the chlorides to destroy the infectious ma ter of fever. Nor am I convinced by the experiments made by Paris and his colleagues (*Bullet. des Sciences Méd.* xix. 233) that these med cines are preservative against the plague. Six individuals clothed them selves with impunity in the garments of men who had died of plagu but which garments had been plunged for six hours in a solution chloride of soda. But, as Bouillaud (*Dict. de Méd. Prat.*, art. *Conta gion*) has truly observed, the experiments, to be decisive, should ha been made with clothing which had already communicated the plague the wearers of it. In Moscow, chlorine was extensively tried and fou unavailing, nay, apparently injurious, in cholera. "At the time," sa Dr. Albers (*Lond. Med. Gaz.* viii. 410) "that the cholera hospital w filled with clouds of chlorine, then it was that the greatest number of t attendants were attacked." (See also Dierbach, *d. neust. Entd. in d. M Med.* i. 411, 2te Ausg. 1837.) Some years ago chlorine was tried at t Small Pox Hospital, with a view of arresting the progress of erysipela all offensive smell, as usual, was overcome, but the power of commu cating the disease remained behind. (*Lond. Med. Gaz.* viii. 472.) Bou quet (*Rev. Méd.* Fev. 1830, p. 264) mixed equal parts of a solution chloride of soda and the vaccine lymph, and found that the latter st possessed the power of producing the usual cow-pox vesicle. These a few of the facts which are adverse to the opinion that chlorine or t chlorurets possess the power of preventing the propagation of infectio contagious, or epidemic diseases. In opposition to them there are but f positive facts to be adduced. Coster (Richter, *Auf. Arzneimittell.* Sup Band. 539) found that a solution of chloride of soda destroyed the infecti properties of the syphilitic poison, and of the poison of rabid anim e statements of Labarraque (Alcock's *Essay*, pp. 56, 58, &c.) and ers as to the preservative powers of the chlorides in typhus, measles, are too loose and general to enable us to attach much value to m.

Considered in reference to medical police, the power of the alkaline orides (hypochlorites) to destroy putrid odours and prevent putrefac- is of vast importance. Thus chloride of lime may be employed to vent the putrefaction of corpses previously to interment, to destroy the ur of exhumed bodies during medico-legal investigations, to destroy smells, and prevent putrefaction in dissecting-rooms and workshops which animal substances are employed (as cat-gut manufactories), to roy the unpleasant odour from privies, sewers, drains, wells, docks, , to disinfect ships, hospitals, prisons, stables, &c. The various modes pplying it will readily suggest themselves. For disinfecting corpses, eet should be soaked in a pailful of water containing a pound of oride, and then wrapped around the body. For destroying the smell issecting-rooms, &c. a solution of the chloride may be applied by ns of a garden watering-pot. When it is considered desirable to se the rapid evolution of chlorine gas, hydrochloric acid may be added hloride of lime.

hloride of lime (or chloride of soda) is the best *antidote* in poisoning ydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potas- , and hydrocyanic acid. It decomposes and renders them inert. A tion should be administered by the stomach, and a sponge or hand- hief soaked in the solution, held near the nose, so that the vapour be inspired. It was by breathing air impregnated with the vapour ng from chloride of lime that Mr. Roberts (the inventor of the miner's oved safety lamp), was enabled to enter and traverse with safety the r of the Bastile, which had not been cleansed for 37 years, and h was impregnated with hydrosulphuric acid. (Alcock's *Essay*.) If rson be required to enter a place suspected of containing hydrosul- ic acid, a handkerchief moistened with a solution of chloride of lime ld be applied to the mouth and nostrils, so that the inspired air may urified before it passes into the lungs.

solution of chloride of lime has been used as a wash in some skin ses. Derheims (*Journ. Chim. Méd.* iii. 575) used a strong solution great success in scabies. This mode of curing itch is much cleaner, more agreeable, than the ordinary method by sulphur frictions. as likewise been found successful by Fantonetti (*Journ. de . Méd.* ix. 305) in tinea capitis: where the discharge is co- , washes of the chloride may be used with advantage. In burns scalds Lisfranc employed lotions of chloride of lime either imme- ly after the accident, or subsequent to the application of emol- poultices.

lutions of chloride of lime have been employed with great benefit in halmia. Dr. Varlez, surgeon to the military hospital at Brussels, *. and Phys. Journ.* Nov. 1827) states that in 400 cases it never dis- inted him once. Mr. Guthrie has also reported favourably of it in cases; as have likewise MM. Colson, Delatte, and Raynaud. The ion used by Dr. Varlez was composed of from a scruple to three or drachms of chloride, and an ounce of water. It was dropped into the eye or injected by a syringe, or applied by means of a camel's hai pencil. Of course other means (bleeding, purging, cold, and, in chroni cases, blisters) should be conjoined. I have found a weak solution of th chloride very successful in the purulent ophthalmia of infants. Gubiau (*Journ. de Chim. Méd.* vi. 315) proposed to apply a solution of chlorid of lime to prevent the pitting from small-pox. The fully maturate pustules are to be opened and washed with a weak solution of this salt desiccation takes place very promptly, and no marks or pits are sai to be left behind.

Chloride of lime may be employed *internally* in the same cases tha chloride of soda is administered (p. 316.) It has been used with gre success by Dr. Reid (*Trans. of the King and Queen's College of Phys cians in Ireland*, v. 266) in the epidemic fever of Ireland. In some of th very worst cases it acted most beneficially, causing warm perspiratio rendering the tongue cleaner and moister, checking diarrhœa, and indu ing quiet sleep. I also can bear testimony to the good effects of th remedy in bad cases of fever. In disease of the pulmonary organs resul ing from febrile excitement, Dr. Reid also found it advantageous. I dysentery likewise it was most valuable. He used it by the mouth an also in the form of glyster. It corrected the intolerable stench of th evacuations, and improved their appearance. Cima (Richter, *aus Arzneimitt.* iv. 305) used it both internally and externally in scrofula.

Administration.—*Internally*, chloride of lime may be given in dos of from one grain to five or six grains, dissolved in one or two ounces water, sweetened with syrup. As the dry chloride of the shops deposi hydrate of lime when put into water, the solution (of the hypochlorite lime and chloride of calcium) should be filtered, to get rid of this. T destroy the unpleasant smell of the breath, *lozenges of chloride of lim* have been used. (*Journ. de Chim. Méd.* iii. 496.)

For *external* use (lotions and gargles) it is also generally employed the form of *solution*, the strength of which must vary according to th quality of the chloride, and the nature and seat of the disease to whic we intend to apply it. The average proportions are from one to fo drachms of chloride to a pint of water. In the cure of itch, Derheim employed a wash composed of three ounces of chloride to a pint of wat The solution is to be filtered to separate the hydrate of lime. Cima em ployed an *ointment of chloride of lime* (composed of from a scruple to drachm of chloride, and an ounce of fresh butter) by way of friction, reduce scrofulous enlargements of the lymphatic glands which h resisted the use of mercurial ointment. When the evacuations from th bowels are very offensive, chloride of lime may be used in the form *enema.* For this purpose, ten or fifteen grains or more may be added the common enema.

Antidotes.—Administer albuminous liquids (as eggs beat up wi water) or milk, or flour and water, or oil, or mucilaginous drinks, an excite vomiting; combat the gastro-enteritis by the usual means. Ca fully avoid the use of acids, which would cause the evolution of chlori gas in the stomach.

Cal'cis Car'bonas.—Car'bonate of Lime.

History.—Some varieties of carbonate of lime were distinguished and ıployed in the most remote periods of antiquity. Marble was proba- used for building 1050 years before Christ (1 Chron. xxix. 2.) iny (*Hist. Nat.* xxxvi.) tells us that Dipœnus and Scyllis were re- wned as statuaries of marble in the 50th Olympiad (*i. e.* 557 years fore Christ.) The *creta*, mentioned by Horace (*Sat.* iii. lib. 2), and iny (*Hist. Nat.* xxxvi. 58, Valp. ed.), was probably identical with our ılk. (On the chalk of the ancients, consult Beckmann's *Hist. of In- it.* i. 212)

Natural History.—Carbonate of lime occurs in both kingdoms of ture.

(*a.*) *In the inorganized kingdom.*—It forms a considerable portion of known crust of the earth, and occurs in rocks of various ages. It is nd in the inferior stratified rocks, but more abundantly in the different ups of the fossiliferous rocks, particularly towards the central and her parts of the series (De la Beche, *Researches in Theoretical ology*, 21.)

In the crystallized form it constitutes calcareous spar and arragonite. e first of these is most extensively distributed, and presents itself under ny hundred varieties of shapes, the primitive form of all being the mbohedron.

Granular carbonate of lime (the *granular limestone* of mineralogists) re commonly occurs in beds, but sometimes constitutes entire moun- ıs. The whitest and most esteemed primitive limestone is that called *uary marble*, or, from its resemblance to white sugar, *saccharoid car- ate of lime.* That from Carrara, on the eastern coast of the Gulf of ıoa, is the kind usually employed by the statuary, and being very e, may be employed for pharmaceutical purposes.

Chalk constitutes the newest of the secondary rocks, and occurs abun- tly in the southern parts of England. It lies in beds, and contains ndance of marine as well as terrestrial organic remains. The upper t of a considerable portion of the chalk of England contains nume- s flints, which are supposed by some (Dr. Grant, *Lect. on Comp. Anat.* the *Lancet*, Nov. 2, 1833) to have once belonged to poriferous mals.

There are various other native forms of carbonate of lime constituting substances called by the mineralogist *schiefer spar*, *rock milk*, *earth n*, *stalactitic carbonate of lime*, *anthraconite*, *oolite*, *pisolite*, *marl*, *t*, &c.

Carbonate of lime is an ordinary ingredient in mineral and common ers, being held in solution by carbonic acid, and, therefore, deposited n this is expelled by boiling or otherwise.

(*b.*) *In the organized kingdom.*—Carbonate of lime is a constituent of e plants, and is obtained from the ashes of most. It is an abundant stituent of animals, especially of the lower classes. Thus in the ate animals we find it in the hard parts of corals, madrepores, &c.; he molluscs, in the shells (as in the oyster). In the articulated ani- s it forms, with phosphate of lime, the crusts which envelop these animals (as the crab and lobster); in the higher classes it is found in bone, but the quantity of it is very small.

PREPARATION.—In the Dublin Pharmacopœia, carbonate of lime (*calcis carbonas præcipitatum*, Ph. D.) is ordered to be prepared by adding a solution of carbonate of soda to a solution of chloride of calcium: double decomposition takes place, chloride of sodium is formed in solution, and carbonate of lime precipitated. Thus prepared, carbonate of lime is directed to be used in the preparation of *hydrargyrum cum cretâ*. By some druggists it is employed, instead of prepared chalk in the manufacture of aromatic confection.

Marble (*marmor*, Ph. L., *marmor album*, Ph. D. & Ed.), or hard carbonate of lime (*carbonas calcis durus*, Ph. L.) is employed for the production of carbonic acid (*vide* p. 190); and, in some Pharmacopœias, for the preparation of chloride of calcium. For the latter purpose, especially, white or statuary marble should be selected, on account of its freedom from iron.

Chalk (*creta*, Ph. L., *creta alba*, Ph. Dub. & Ed.) or friable carbonate of lime (*calcis carbonas friabilis*, Ph. L., *carbonas calcis mollior*, Ph. Ed.) is found in great abundance in the southern parts of England. To reduce it to a fine state of division, and to deprive it of its coarser parts, it is submitted to the process of elutriation, and is then called *prepared chalk* (*creta præparata*, Ph. L. & Dub., *carbonas calcis præparatus*, Ph. Ed. & U. S.)

Carbonate of lime is prepared, for medical purposes, from several molluscous animals; as from the shell of the oyster (*Ostrea edulis*), the gastric concretions (called *crabs' eyes* or *stones*) of the crawfish (*Astacus fluviatilis*), and the crustaceous envelope of the claws of the crab (*Cancer pagurus*). The carbonate procured from these sources is called, respectively, *testæ præparatæ* (Ph. L.), *lapilli cancrorum*, and *chelæ cancrorum*, and will be described in a subsequent part of this work (*vide Animal Materia Medica*).

PROPERTIES.—Pure carbonate of lime is a tasteless, odourless solid. When heated to redness in a current of air its carbonic acid is expelled, leaving quicklime. It is almost insoluble in water; one part of carbonate requiring 1600 parts of water to dissolve it. It is much more soluble in carbonic acid water: the solution reddens litmus, but changes the yellow colour of turmeric paper to brown; and by boiling, or exposure to the air, gives out its carbonic acid, by which the carbonate of lime is deposited.

Carbonate of lime is a dimorphous substance; that is, it crystallizes in two distinct and incompatible series of forms,—viz. those of the rhombohedric system (calcareous spar), and those of the right rectangular prismatic system (arragonite). According to Gustav Rose (*Lond. & Ed. Phil. Mag.* June 1838), both calcareous spar and arragonite may be formed in the humid way, but the first at a lower, the latter at a higher temperature: in the dry way, calcareous spar alone is formed. Both minerals doubly refract the rays of light, and expand unequally in their different parts when heated; but calcareous spar has only one axis of double refraction, whereas arragonite has two.

·gle system of rings seen by looking through a slice of calcareous spar (cut perpendicular to the axis of the crystal) placed between two plates of tourmaline (cut parallel to the axis of the crystal).

FIG. 54.

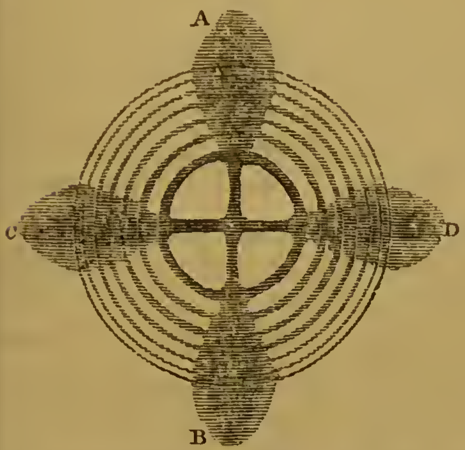


FIG. 55.

54 is seen when the plane of the axis of the calcareous spar is parallel or perpendi- ılar to the plane of polarization. Fig. 55 is seen when the calcareous spar is turned 45°.

ıranular limestone (of which white marble is the purest kind) is mas- ;, and consists of small grains or minute crystals, presenting a lamellar .cture and brilliant lustre, but intersecting each other in every direc- ı, and thereby giving a glimmering lustre to the mass.

'halk is massive, opaque when pure white, and has an earthy fracture. ˎs usually soft to the touch, and adheres to the tongue.

'HARACTERISTICS.—Carbonate of lime is recognized as a carbonate he tests already mentioned for this class of salts (p. 191). As a cal- :ous salt it is known by the characters before described (p. 343) for '.

'OMPOSITION.—Carbonate of lime has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Marcet.	Stromeyer.	Berzelius; Ure.
ıe	1	28	56	56·1	56·35	56·4
bonic Acid	1	22	44	43·9	43·65	43·6
bonate of Lime	1	50	100	100·0	100·00	100·0

URITY.—Pure marble or chalk should be perfectly soluble, with effer- ence, in hydrochloric acid, by which the absence of silica is shown. nonia should not cause any precipitate with this solution, by which reedom from alumina, oxide of iron, &c. may be inferred: nor should olution of sulphate of lime throw down any thing by which the ·nce of baryta and strontian is proved.

HYSIOLOGICAL EFFECTS.—The local effects of chalk are those of an orbent, antacid, and mild desiccant. When swallowed it neutralizes free acid of the gastric juice, and in this way alone must, by conti- l use, injure the digestive functions. It causes constipation, an effect ımonly observed from the use of a few doses in diarrhœa. By the on of the free acids (acetic and hydrochloric) of the alimentary canal, converted into two soluble calcareous salts (acetate of lime and ride of calcium), which become absorbed. Hence the continued of carbonate of lime is attended with the constitutional effects of the areous salts, and consequently the statements which have been made the influence of chalk over the lymphatic vessels and glands, and its effect in diminishing excessive secretion, may be correct. Sundelin (*Heilmittellehre*, i. 179) thinks it may even promote the deposit of bone-earth in diseases attended with a deficiency of this substance. Carbonate of lime, prepared from animal matter, has been erroneously supposed to be more digestible than chalk, and therefore less likely to occasion dyspeptic symptoms (Wibmer, *die Wirkung*, &c. ii. 10). Dr. A. T. Thomson (*Elements of Materia Medica*, ii. 82) says, that "after chalk has been used for some time, the bowels should be cleared out, as it is apt to form into hard balls, and to lodge in the folds of the intestines."

Uses.—As an *absorbent* and *desiccant*, prepared chalk is used as a dusting powder in moist excoriations, ulcers, the intertrigo of children, burns and scalds, erysipelatous inflammation, &c.

As an *antacid* it is exhibited in those forms of dyspepsia accompanied with excessive secretion of acid; and as an antidote in poisoning by the mineral and oxalic acids.

It has also been used in some diseases which have been supposed to depend on, or be accompanied by, excess of acid in the system—as in gouty affections, which are usually attended with the excessive production of uric acid, and in rachitis, which some have ascribed to a preponderance of phosphoric acid, or to a deficiency of lime in the system.

To diminish alvine evacuations, it is employed in diarrhœa. Its efficacy can hardly be referred solely to its antacid properties; for other antacids are not equally successful. Moreover, in many cases of diarrhœa in which chalk is serviceable, no excess of acidity can be shown to exist in the bowels. Aromatics are useful adjuncts to chalk in most forms of diarrhœa. In old obstinate cases, astringents (as catechu or kino) may be conjoined with great advantage; and in severe cases, accompanied with griping pains, opium.

Administration.—Prepared chalk is given in the form of powder or mixture, in doses of from ten grains to one or two drachms. It enters into a considerable number of officinal preparations.

1. *Mistura Cretæ*, Ph. L. & Dub.; *Potio Carbonatis Calcis*, Ph. Ed. *Mistura Calcis Carbonatis*, Ph. U. S. (Prepared chalk, ℥ss.; sugar, ʒiij.; mixture of acacia, f.℥iss.; cinnamon water, ℥xviii. *Ph. L.*) In the other Pharmacopœias the proportions are somewhat different. This is a very convenient form for the exhibition of chalk, and is in common use in diarrhœa. Aromatics (as the aromatic confection), astringents (as kino or catechu), or narcotics (as opium), are frequently combined with it. The dose is from one to three table-spoonfuls.

2. *Pulvis Cretæ Compositus*, Ph. L. & Dub. (Prepared chalk, ℔ss.; cinnamon, ℥iv.; tormentil and acacia, āā. ℥iij.; long pepper, ℥ss.):—This preparation is aromatic and astringent, and is used in diarrhœa. The dose is from 10 to 20 grains. The *pulvis carbonatis calcis compositus* (Ph. Ed.) consists of chalk flavoured with nutmegs and cinnamon.

3. *Confectio Aromatica*, Ph. L. & Dub. (Prepared chalk, ℥xvi.; cinnamon and nutmegs, āā. ℥ij.; cloves, ℥j.; cardamoms, ℥ss.; saffron, ℥ij.; [water, ℔j., Ph. D.]) The London College order the water to be added when the preparation is used, in order to avoid fermentation, to which this compound is subject. Druggists sometimes substitute a strong infusion of saffron instead of the solid saffron here ordered; and those who are desirous of producing a very fine preparation, employ precipitated carbonate of lime instead of chalk. This preparation possesses the

ubined properties of chalk and spices (p. 72). It is therefore antacid, matic, and stimulant. It is frequently added to the ordinary chalk xture in diarrhœa, and is employed on various other occasions where ces are indicated. The dose of it is from 10 grains to a drachm.

Cal'cis Phos'phas.—Phos'phate of Lime.

Iistory.—Scheele, in 1769, discovered phosphate of lime in bones.

Natural History.—Phosphate of lime is found in both kingdoms of ıre.

a.) *In the inorganized kingdom.*—It is a constituent of the mineral ned *Apatite*, and of some mineral waters; as those of Karlsbad udel, and of Franzensbrunn, near Eger.

b.) *In the organized kingdom.*—It has been found in some plants, and ch more frequently and copiously in animals. Thus it constitutes principal part of the earthy matter of the bones of the vertebrata, and ortion of the crusts of the articulata.

Preparation.—Phosphoric acid combines with lime in several protions, forming *basic*, *neutral*, and *acid* salts. The compound used nedicine is a *sub-* or $\frac{2}{3}$ *phosphate of lime.* When obtained by calng bones in an open vessel, it is called *earth of bones* (*terra ossium*) one-ash (*ossa usta alba; o. deusta; o. ad albedinem usta; o. calcinata; lium album*), and contains some carbonate of lime and other mat- mixed with it. If bone-ash be digested in diluted hydrochloric l, and caustic ammonia added to the filtered solution, phosphate lime, free from carbonate, is thrown down in a very minute state livision, and when washed and dried, it constitutes the *precipitated sphate of lime* (*calcis phosphas præcipitatum*) of the Dublin Pharmaœia. When the horns (*cornua*) of the deer (*cervus*) are calcined in a open vessel until they become perfectly white, and the residual ash)-phosphate of lime) prepared by elutriation (as creta præparata) obtain *burnt hartshorn* (*cornu ustum*, Ph. L.; *cornu ustum præparatum*).

Properties.—Subsesquiphosphate of lime is white, tasteless, odour-, insoluble in water, but soluble in nitric, hydrochloric, and acetic ls, from which solutions it is thrown down unchanged, in composition, ammonia, potash, and their carbonates. When exposed to a very nse heat, it fuses, and undergoes no other change. The primary n of the crystals of apatite (native subsesquiphosphate of lime) is the sided prism.

Characteristics.—It is known to be a phosphate by its solubility in rochloric acid, and its being again thrown down as a white precite when the acid solution is supersaturated with caustic ammonia. t be digested in a mixture of sulphuric acid and alcohol, sulphate of e is precipitated, and an alcoholic solution of phosphoric acid ained. The acid may then be recognised by the tests for it already ntioned (p. 253). If the precipitated sulphate of lime be dissolved in er, the solution may be known to contain lime by the tests before ribed for the calcareous salts (p. 343). The subsesquiphosphate of e of bones is distinguished from the neutral phosphate by its fusing h greater difficulty, and dissolving more readily in hydrochloric acid. ery delicate test of the neutral phosphate is its crystallizing from rochloric acid by evaporation (Wollaston, *Phil. Trans.* for 1797, 396 & 397).

Composition.—The composition of subsesquiphosphate of lime is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius. (Artificial.)	Fuchs. (Artificial.)	Vauquelin (Apatite.)
Lime	1½	42	53·85	51·68	54·74	54·28
Phosphoric Acid	1	36	46·15	48·32	45·26	45·72
Subsesquiphosphate of Lime	1	78	100·00	100·00	100·00	100·00

Bone-ash obtained from the bones of the ox consists of subsesquiphosphate of lime, carbonate of lime, phosphate of magnesia, and a trace of fluoride of calcium.

Physiological Effects.—Its effects are not very obvious. "As phosphate of lime is very difficultly soluble," observes Wibmer (*die Wirkung*, &c. ii. 9), "it is absorbed in small quantity only, and then acts more or less like lime, as a slight astringent on the tissues and the secretions, and increases, incontestibly, the presence of calcareous salts in the bones, the blood, and the urine. Large doses disorder the stomach and digestion by their difficult solubility."

Uses.—It has been administered in rickets, with the view of promoting the deposition of bone-earth in the bones. The sesquioxide of iron may be advantageously conjoined with it.

Administration.—The dose of subsesquiphosphate of lime is from ten grains to half a drachm. For internal use the preparation of the Dublin College is to be preferred.

Order 14. Compounds of Magnesium.

Magne'sia.—Magne'sia.

History.—It was first chemically distinguished from lime in 1755, by Dr. Black, who also shewed the difference between magnesia and its carbonate. From the mode of procuring it, it is frequently termed *calcined* or *burnt magnesia* (*magnesia calcinata* seu *usta.*) It is sometimes called *talc earth* (*Talkerde*), or *bitter earth* (*Bittersalzerde.*)

Natural History.—It occurs in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Magnesia is found native, in the solid state or in solution, in sea or some mineral waters, in combination with water and various acids (carbonic, sulphuric, boracic, silicic, and nitric.) Chloride of magnesium exists in sea water, as also in some springs.

(*b.*) *In the organized kingdom.*—Combined with acids it is found in some vegetables (as *Salsola Kali* and *Fucus vesiculosus*), and animals (as in the urine and some urinary calculi of man.)

Preparation.—Magnesia is obtained by exposing the subcarbonate to a full red heat for two hours in a crucible, so as to drive off the carbonic acid.

Properties.—It is a light, fine, white, colourless, odourless, and tasteless powder, having a sp. gr. 2·3. When moistened with water it reacts as an alkali on test papers. It is very slightly soluble in water, and like lime is more soluble in cold than in hot water. Dr. Fyffe states that it requires 5142 parts of cold, and 36000 parts of hot water to dissolve it. Unlike lime it evolves scarcely any heat when mixed with water. By the combined voltaic and oxy-hydrogen flames it has been fused by Mr. Brande (*Manual of Chemistry.*) It absorbs carbonic acid slowly from the atmosphere.

Characteristics.—It is soluble in the dilute mineral acids without ervescence. The solution does not occasion any precipitate with the ocyanides, hydrosulphurets, oxalates, or bicarbonates. The neutral aline carbonates, when unmixed with any bicarbonate, throw down a ite precipitate. Ammonia with phosphate of soda causes a white cipitate (ammoniacal-phosphate of magnesia.) Magnesia is insoluble alkaline solutions, and is thereby distinguished from alumina. Its ution in sulphuric acid is remarkable for its great bitterness.

Composition.—Magnesia has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Wollaston.	Gay-Lussac.	Berzelius.
nesium	1	12	60	59·3	59·5	61·29
gen	1	8	40	40·7	40·5	38·71
nesia	1	20	100	100·0	100·0	100·00

Purity.—Its freedom from any carbonate is shewn by its dissolving in ute mineral acids without effervescence. Its hydrochloric solution uld occasion no precipitate with the oxalates, bicarbonates, and ytic salts, by which the absence of lime and sulphates may be inferred.

Physiological Effects.—When taken into the stomach, magnesia utralizes the free acids contained in the stomach and intestines, and ns therewith soluble magnesian salts. In full doses it acts as a laxa-; but as it occasions very little serous discharge, Dr. Paris (*Pharmacogia*, vol. i. art. *Cathartics*) ranks it among purgatives "which urge bowels to evacuate their contents by an imperceptible action upon muscular fibres." Part of its laxative effect probably depends on the ion of the soluble magnesian salts (chloride of magnesium and acetate magnesia) which it forms by union with the acids of the alimentary ial. Magnesia exercises an influence over the urine analogous to that he alkalies, namely, it diminishes the quantity of uric acid in the ne, and when continued for too long a period occasions the deposit of earthy phosphates in the form of white sand. (W. T. Brande, *Phil. ans.* 1810, p. 136; and 1813, p. 213.) On account of its greater insoility, it requires a longer time to produce these effects than the ilies. When taken in too large quantities and for a long period it has ıetimes accumulated in the bowels to an enormous extent, and being creted by the mucus of the bowels, created unpleasant effects. A y took every night during two years and a half, from one to two teaonfuls of Henry's calcined magnesia (in all between 9 and 10 lbs. troy) a nephritic attack, accompanied with the passage of gravel; subseıntly she became sensible of a tenderness in the left side just above the in, connected with a deep-seated tumor, obscurely to be felt on pres-, and subject to attacks of constipation, with painful spasmodic action he bowels, tenesmus, and a highly irritable state of stomach. During of these attacks she evacuated two pints of "sand;" and on another asion voided soft light brown lumps, which were found to consist irely of subcarbonate of magnesia concreted by the mucus of the vels, in the proportion of 40 per cent. In another case a mass of a ilar description, weighing from 4 to 6 lbs., was found imbedded in the d of the colon, six months after the patient had ceased to employ any gnesia. (E. Brande, *Quart. Journ. of Science*, i. 297.)

Uses.—As an *antacid* it is as efficacious as the alkalies, while it has an advantage over them in being less irritant, and thereby is not so apt to occasion disorder of the digestive organs. It may be employed to neutralize acids introduced into the stomach from without, (as in cases of poisoning by the mineral acids) or to prevent the excessive formation of, or to neutralize when formed, acid in the animal economy. Thus it is administered to relieve heartburn arising from, or connected with, the secretion of an abnormal quantity of acid by the stomach: its efficacy is best seen in persons of a gouty or rheumatic diathesis, in which the urine contains excess of uric acid. It often relieves the headache to which such individuals are not unfrequently subject. It is most efficacious in diminishing the quantity of uric acid in the urine, in calculous complaints, and according to Mr. Brande (*Phil. Trans.* 1813, p. 213) it is sometimes effectual where the alkalies have failed. It will be found of great value in those urinary affections in which alkaline remedies are indicated, but in which potash and soda have created dyspeptic symptoms.

As a *laxative*, magnesia is much employed in the treatment of the diseases of children. It is tasteless, mild in its operation, and antacid,—qualities which render it most valuable as an infant's purgative. Independently of these, Hufeland ascribes to it a specific property of diminishing gastro-intestinal irritation by a directly sedative influence. In flatulency it is combined with some carminative water (dill or anise); in diarrhœa, with rhubarb. It is employed as a purgative by adults in dyspeptic cases—in affections of the rectum, as piles and stricture—and in diarrhœa. It is associated with the carminative waters—with some neutral salts, as sulphate of magnesia, to increase its cathartic operation—or in diarrhœa, with rhubarb.

Administration.—As a purgative, the dose, for adults, is from a scruple to a drachm; for infants, from two to ten grains. As an antacid, the dose is from ten to thirty grains twice a day. It may be conveniently given in milk. It is sometimes administered in combination with lemon juice: the *citrate of magnesia* thus formed acts as a pleasant and mild aperient.

Magne'siæ Subcar'bonas.—Subcar'bonate of Magne'sia.

History.—Subcarbonate of magnesia, also called *magnesia alba* and *carbonate of magnesia*, was exposed for sale at Rome at the commencement of the 18th century, by Count di Palma, in consequence of which it was termed *Comitissæ Palmæ pulvis.* In 1707, Valentini informed the public how it might be prepared.

Natural History.—Neutral carbonate of magnesia is found native in various parts of Europe, Asia, and America. It constitutes a range of low hills in Hindostan, from whence it has sometimes been imported in considerable quantities into this country, but has been found, as I am informed, unsaleable here. The samples offered for sale about two years since consisted of reniform, opaque, dull masses, adherent to the tongue, having a conchoidal fracture, and considerable hardness. Internally, they were whitish; externally, greyish or yellowish white. The same substance was brought over about a year ago in the calcined state, and was nearly white. It was called *calcined Indian magnesia.* Carbonate of magnesia is found in some mineral waters.

REPARATION.—Subcarbonate of magnesia is prepared by mixing solu-s of sulphate of magnesia (or chloride of magnesium) and carbonate oda (or carbonate of potash). The directions of the London Phar-opœia are as follow:—Dissolve separately four pounds of sulphate nagnesia, and four pounds and eight ounces of carbonate of soda, in gallons of water, and strain: then mix the liquors, and boil for a ter of an hour, constantly stirring with a spatula: lastly, having ed off the liquor, wash the precipitated powder with boiling distilled r, and dry it.

wo kinds of subcarbonate of magnesia are known and kept in the s, the *light* and the *heavy*. *Heavy magnesia* (*magnesia ponderosa* of shops) is thus prepared:—Add one volume of a cold saturated solu- of carbonate of soda to a boiling mixture of one volume of a satu-d solution of sulphate magnesia, and three volumes of water. Boil l effervescence has ceased, constantly stirring with a spatula. Then te with boiling water, set aside, pour off the supernatant liquor, and h the precipitate with hot water on a linen cloth: afterwards dry it heat in an iron pot. *Light magnesia* (*magnesia* of the shops) is pre-d by employing dilute solutions of the sulphate of magnesia and onate of soda. If no heat be used, it is apt to be gritty. A *heavy gritty* magnesia is prepared by separately dissolving 12 parts of hate magnesia and 13 parts of crystallized carbonate of soda in as ll a quantity of water as possible, mixing the hot solutions, and hing the precipitate.

he *theory* of the process is as follows:—When sulphate of magnesia carbonate of soda are mixed, double decomposition takes place: the huric acid combines with the soda to form sulphate of soda, and the onic acid with the magnesia. The neutral carbonate of magnesia, ch we presume to be first formed, is immediately resolved by the er into a subcarbonate, which, with some water, precipitates, and the rbonate which remains is dissolved in the cold liquid. 5 eq. of the tral carbonate, with 4 eq. of water, produce 1 eq. of bicarbonate; le the 4 eq. of magnesia, 3 eq. carbonic acid, and 4 eq. of water, ipitate. If we mix the boiling solutions together, 4 eq. of the neutral onate give out 1 eq. of free carbonic acid, and a precipitate is formed sisting of 4 eq. of magnesia, 3 eq. of carbonic acid, and 4 eq. of water. precipitate in both of these cases constitutes the subcarbonate of gnesia of the shops.

ROPERTIES.—Subcarbonate of magnesia, as usually met with, is in form of a white, inodorous, and tasteless powder. The *light* variety rs as a very fine light powder, or in large rectangular masses with elled edges, or in smaller cubical cakes. The *heavy* carbonate is, as name indicates, of greater specific gravity than the light. Both kinds stened with water have a feebly alkaline reaction on test paper, but n boiled in water do not communicate this property to water. Sub-bonate of magnesia is nearly insoluble in water: it readily dissolves carbonic acid water.

HARACTERISTICS.—It is distinguished from caustic or calcined mag-a by the effervescence which takes place on the addition of a dilute eral acid. Its other characteristics are the same as for the latter stance (vide p. 361.)

Composition.—The following is the composition of subcarbonate
magnesia of the shops :—

	Kirwan.	Bergman.	Klaproth.	Bucholz. Light.	Bucholz. Heavy.	Berzelius.	Philli
Magnesia	45	45	40	33	42	41·60 to 43·2	40·8
Carbonic Acid	34	25	33	32	35	36·58 — 36·4	36·0
Water........	21	30	27	35	23	21·82 — 20·4	23·2
Magnesia alba	100	100	100	100	100	100·00 — 100·0	100·0

Several reasons have led chemists to reject the idea of this compoun
being an ordinary subsalt (vide Berzelius, *Traité de Chém.* iv. 101); bu
they are not agreed as to the precise mode in which the constituents a
combined, as the following table shews :—

Berzelius.

	Eq.	Eq.Wt.
Hydrd. Carb. Magn.	3	148·59
Hydrte. Magnes...	1	29·72
Magnesia alba	1	178·31

Brande.

	Eq.	Eq.Wt.			Eq.	Eq.Wt.
Carb. Magn.	1	42	or	Hydrd. Carb. Magn.	1	51
Quadrihydr.	1	56		Trihydrte. Magn. ..	1	47
	1	98			1	98

Phillips.

	E
Hydrd. Carb. Magn.	4
Bihydrd. Magn. ..	1
	1

Purity.—Subcarbonate of magnesia should be perfectly white an
tasteless. The water in which it has been boiled should have no alka
line reaction on turmeric paper, nor throw down anything on the addi
tion of chloride of barium or nitrate of silver: by which the absence o
alkaline carbonates, sulphates, and chlorides, is proved. Dissolved i
dilute sulphuric acid the oxalates and bicarbonates should occasion n
precipitate, by which the non-existence of any calcareous salt is shewn.

Physiological Effects.—The effects of subcarbonate of magnesi
are nearly the same as those of pure magnesia. We can readily con
ceive that the local operation of the first is somewhat milder than that o
the latter (as in the case of the alkalies and their carbonates), but th
difference is hardly perceptible in practice. As the subcarbonate effer
vesces with acids it is more apt to create flatulence when swallowed.

Uses.—The uses of the subcarbonate are the same as those of calcine
magnesia ; except where the object is to neutralize acid in the alimentar
canal (as in cardialgia and in poisoning by the mineral acids), when th
latter preparation is to be preferred on account of its not effervescin
with acids, and thereby not causing flatulency.

In the Pharmacopœia, subcarbonate of magnesia is directed to b
employed for the extemporaneous preparation of the so-called Distille
Waters (*aquæ distillatæ*). A drachm of any distilled oil is to be carefull
triturated with a drachm of subcarbonate of magnesia, and afterward
with four pints of distilled water; the water is then to be strained. Fo
ordinary purposes no objection exists to the use of waters thus prepare
but they are incompatible with bichloride of mercury, on account of th
small quantity of magnesia which they hold in solution.

Administration.—The dose of subcarbonate of magnesia, as a pur
gative, is from ten grains to a drachm; as an antacid, from five grains t
a scruple.

Aqua Magnesiæ Bicarbonatis. (*Magnesia Water: Aerated Magnesi
Water.*)—This solution is prepared by passing a stream of carbonic aci
through water in which a given quantity of subcarbonate of magnesia i
suspended. Or it may be made extemporaneously by adding subcarbo
nate of magnesia (or a mixture of sulphate of magnesia and carbonate o
soda) to the ordinary bottle-soda water (carbonic acid water.) It is a
agreeable mode of exhibiting magnesia in nephritic affections.

Magne'siæ Sul'phas.—Sul'phate of Magne'sia.

ISTORY.—This salt was originally procured from the Epsom waters)r. Grew in 1675. It has had a variety of names, such as *Epsom* or *bitter purging salt, sal Anglicum, sal Seidlitzense, sal catharticum, olated magnesia*, &c.

ATURAL HISTORY.—It is a constituent of sea and many mineral rs: it occurs as an efflorescence on other minerals, forming the *hair* of mineralogists; and with sulphate of soda and a little chloride of nesium, constitutes *Reussite*.

REPARATION.—The two great sources of the sulphate of magnesia of lish commerce are *dolomite* and *bittern*. Dolomite or magnesian stone is a compound of carbonate of lime and carbonate of magnesia. curs in enormous quantities in various counties of England (as those omerset, York, and Nottingham), and is employed for building. Minster and Westminster Hall are built of it. Bittern is the residual liquor of sea-water, from which common salt (chloride of sodium) been separated. It contains chloride of magnesium and sulphate of nesia.

ulphate of magnesia may be extracted from bittern by evaporation, ocess practised at Lymington, in Hampshire (Dr. Henry, *Phil. Trans.*), p. 94). If sulphuric acid be added to bittern, a further quantity of hate may be obtained by the decomposition of chloride of magnum. Sulphate thus procured is preferred at Apothecaries' Hall for ing magnesia, as it yields a whiter product than sulphate made from mite.

arious methods of manufacturing sulphate of magnesia from dolomite been described. The usual method is to treat this mineral by e sulphuric acid: carbonic acid escapes, and a residue, composed of hate of magnesia and sulphate of lime, is obtained. These two salts separated from each other by crystallization.

1816, Dr. William Henry, of Manchester (*Repert. of Arts*, vol. xxx. 12, 2nd Ser.) took out a patent for the following process:—Calcine nesian limestone, so as to expel the carbonic acid; then convert the tic lime and magnesia into hydrates by moistening them with water. rwards add a sufficient quantity of hydrochloric (or nitric or acetic) (or chlorine), to dissolve the lime, but not the magnesia, which, being washed, is converted into sulphate by sulphuric acid (or, re the cost of this is objectionable, by sulphate of iron, which is y decomposed by magnesia). Or the mixed hydrates of lime and nesia are to be added to bittern: chloride of calcium is formed in ion, while two portions of magnesia (one from the bittern, the other the magnesian lime) are left unacted on. Or hydrochlorate of ammomay be used instead of bittern: by the reaction of this on the ated magnesian lime, chloride of calcium and caustic ammonia in in solution, while magnesia is left undissolved: the ammonia is rated from the decanted liquor by distillation.

arbonate of ammonia has also been employed to separate lime from nesia: carbonate of lime is precipitated, and the magnesia remains olution, from which it may be easily separated by ebullition (*Journ. Science*, iii. 217; vi. 313; ix. 177). At Monte della Guardia, near

Genoa, sulphate of magnesia is manufactured from schistose minera containing sulphur, magnesia, copper, and iron. After being roasted, a moistened to convert them into sulphates, they are lixiviated, and t solution is deprived, first, of copper by refuse iron, and afterwards of ir by lime (Dr. Holland, *Phil. Trans.* 1816, p. 294). In Bohemia, sulph of magnesia is procured, by evaporation, from the waters of Seidlitz a Saidschütz. Hermann (Poggendorff's *Annalen*, xi. 249) extracts it fro liquids containing chloride of magnesium, by means of sulphate of sod At Baltimore, sulphate of magnesia is procured from the siliceous hydra of magnesia or *marmolite*, by reducing the mineral to powder, saturati with sulphuric acid, and calcining the dried mass to peroxidize the iro It is then re-dissolved in water (from which solution the remaining ir is separated by sulphuret of lime), and crystallized. By a second cry tallization it is obtained nearly pure (D. B. Smith, in the *Dispensato of the U. S. of America*).

Properties.—The impure sulphate obtained from bittern is call *singles*, and when purified by re-crystallization, *doubles*. The sulpha usually met with in the shops is in small acicular crystals. By soluti and re-crystallization we readily obtain tolerably large four-sided prism with reversed diëdral summits, or four-sided pyramids: the prima form of the crystals is the right rhombic prism. Both large and sm crystals are colourless, transparent, and odourless, but have an extreme bitter taste. When heated they undergo the watery fusion, then give o their water of crystallization, become anhydrous, and at a high temper ture undergo the igneous prism, and run into a white enamel, but witho suffering decomposition. Exposed to the air the crystals very slowly a slightly effloresce. It dissolves in its own weight of water at 60°, and three-fourths of its weight of boiling water. It is insoluble in alcohol.

Characteristics.—It is known to contain sulphuric acid by the tes for the sulphates already mentioned (p. 265). The nature of its base shown by the tests for magnesia before described (p. 361).

Composition.—The following is the composition of crystallized su phate of magnesia :—

	Eq.	Eq. Wt.	Per Cent.	Gay-Lussac.	Wenzel
Magnesia	1	20	16·26	16·04	16·86
Sulphuric Acid	1	40	32·52	32·53	30·64
Water	7	63	51·22	51·43	52·50
Cryst^{d}. Sulphate of Magnesia	1	123	100·00	100·00	100·00

Purity.—The sulphate of magnesia met with in the shops is usual sufficiently pure for all medicinal and pharmaceutical purposes. should be colourless, and undergo no change when mixed with ferr cyanides or hydrosulphurets. When obtained from bittern it is som times contaminated with chloride of magnesium, which, by its affini for water, keeps the sulphate in a damp state. By digestion in alcoh the chloride is dissolved, and by evaporating the spirituous solution, m be obtained in the solid state. It is said, that occasionally small cryst of sulphate of soda are intermixed with those of sulphate of magnesia- a fraud I have never met with in English commerce, nor is it likely occur at the present low price of the magnesian salt. Should such adulteration be suspected, there are several methods of detecting it: t sophisticated salt would effloresce more rapidly than the pure salt, a would communicate a yellow tinge to the flame of alcohol. Boiled wi stic lime and water, all the magnesian sulphate would be decomposed, the liquor being filtered, to separate the precipitated magnesia and phate of lime, yields, on evaporation, sulphate of soda. If shaken in cold with carbonate of baryta, a solution of carbonate of soda would obtained, easily recognized by its alkaline properties. 100 grains of e sulphate of magnesia, dissolved in water, and mixed with a boiling ution of carbonate of soda, yields 34 grains of subcarbonate of mag- ia when dried. If sulphate of soda were present, the precipitate uld weigh less. (Phillips, *Transl. of Pharm.*)

'HYSIOLOGICAL EFFECTS.—Sulphate of magnesia is a mild and per- ly safe antiphlogistic purgative, which promotes the secretion as well he peristaltic motion of the alimentary canal. It is very similar in operation to sulphate of soda, than which it is less likely to nauseate, otherwise disorder the digestive functions, while it acts somewhat e speedily on the bowels. It does not occasion nausea and griping, some of the vegetable purgatives, nor has it any tendency to create ile disorder or inflammatory symptoms; but, on the other hand, has efrigerant influence: hence it is commonly termed a cooling purgative. small doses, largely diluted with aqueous fluids, it slightly promotes action of other emunctories: thus, if the skin be kept cool, and lerate exercise be conjoined, it acts as a diuretic; whereas if the skin warm, it operates as a diaphoretic.

Jses.—On account of the mildness and safety of its operation, its dy solubility, and its cheapness, sulphate of magnesia is by far the st commonly employed purgative, both by the public and the profes- 1. The only objection to its use is its bitter and unpleasant taste. To e all the cases in which it is administered, would be to enumerate nearly whole catalogue of known diseases. It must, therefore, be sufficient to ition, that it is excellently well adapted as a purgative for febrile inflammatory diseases, obstinate constipation, ileus, lead colic, even arcerated hernia, narcotic poisoning, &c. It may be used as an anti- e in poisoning by the salts of lead and baryta.

ADMINISTRATION.—As a purgative it is usually administered in doses from half an ounce to an ounce and a half; but if dissolved in a large ntity of water, a smaller dose will suffice. Thus, two drachms in f a pint or more of water, taken in the morning fasting, will act edily, sufficiently, and mildly, in ordinary cases; and in delicate ales, a drachm, or even less, in the above quantity of water, will ally produce the desired effect. Some carminative or aromatic (as permint water or tincture of ginger) is frequently conjoined to obviate ulency. In febrile and inflammatory diseases, the solution may be dulated with dilute sulphuric acid with great advantage; or the sul- ite may be dissolved in the compound infusion of roses. It is fre- ently used as an adjunct to the compound infusion of senna, whose gative effect it promotes, but whose griping tendency it is said to ck. In dyspeptic cases, accompanied with constipation, it is com- ied with bitter infusions (as of quassia, gentian, calumba, &c.). As a gative enema, an ounce or more of it may be added to the ordinary ster.

The *bitter* purging saline waters (*vide* p. 174), as those of Seidlitz, som, Beulah, Kilburn, and the Cheltenham pure saline, owe their gative property principally to sulphate of magnesia.

Order 15. Compound of Aluminum.

Potas'sæ Alu'mino-Sul'phas seu *Alu'men.*—*Alu'mino-Sul'phate of Pot'ash* or *Al'um.*

History.—Although the term alum (*alumen* of the Romans—στυπτηρία of the Greeks) occurs in the writings of Herodotus (*Euterpe*, clxxx.), Hippocrates (*De fistulis*, *De ulceribus*, &c.), Pliny (*Hist. Nat.* xxxv.), Dioscorides (Lib. v. cap. 123), and other ancient writers, yet it is not satisfactorily proved that our alum was the substance referred to. On the contrary, the learned Beckmann (*Hist. of Invent.* i. 288) has asserted that the alum of the Greeks and Romans was sulphate of iron, and that the invention of our alum was certainly later than the 12th century. But Geber (*Search of Perfection*, ch. iii., and *Invention of Verity*, ch. iv.), who is supposed to have lived in the 8th century, was acquainted with three kinds of our alum, and describes the method of preparing burnt alum; and it is not, I think, improbable, that even Pliny was acquainted with our alum, but did not distinguish it from sulphate of iron, for he tells us that one kind of alum was white, and was used for dyeing wool of bright colours.—[For further information, consult Parkes's *Chemical Essays*, i. 625, and Thomson's *Hist. of Chem.* i. 125].

Natural History.—It is found native in the neighbourhood of volcanoes, and constitutes the mineral called *native alum.* Native alum occurs in bituminous shale and slate clay, at Hurlett, near Paisley, and near Whitby, in Yorkshire.

Preparation.—The method of preparing alum varies somewhat in different places. The mineral from which (in this country) it is procured is called *aluminous slate*, *aluminous shale*, or *aluminous schist* (*schistus aluminaris*). This substance varies somewhat in its composition in different localities, but always contains sulphuret of iron, alumina, carbon, and sometimes a salt of potash. The most extensive alum manufactory in Great Britain is at Hurlett, near Paisley. Here the aluminous schist lies between the stratum of coal and limestone (Williams, *Nat. Hist. of the Mineral Kingdom*, 2nd. ed. ii. 315). By the action of the air it undergoes decomposition, and falls down on the floor of the mine. The sulphur attracts oxygen, and is converted into sulphuric acid, which combines partly with the iron (oxidized by the air), and partly with the alumina. The solution obtained by lixiviating the decomposed schist is evaporated, and the sulphate of iron allowed to crystallize: to the mother liquor, which contains sulphate of alumina, sulphate of potash is added, by which crystals of alum are procured, which are purified by a second crystallization.

At Whitby, in Yorkshire, the method of making alum is somewhat different. The schist is piled in heaps, and burnt by means of a slow smothered fire. The calcined ore is lixiviated, and a salt of potash added to the solution after it has deposited sulphates of lime and iron and earthy matters (Winter, in *Nicholson's Journal*, vol. xxv.)

Properties.—Alum crystallizes usually in regular octahedrons, frequently with truncated edges and angles, and sometimes in cubes. The ordinary alum of the shops consists of large crystalline masses, which d present any regular geometrical form; but, by immersion in water ing a few days, octahedral and rectangular forms are developed in its aces. (Daniel, *Quart. Journ.* i. 24.) Alum has an astringent and etish acid taste: its reaction on vegetable colours is that of an acid. sp. gr. is 1·7. By exposure to the air it slowly and slightly efflo-es. Its transculent or diathermanous power is very slight.

Vhen heated, alum undergoes the watery fusion, swells up, gives out vater of crystallization, and becomes a white spongy mass, called *d* or *burnt alum* (ALUMEN EXSICCATUM, Ph. L., *alumen ustum*), which a more astringent taste, and does not so quickly dissolve in water as crystallized salt. If too much heat be applied a portion of the acid expelled, and escapes, partly as sulphuric acid, partly in the form of gen and sulphurous acid, and the residue consists of alumina and sul-te of potash: the acid liquor obtained by heating alum was formerly ied *spirit of alum.* In the preparation of burnt alum care should be en not to apply too great a heat in order that the acid may not be en off. On this account a shallow earthen vessel is preferable to a cible.

Vhen alum is calcined with charcoal or some carbonaceous substance, ugar, we obtain a spontaneously inflammable substance called *Hom-t's Pyrophorus*, composed of sulphur, potassium, alumina, and charcoal. dum dissolves in 18 times its weight of cold and less than its own ght of boiling water.

The alum procured at Tolfa and other parts of Italy, and called *ian alum* (*alumen Romanum*) is covered with a pale, rose-coloured orescence, composed of oxide of iron and an aluminous sulphate of ash. Under the name of *Roche* or *Rock alum* (*alumen rufeum*, seu *nen de Rochi*, so called from Roccha, in Syria, whence a red-oured alum was formerly brought) we find in English commerce crys-ne fragments of alum, not larger than almonds, coloured externally 1 bole or rose-pink.

HARACTERISTICS.—That alum is a sulphate is shewn by the tests for soluble sulphates already mentioned (p. 265). It reddens litmus, and is sulphate of lead when mixed with pure carbonate of lead: in these erties it agrees with the supersulphates. The nature of its basic stituents is shewn by the following tests:—The ferrocyanides, the lates, and hydrosulphuric acid, occasion no precipitate in a solution lum. Hydrosulphuret of ammonia, the caustic alkalies and their onates, and phosphate of soda, throw down white precipitates: that luced by the alkalies is soluble in an excess of alkali, but is insoluble olutions of the carbonated alkalies: these characters shew the pre-e of alumina. Potash is recognised by perchloric acid and chloride latinum (vide p. 274.) Lastly, the crystalline form of the salt assists ecognising it.

OMPOSITION.—The composition of alum is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Thomson.	Berzel.
ina	3	54	11·088	11·09	10·76
h	1	48	9·856	9·86	9·95
uric Acid	4	160	32·854	32·85	33·74
r	25	225	46·201	46·20	45·55
d. Potash-Alum	1	487	99·999	100·00	100·00

or

	Eq.	Eq. Wt.	Per Cent.
Sulphate of Alumina	3	174	35·728
Sulphate of Potash	1	88	18·069
Water	25	225	46·201
Crystd. Al ino-Sulphte. Potash	1	487	99·998

n the above table I have assumed, with Thomson, Brande, and Phillips, alumina to be a protoxide of aluminum, and that its equivalent is 18. Berzelius and Turner regard it as a sesquioxide, and adopt 51·4 as its equivalent. According to the views of the latter chemists the equivalent for alum $\left(\dot{K}\dddot{S} + \underline{\dddot{Al}}\,\dddot{S}^3 + 25\,\dot{H}\right)$ is 474·95.

Purity.—Alum should be colourless, completely soluble in water (by which the absence of uncombined earthy matter is shewn), with a solution of caustic potash or ammonia should form a colourless precipitate of hydrate of alumina soluble in excess of alkali, and should not suffer any change of colour by the addition of tincture of nutgalls or hydrosulphuric acid. The ferro-sulphate of potash, sometimes mixed with alum, cannot be distinguished from the latter, by its form, colour, or taste ; but it readily detected by potash, which throws down oxide of iron, and by tinc- ture of nutgalls, which communicates a bluish black colour to it.

Physiological Effects. (*a.*) *On vegetables.*—Alum is probably inju- rious to plants. (Decandolle, *Physiol. Végét.* 1341).

(*b.*) *On animals.*—Dogs support large doses of alum with impunity. Orfila (*Ann. d'Hyg. Publiq. et de Méd. Lég.* i. 235) gave seven drachms of *crystallized* alum in powder to dogs : the animals retained it for from ten to thirty minutes, then vomited, and in an hour or two were apparently well. Two ounces of *burnt* alum in four ounces of cold water occa- sioned vomiting only. When the œsophagus was tied to prevent vomiting, death took place in five hours with symptoms of great ex- haustion and diminished sensibility. On a post-mortem examination the mucous membrane of the stomach was found inflamed in the whole of its extent. One ounce of finely-powdered burnt alum applied to the subcutaneous cellular tissue of the thigh, caused excessive suppuration and death in fifteen hours. Devergie (*Méd. Légale*, ii. 653) found burnt alum somewhat more active : he says 6½ drachms killed a dog when the œsophagus was tied, and 2 ounces when it was not tied. Moreover, he found burnt alum suspended in cold water, more active than when dis- solved in warm water. Veterinarians employ it in doses of from 1 to (drachms for large animals. Bourgelat has seen a phthisical condition induced in horses by the use of alum in too great quantities. (Moiroud, *Pharm. Vétér.* 225.)

(*c.*) *On man.*—The immediate topical effect of a solution of alum is that of an astringent, namely, corrugation of fibres and contraction of small vessels, by virtue of which it checks or temporarily stops exhala- tion and secretion, and produces paleness of parts by diminishing the diameters of the small blood-vessels. It is by these local effects that alum, when taken internally, causes dryness of the mouth and throat, somewhat increases thirst, checks the secretions of the alimentary canal, and thereby diminishes the frequency and increases the consistency of the stools, as observed by Wibmer (*die Wirkung*, &c. i. 114) in his expe- riments made on himself, with alum in doses of 3 grains dissolved in drachms of water, and taken several times during the day.

But when alum is applied to a part in larger quantities, and for a longer period, the astriction is soon followed by irritation, the paleness by preternatural redness. And thus taken internally in large doses, alum excites nausea, vomiting, griping, purging, and even an inflammatory condition of the intestinal canal,—effects which may be perhaps induced by small quantities in persons endowed with unusual or morbid sensibity of the stomach and bowels, as in the case of the lady in whom dan-erous gastro-enteritis was apparently induced by a single dose of a solu-on containing between 10 and 20 grains of burnt alum (*Ann. d Hyg. ublique et de Méd. Lég.* i.) Ordinarily, however, tolerably large doses ' alum may be given without any unpleasant effects. Thus Professor umeril has given a drachm, properly diluted, in chronic diarrhœas, ithin twenty-four hours: Professor Marc, two drachms, in passive morrhages, within the same period of time: and MM. Kapeler and endrin have administered 3 drachms, at one dose, in colica pictonum.)evergie, *Méd. Lég.* ii. 656.)

After its absorption, alum appears to act as an astringent or astringent-nic on the system generally, and to produce more or less general astric-on of the tissues and fibres, and a diminution of secretion. Such at ast appears to be its effects in some passive hemorrhages and mucous scharges. Barbier (*Traité Elément. de Mat. Méd.* 2d ed. i. 440) says um "irritates the lungs and often provokes cough," but I am not aware any other practitioner having confirmed this statement. Kraus (*Heil-ittellehre*, 255) observes, that the urine becomes remarkably acid from e use of alum.

Uses.—Alum is employed both as an external or topical, and as an ternal remedy.

(*a.*) *As a topical remedy.*—Burnt or calcined alum is employed as a ry mild *escharotic* to destroy exuberant spongy granulations, commonly own by the name of proud flesh.

Solutions of alum are sometimes employed *to produce contraction or rrugation of the tissues,* and thereby to prevent displacements of parts, pecially when accompanied with excessive secretion. Thus it is used a gargle in relaxation of the uvula with evident advantage. In the rly stage of prolapsus of the rectum, a solution of alum, applied as a ush, is sometimes of service, especially when the disease occurs in fants. Washes or injections containing alum are of occasional benefit prolapsus of the uterus.

In hemorrhages, whether proceeding from an exhalation or exudation om the extremities or pores of the minute vessels, or from the rupture of blood-vessel, a solution, or, in some cases, the powder of alum, may be ed with advantage as a *styptic*, to constringe the capillary vessels, and ose their bleeding orifices. Thus in epistaxis, when it is considered visable to arrest the hemorrhage, assistance may be gained by the ection of a solution of alum into the nostrils, or by the introduction of it moistened with the solution. Where this fails to give relief, finely wdered alum may be employed in the manner of snuff. In hemor-age from the mouth or throat, gargles containing alum are useful. In ematemesis, as well as in intestinal hemorrhage, alum whey may be ministered, though of course no reliance can be placed on it, as the morrhage usually depends on circumstances which astringents merely nnot be expected to obviate. In uterine hemorrhage a sponge soaked a solution of alum may be introduced into the vagina with good effect. check the hemorrhoidal flux when immoderate, washes or enemata ntaining alum may be employed. To stop the bleeding after leech tes in children, a saturated solution, or the powder of alum, may be plied to the punctures.

In certain inflammations, alum has been used as a *repellent*; that is, it has been applied to the inflamed part in order to produce contraction of the distended vessels, and thereby to diminish the quantity of blood in the seat of the disease in a manner almost mechanical. Thus, in the first stage of ophthalmia, it is sometimes considered expedient to cut short the disease by the application of a strong astringent solution (as a saturated solution of alum or of acetate of lead). "It is not to be denied," observes Dr. Jacob (*Cyclopædia of Prac. Med.* art. *Ophthalmia*), "that such applications may have the effect of arresting the progress of the disease at once; but if they have not that effect, they are liable to produce an increase of irritation." But, as the details necessary for making the student acquainted with all the circumstances respecting the use of stimulating or astringent applications in the first stage of ophthalmia are too lengthened and numerous to admit of their proper discussion in this work, I must refer for further particulars to the essay of Dr. Jacob before quoted, as well as to the treatises of writers on ophthalmic surgery. I may, however, add, that whatever difference of opinion exists as to the propriety of these applications in the first stage of ophthalmia, all are agreed as to their value after the violence of vascular action has been subdued.

In angina membranacea, called by Bretonneau (*Rech. sur l'Inflam. spéc. du Tissu Muqueux*, 1826) diptheritis, great importance has been attached to the employment of local applications. Of these hydrochloric acid, calomel, and alum, have, in succession, been highly praised by this writer. In order to promote the expulsion of the false membrane, he recommends the insufflation of finely-powdered alum. This is effected by placing a drachm of it in a tube, and blowing it into the throat. (See also Trousseau and Pidoux, *Traité de Thérap.* ii. 291). Velpeau has subsequently confirmed the statements of Bretonneau, and extended the use of alum to other inflammatory affections of the throat, as those arising in scarlatina, small-pox, &c. In these cases powdered alum may be applied to the affected parts by means of the index finger. Gargles containing this salt will be found useful in most kinds of sore throat, ulcerations of the mouth and gums, aphtha, &c. In inflammation of the vulva, accompanied with membraniform exudation, alum washes are serviceable both in children and adults (Trousseau and Pidoux, *op. cit.*)

Alum has been employed as an *astringent*, to diminish or stop excessive secretion from the mucous surfaces. Thus, a weak solution of this salt is used to repress the discharge in the latter stages of conjunctival inflammation; to check profuse ptyalism, whether from the use of mercury or other causes; and to remove gleet or leucorrhœa. In old-standing diarrhœas it has been administered, in combination with the vegetable astringents (kino, for example), with occasional advantage. It is also applied to check profuse secretion from ulcers.

(*b.*) *As an internal remedy.*—Alum has been employed, in conjunction with nutmeg, as a remedy for intermittents. Given just before the expected paroxysm, it has in some cases prevented it (Cullen, *Materia Medica*).

In the treatment of *lead colic*, alum has been found more successful than any other agent or class of remedies. It was first used in this disease by a Dutch physician, named Grashuis (*De Colica Pictonum*, Amst. 1752, et *Append.* 1755), and was afterwards administered in fifteen cases by Dr. Percival (*Essays, Med. & Exper.* ii. 194) with great success.

s efficacy has been fully established by Kapeler, physician to the [ôpital St.-Antoine, in Paris, and Gendrin (quoted by Trousseau and idoux, *op. cit.*) and by Dr. Copland (*Dict. of Med.* i. 374), as well as y several other distinguished authorities. It allays vomiting, abates flatu-nce, mitigates pain, and opens the bowels more certainly than any other edicine, and frequently when other powerful remedies have failed. It ιould be given in full doses (as from a scruple to two drachms), dissolved some demulcent liquid (as gum-water) every three or four hours. pium and (according to Dr. Copland) camphor may be advan-geously conjoined. Kapeler also employs oleaginous enemata. he modus operandi of alum in lead colic is not very clear. The enefit has been ascribed by some to the chemical action of the sul-uric acid on the lead supposed to be contained in the intestines; ιd in support of this view must be mentioned the fact, that other ılphates (as those of magnesia, soda, zinc, and copper) as well as ıe sulphuric acid, have been successfully employed in lead colic. But, ı the other hand, the presence of lead in the primæ viæ or evacuations, ıd, consequently, the formation of sulphate of lead in saturnine colic, ıve not been demonstrated; though the experiments of Dr. C. G. Mits-ıerlich (*Müller's Archiv*, No. V. 353, 1836, quoted in *Brit. Ann. of Med.* ıl. i. 204, 1837) have shown, that when the acetate of lead is swallowed, e greater part of it forms an insoluble combination with the gastro-testinal mucus, and in this state may remain some time in the ali-entary canal. Moreover, alum has been found successful by Kopp *Denkwurdigkeit*, i. 342, quoted by G. A. Richter, *ausführ. Arzneim.* ıppl. Bd. 515) in other varieties of colic not caused by lead, and unac-ompanied by constipation. Dr. Copland is disposed to ascribe the enefit of alum, and other sulphates in lead colic, to their "exciting the tion of the partially paralysed muscular coat of the bowels, and thereby ıabling them to expel retained matters of a morbid or noxious descrip-on,"—an explanation which is inconsistent with the observation of opp just quoted.

Alum is administered internally in several other diseases, of which a ief notice only can be given. In passive or asthenic hemorrhages om distant organs; as hæmoptysis, menorrhagia and other uterine emorrhages, hæmaturia, &c. In colliquative sweating, diabetes, gleet, ıd leucorrhœa. Kreysig (*Die Krankh. d. Herzens*, Bd. ii. Abt. 2, S. 714, Richter, *op. cit.*) has advised its use in dilatation of the heart and aortic ıeurism. More recently Dzondi (*Aeskulap.* Bd. 1, St. 1, 1821, in Richter) ıs also recommended it in these diseases; and Sundelin (*Heilmittellehre*, 278) has mentioned a case of supposed dilatation of the heart, in which lief was gained by the use of alum. In chronic diarrhœa, alum is occa-onally serviceable.

Administration.—The dose of alum is from ten grains to one or two ruples. It may be taken in the form of powder, or made into pills ith some tonic extract, or in solution. To prevent nausea, an aromatic s nutmeg) should be conjoined. A pleasant mode of exhibition is in ıe form of *alum whey* (*serum aluminosum*, seu *serum lactis aluminatum*), epared by boiling two drachms of powdered alum with a pint of milk, ıen straining: the dose is a wine-glassful. The *saccharum aluminatum* the Prussian Pharmacopœia is composed of equal parts of white sugar ıd alum: it may be given to children as well as adults. In prescribing alum, it is to be recollected that the vegetable astringents decompose it; by which the astringent property of the mixture is probably diminished.

For topical uses, alum is used in the form of powder, solution, and poultice. The powder of burnt alum is sprinkled over ulcers, to destroy spongy granulations. Powder of crystallized alum is applied to the mouth and throat as before mentioned. Solutions of alum are made, for topical purposes, of various strengths, according to the object in view.

The *Cataplasma Aluminis*, Ph. Dub. (*Alum curd of Riverius, Albumen Aluminosum*) is prepared by shaking the whites of two eggs with a drachm of alum. "In cases of chronic and purulent ophthalmia, it is applied to the eye between two folds of old linen. It has been praised as a good application to chilblains which are not broken" (Barker and Montgomery's *Observations on the Dub. Pharm.*)

The *Liquor Aluminis Compositus*, Ph. L. (*Aqua aluminosa Bateana*, or *Bates's alum water*) consists of alum, sulphate of zinc—each an ounce; boiling water, three pints: dissolve and strain. It is used as a detergent and astringent wash in old ulcers; when diluted, as a collyrium in mild conjunctival inflammation, as an injection in gleet and leucorrhœa, and as an application to chilblains and slight excoriations.

Antidote.—In a case of poisoning by alum, let the contents of the stomach be immediately evacuated. Promote vomiting by the use of tepid diluents. The inflammatory symptoms are to be combated by the usual antiphlogistic means. Magnesia has been employed, but is said by Devergie to be altogether useless.

Order 16. Compounds of Arsenicum.

Ac'idum Arsenio'sum.—Arse'nious Ac'id.

History.—Arsenious acid, commonly termed *white arsenic* (*arsenicum album*) or *oxide of arsenic*, is first distinctly mentioned by Geber (*Invent. of Verity*, ch. vii.), who seems to have been also acquainted with metallic arsenic (*Sum of Perfection*, book i. part iv. ch. ii.) Hippocrates (*De Ulceribus*) employed ἀρρενικὸν (*orpiment* or *sesquisulphuret of arsenicum*) and σανδαράκη (*realgar* or *sulphuret of arsenicum*) as topical remedies. Dioscorides (lib. v., cap. xxi.) is the first author who uses the word ἀρσενικὸν (*orpiment*).

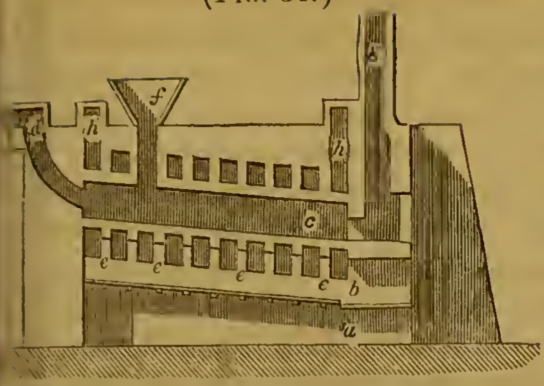
Natural History.—Arsenious acid occurs only in the mineral kingdom. It is rather a rare mineral, and is found at Andreasberg, in the Hartz; at Joachimsthal, in Bohemia; and at some few other places.

Preparation.—It is prepared in Silesia, Bohemia, Saxony, and Cornwall.

At Altenberg it is obtained from arsenical iron (*Mispickel*), a compound of arsenicum, iron, and sulphur. After being reduced to powder the ore is roasted in a muffle furnace (fig. 56), by which the arsenicum is converted into arsenious acid. This is conveyed in the state of vapour, called *flowers of arsenic* or *smeltinghouse-smoke* (*Hüttenrauch*), into the condensing chamber (fig. 57), where it is deposited in a pulverent form, and in this state is called *rough arsenious acid*, or *poison-flour* (*Giftmehl*).

The rough arsenious acid is refined by sublimation. This is effected in cast-iron pots, as shewn in fig. 58, p. 376, to which cylindrical iron

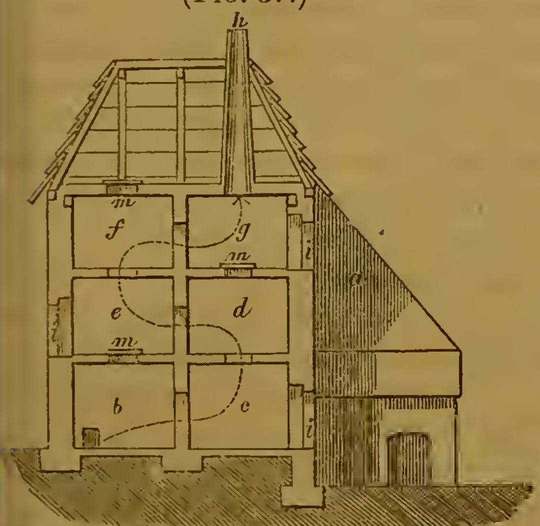
(Fig. 56.)



Section of the Roasting Furnace.

Ash-pit. (*b*) Fire-place.
)Brick arches for supporting the muffle.
Earthen muffle for receiving the ore.
) Hopper for introducing the ore.
Passage for the fumes into the condensing chamber.
) Flue.
Vent for protecting the workmen from the arsenical fumes.

(Fig. 57.)



Condensing Chamber.

c d e f g h) Course of the vapour.
i i) Doors into the chamber.
mmm) Communications between the floors.

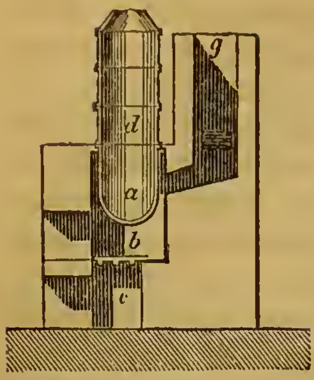
heads (*d*) are attached, which at the tops are contracted into cones (*e*), each terminating in a pipe made of sheet iron, and communicating with the condensing chamber (fig. 57). Heat is applied for twelve hours, by which the acid is sublimed and condensed on the sides of the iron head in the form of a glassy mass, called *glacial white arsenic* (*weissen Arsenikglas*), which is sometimes purified by a second, or even third sublimation. If it contain any sulphuret of arsenicum, a little potash is mixed with it, to prevent the sublimation of the sulphur.

At Reichenstein, arsenious acid is procured from the mineral called arsenical pyrites (a compound of arsenicum and iron, with a small portion of sulphur).

Arsenious acid is procured in some parts of Saxony as a secondary product in the roasting of cobalt ores (the arseniets of cobalt). It is deposited in long horizontal flues (*poison-flues*, or *Giftfängen*), and is purified by sublimation. (For other particulars consult the paper of J. H. Vivian, *Trans. Royal Geol. Society of Cornwall*, i. 60).

Arsenious acid is manufactured in Cornwall. In the impure state it is deposited in the long hori-
ntal flues of the tin burning houses (Mr. J. Taylor, *Ann. Phil.* N.S. iii. 2); from which it is taken for the use of refiners, its value being about shillings per ton (*Quart. Min. Rev.* vol. ii. p. 88; and Mr. Davies bert, *Paroch. Hist. of Cornwall*, iii. 305). In this condition it has a y colour, and is either pulverent or in soft crystalline masses. Mr. rris, of Truro, (to whom I am indebted for samples of this impure d obtained from Wheal Vor tin-mine), tells me that it is conveyed in n waggons to the arsenic-works, of which there are two in the neighrhood of Truro; one in the parish of Perran Arworthall, the other Bissow, in the parish of Kea; the former about half a mile, the latter re than a mile, from the Devoron and Carnon stream-works. Here it purified by sublimation. The fumes from these works are most injuus to neighbouring vegetables and animals. In the human subject, ptions, principally about the lips and nose, are produced by them. In 26, eighty-three tons of manufactured arsenic were shipped at Penryn *ans. Royal Geol. Soc. of Cornwall*, iii. 360).

(Fig. 58.)



Refining Furnace.
(*c*) Ash-pit. (*b*) Fire-place.
(*a*) Cast-iron pot.
(*d*) Cylindrical head.
(*g*) The chimney.

Properties.—When recently prepared, arseniou acid is in the form of large, glassy, transparent cakes sometimes colourless, at others having a yellowisl tinge. Frequently the cakes consist of concentri laminæ, formed by successive sublimations. Mos curiously, these masses soon become opaque an white externally, like enamel, the opacity graduall extending towards the centre; and, in some cases the acid becomes friable and pulverulent. On wha does this alteration depend? Krüger (*Kastn. Arch* ii. 473, quoted in Gmelin's *Handb. d. Chem.*), as cribes the change to the absorption of water from the atmosphere, for he says it only takes place in moist air, and is attended with an increase of weight but only to the extent of $\frac{1}{163}$ of the whole mass. Mr Phillips (*Transl. of the Pharm.* 3d. ed. 1838) ha taken the same view of the subject. But, as Ber zelius has observed, the augmentation of weight is too trivial to admit of thi explanation. Moreover, I find the opacity takes place in an air-tight vessel Does not the opacity (as in opaque gum arabic) depend on innumerabl cracks, imperceptible from their minuteness? Professor Guibourt, Mr Phillips, and Mr. Taylor, have each found the density of the opaqu variety to be less than that of the transparent. *Transparent* arseniou acid has a sp. gr. of 3·7391, according to Guibourt (3·715, Phillips 3·208 to 3·333, Mitchell and Durand; 3·798, Taylor.) It dissolves, ac cording to the same authority, in 103 parts of water at 59°, or in 9·3 parts of boiling water, and the solution feebly reddens litmus. *Opaqu* arsenious acid, on the other hand, according to Guibourt, has a sp. gr. o 3·695 (3·529, Taylor; 3·620, Phillips), is soluble in 80 parts of wate at 59°, or in 7·72 parts of boiling water, and the solution restores the blu colour of reddened litmus. But I find both kinds redden litmus, and Dr. Christison has observed the same. Mr. Taylor (*Guy's Hospital Re ports*, vol. ii. p. 83), did not find any difference in the solubility of th two varieties. He found that water boiled for an hour on this substanc dissolved $\frac{1}{24}$ of its weight; that this water on perfect cooling did no retain more than $\frac{1}{40}$ of its weight; and that water at ordinary tempera tures will dissolve from about $\frac{1}{1000}$ to $\frac{1}{500}$ of its weight. It appears, then that water perfectly cooled from a boiling saturated solution will retai from ten to twenty or more times the quantity of acid in solution than i will take up at common temperatures without heat,—a fact which is as curious as it is inexplicable (*op. cit.* p. 96.) Arsenious acid is solubl in alcohol and oils. It is of importance to know that the presence o organic matters very much impairs the solvent power of water for thi acid—a circumstance which readily explains why arsenious acid has not in some cases, been found in the liquid contents of the stomach o persons poisoned by it. Arsenious acid has little or no taste, as Plencl (*Toxicologia*, ed. 2nda. 26), Addison, and Christison, have remarked: and neither in the solid nor vaporous form has it odour. The acid may b readily obtained in a crystalline condition by sublimation or by coolin a boiling saturated solution: the crystals are transparent, usually regula octahedra, sometimes tetrahedra or acicular. At a temperature of 380° F it volatilizes: when heated under pressure it liquefies, and is converte into a transparent glass.

Characteristics.—These may be conveniently and usefully discussed nder three heads:—(*a*.) The characteristics of solid arsenious acid; .) the characteristics of a pure solution of arsenious acid; (*c*.) the characteristics of arsenious acid in organic mixtures.

(*a*.) *Of Solid Arsenious Acid.*—The characteristics of solid arseous acid are (besides its physical properties before mentioned) principally ree—its volatility, the garlic odour evolved by throwing it on ignited charal, and the qualities of the metallic crust obtained by reducing the acid.

1. *Its volatility.*—Heated on the point of a penknife in the flame of a irit lamp arsenious acid produces a white smoke, and speedily disapars. If the acid be heated in a test tube, a crystalline sublimate is tained: the crystals when examined by a magnifying glass are found be regular octahedra. The *impediments* to the operation of this test e alkaline or earthy bases which retain a portion of the arsenious acid, d prevent its rising in vapour: boracic acid may be used to counteract eir influence. The *fallacy* of this test is, that other white solids (as drochlorate of ammonia, oxalic acid, &c.) are volatile, and produce a hite smoke when heated.

2. *Garlic odour.*—If arsenious acid or an arsenite be put on a red-hot nder (placed for convenience in a saucer), it evolves a scarcely visible pour (of metallic arsenicum) having a garlic odour, and which, at the stance of an inch or two from the cinder, is converted into a dense, hite, odourless smoke (arsenious acid.) The deoxidation of the acid is sential to the production of the garlic odour: hence no odour is perived when arsenious acid is placed on a heated metallic or glass plate. he *impediment* to the action of this test is the presence of organic matter s flour): this, by burning, developes a strong odour, which masks the nell of the vapour of arsenicum. The *fallacy* attending it is, that some her bodies (as phosphorus, with certain of its compounds and some ganic matters) evolve when heated a garlic odour. Vauquelin, Barruel, d Orfila, have shewn that a compound of albumen and fat, which haled this odour when heated, did not contain a particle of arsenious id. "It is true," say these experimenters, "that arsenicum does evolve garlic odour when volatilized; but even when this is well characterized, is insufficient to establish the existence of the oxide of arsenic, since it longs to some other substances; and it is not impossible that there may developed in the stomach, during digestion, substances which exhale analogous odour, when heated."

3. *Formation of a metallic crust. Reduction test.*—If arsenious acid be intimately mixed with freshly-ignited but cold charcoal, and heated in a glass tube, the acid is deoxidized, and yields arsenicum, which is sublimed into a cooler portion of the tube, where it condenses, and forms a metallic crust. A common cylindrical test tube answers very well, but the reduction tube of Berzelius (fig. 59) is to be preferred. The characters of the arsenical crust are—the brilliancy of its outer surface, which is frequently equal to polished steel or looking-glass; the crystalline appearance and greyish white colour of its inner surface; its volatility; its conversion, by sublimation, up and down the

Fig. 59.

Berzelius's Red^n. tube.

tube, into octahedral crystals of arsenious acid, which may be dissolved in distilled water, and tested by the liquid re-agents presently to be mentioned; and its yielding arsenic acid by dissolving it in nitro-hydrochloric acid, and carefully evaporating the solution to dryness. The arsenic acid is known by the red precipitate (arseniate of silver) produced on the addition of nitrate of silver: but if the evaporation has not been carried on sufficiently far, some hydrochloric acid or chlorine will be left, which will form a white precipitate (chloride of silver) with nitrate of silver. The arseniate of silver may be reduced, if necessary, by mixing it with charcoal and boracic acid, and heating it in a glass tube.

In some cases the metallic crust is imperfectly formed, or is masked by some decomposed organic matter. Whenever any doubt respecting its nature is entertained, proceed as follows:—Cut off with a file the portion of the tube which contains the suspected crust, roughly powder it, introduce it into another glass tube, and apply heat.

The *fallacies* to which this test is liable are principally two—a charcoal crust may, by an inexperienced experimenter, be mistaken for the arsenical crust; and I have seen students confound a stratum of globules of mercury (obtained by reducing calomel) with the arsenical crust. Careful examination, especially by a magnifying glass, will, however, easily enable the experimenter to distinguish them: the inner surface of the charcoal crust is brown, powdery, and dull, whereas that of the arsenical crust has a crystalline texture, grey colour, and shiny appearance; the sublimate obtained by reducing calomel or mercurial compounds has all the brilliancy of arsenicum, but by a glass is found to consist of minute globules which may be made to coalesce by the point of a knife. Lastly, the arsenical may be distinguished from all other crusts by oxidating it, as before directed, and converting it into arsenious or arsenic acid which can be readily recognised by the tests already mentioned:—*a proceeding which ought never to be omitted.*

As a deoxidizing agent I have directed freshly ignited charcoal to be employed to convert arsenious acid into arsenicum. If carbonate of soda or of potash be mixed with the charcoal, a part only of the arsenicum is disengaged, an arseniuret of sodium or of potassium being formed: hence when the quantity of acid to be reduced is small, charcoal only should be employed. "Where the quantity of material, however, is considerable, it is preferable to employ the black flux, or still better, as not being deliquescent, a mixture of charcoal and carbonate of soda, deprived of water of crystallization by heat." (Christison's *Treatise on Poisons*, 3d ed. 237.) If the substance to be reduced be an arsenite (as of silver, copper, or lime), or an arseniate (as of silver), a mixture of charcoal and boracic acid should be used. For the reduction of the arsenical sulphurets (as the precipitate obtained by passing hydrosulphuric acid gas through a solution of arsenious acid) a mixture of 2 parts of ignited carbonate of soda and 1 of charcoal should be employed. The alkali is here essential in order to combine with the sulphur. Black flux (prepared by deflagrating 1 part of nitre and $2\frac{1}{2}$ of bitartrate of potash) is objectionable on account of its deliquescent property. Various other deoxidizing agents have been recommended, as formate of soda by Goebel (Griffin's *Chem. Recreat.* 8th ed. 140), oxalate of lime by Du Menil (*Handb. d. Reag. u. Zerlegungslehre*, ii. 268), and oxalate of soda by Dr. M'Gregor (*Lond. Med. Gaz.* xxii. 613.) I find that binoxalate of potash answers very

. None of these, however, present any advantage over charcoal save of not soiling the tube (an occurrence easily avoided by using a glass iel, as recommended by Dr. Christison, or which may be obviated by ing the tube, after the introduction of the mixture, with a wisp of er), while their comparative scarcity and greater cost are objections ıeir employment. (For further details concerning the reduction pro-, consult Dr. Christison's *Treatise*, so frequently referred to.)

.) *Characters of a pure aqueous solution of Arsenious d.*—A clear watery solution of white arsenic may be recognized by ain liquid reagents which give rise to peculiar precipitates, as well as ıascent hydrogen, which causes the formation of a gas (arseniuretted rogen) possessed of remarkable and peculiar properties. The liquid ;ents which deserve notice are four only—namely, *lime water*, *ammo-o-sulphate of copper*, *ammoniaco-nitrate of silver*, and *hydrosulphuric* '. Their relative delicacy, as stated by Devergie, (*Méd. Lég.* ii. 718), the delicacy of the nascent hydrogen test, as ascertained by Mohr *ırn. de Pharm.* xxiii. 566), are as follows:—

	Dilution of arsenious solution.
Lime water ceases to act at	2·000
Ammoniaco-sulphate of copper, ditto at	5·200
Hydrosulphuric acid, ditto at	200·000
Ammoniaco-nitrate of silver, ditto at	400·000
Marsh's nascent hydrogen test, ditto at	500·000

. *Lime Water.*—Lime water occasions a white precipitate (arsenite of ə), with a solution of arsenious acid. The precipitate is soluble in ıt acids. The *impediments* to the operation of this test are, a large ıntity of water and free acids, which hold it in solution, and gelatinous oleaginous liquids, which keep it suspended. The *fallacies* of this are, carbonates, oxalates, tartrates, &c. which also throw down white :ipitates with lime water. On the whole, it is a test of very little value.

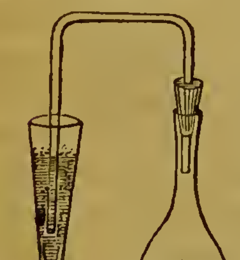
. *Ammoniaco-sulphate of Copper.*—If a dilute solution of ammoniaco-ıhate of copper be added to a solution of arsenious acid, a pale green :ipitate (arsenite of copper, or Scheele's green) is obtained, and sul-ıte of ammonia remains in solution. This test is prepared as follows:—l (cautiously) liquor ammoniæ to a solution of the sulphate of copper, .s to re-dissolve the oxide of copper, which it at first throws down. e must be taken not to employ too much alkali, otherwise the test not act. Moreover, the solution must not be concentrated, or no :ipitate will be obtained. The *impediments* to the action of this test astringents, as tea, infusion of galls, &c. which prevent its acting racteristically. The *fallacies* to be guarded against, are, yellow-ıured and other organic fluids, which give a green colour, and slight :ipitate, even though no arsenic be present.

. *Ammoniaco-nitrate of silver: Hume's test.*—If a solution of ammo-:o-nitrate of silver be added to a solution of arsenious acid, a yellow :ipitate (arsenite of silver) takes place, and nitrate of ammonia remains olution. The precipitate is soluble in liquid nitric acid, ammonia water, a solution of nitrate of ammonia. The mode of preparing this test is ollows:—Add a few drops of liquor ammoniæ to a solution of nitrate of er, so that the oxide of silver which the alkali at first throws down y be nearly, but not entirely, redissolved. Great care is requisite to l neither too much nor too little; for if too much be employed, the ıtion will not occasion any precipitate with arsenious acid; and if too little, it will produce a precipitate with phosphate of soda similar colour to that produced with arsenious acid. The only certain way knowing when the proper quantity has been employed is to test Arsenious acid, but not phosphate of soda, ought to occasion a precipit with it. The *impediments* to the operation of this test, are, free acids hydrochloric nitric, acetic, citric, or tartaric), chlorides, and organic m ters. The acids may be readily neutralized by an alkali. If comm salt, or other metallic chloride be present, ammoniaco-nitrate of sil throws down a white precipitate (chloride of silver), even though a c siderable quantity of arsenic be present. To obviate this, add a f drops of nitric acid, then an excess of a solution of nitrate of silv Filter to get rid of the precipitated chloride of silver, and apply t ammoniaco-nitrate of silver. The presence of much organic matter i pedes the action of this test. Ammoniaco-nitrate of silver, when p perly prepared, does not occasion a yellow precipitate with any substa save arsenious acid; and hence is not subject to any *fallacy* of that ki If, however, it be not properly prepared, it may occasion a yellow pre pitate (subphosphate of silver) with phosphate of soda. There is optical fallacy, against which the student should be put on his gua if ammoniaco-nitrate of silver be added to certain yellow liquids co taining common salt, a white precipitate (chloride of silver) is produc which, seen through a yellow medium, might, by a careless observer, mistaken for a yellow precipitate.

4. *Hydrosulphuric Acid* (*Sulphuretted Hydrogen*).—If this gas be pass through a solution of arsenious acid, a yellow precipitate of sesquis phuret of arsenicum (orpiment) is produced, while the oxygen of t arsenious acid, and the hydrogen of the hydrosulphuric acid, unite form water. In order, however, for this effect to be produced, it is nec sary that the liquid be slightly acidified by some acid (as the hyd chloric). If the liquid be already acid, we must neutralize it by ca tiously adding an alkali, and then acidify by hydrochloric acid.

In applying this test we may place the suspected liquid in a test-tu or conical wine or ale-glass (fig. 60); the gas being developed in a co mon Florence flask (or two-necked bottle, as reco mended by Dr. Christison): the mouth of the flask closed by a cork, perforated by a tube curved twice right angles. The ingredients for developing the g are a metallic sulphuret (as of iron or of antimony) a sulphuric or hydrochloric acid. I prefer the sulphu of iron with sulphuric acid diluted with water. The are to be introduced into the flask previous to t adaptation of the cork. After the gas has pass through the arsenical liquid for a few minutes, porti of the yellow sesquisulphuret of arsenicum (orpime begin to fall down. The separation of the precipit is promoted by ebullition, and the exposure of t solution for a few hours to the air. The essential ch racters of the precipitate are, its yellow colour, rapid solution in liquor ammoniæ, forming a colourless and very limp liquid, and its yielding metallic arsenicum when dried and heated wi black flax, or a mixture of ignited carbonate of soda and charco When the quantity of sesquisulphuret is small, some difficulty may

FIG. 60.



Mode of passing Hydrosulphuric Acid through an arsenical solution.

rienced in removing it from the filter for reduction. The readiest is that recommended by Devergie:—Collect it on the filter in as l a space as possible, then wash it with liquor ammoniæ, which dis-es it. The filtered liquid may then be evaporated in a capsule or h-glass: the ammonia flies off, and leaves the sesquisulphuret.

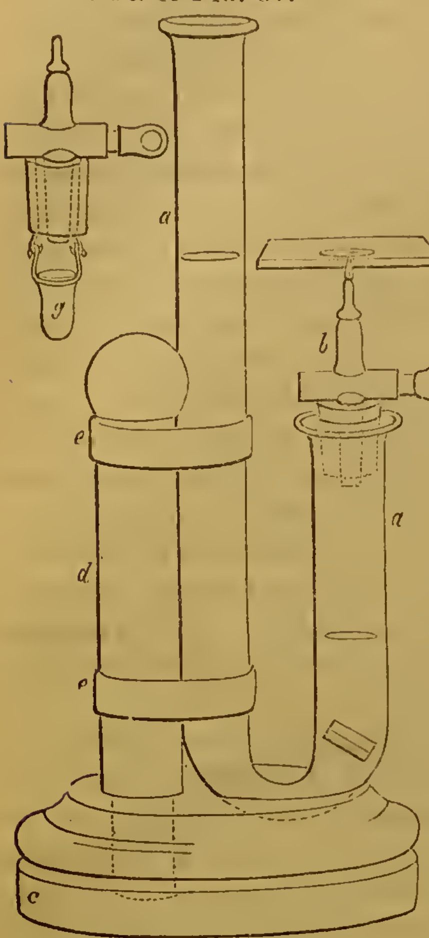
he *fallacies* of the hydrosulphuric acid test are, the *salts of cadmium*, *persalts of tin*, the *antimonial compounds*, and *selenic acid*, which sion precipitates with hydrosulphuric acid, more or less analogous in ur to that produced by arsenious acid. The precipitate with cadmium ely resembles that with arsenic. This metal (cadmium) has been cted in some of the preparations of zinc (*vide* Thomson's *Hist. of nistry*, ii. 220). The perchloride of tin, sold for the use of dyers r the name of *spirit of tin*, occasions a yellow precipitate (bisul-ret of tin) somewhat resembling sesquisulphuret of arsenicum. Very solutions of emetic tartar form a reddish yellow liquid, or throw n a reddish precipitate (sesquisulphuret of antimony) somewhat ana-us in appearance to that formed by an arsenical liquid. If hydrosul-ric acid be transmitted through a liquid in which *pulvis antimo-s* has been boiled, the solution acquires a yellowish red colour, from formation of some sesqui- or bisulphuret of antimony. From all the e precipitates sesquisulphuret of arsenicum is readily distinguished he reduction test already mentioned.

ydrosulphate of ammonia (described at p. 271) is sometimes em-ed as a substitute for hydrosulphuric acid, an acid being added at time of applying it, to neutralize the ammonia; but it is liable to ral serious objections. When fresh prepared, it causes a yellowish ipitate with arsenious acid, red with emetic tartar, and black with solu-s of lead; but by exposure to the air for a day or two it forms a white ipitate with arsenious acid, yellow with emetic tartar, and red with lead!

Nascent Hydrogen: Marsh's test.—If arsenious acid be submitted he action of nascent hydrogen, it is deoxidized, and the metallic nicum thereby obtained, combining with hydrogen, forms arse-etted hydrogen gas.

his test, which is the discovery of Mr. Marsh, of Woolwich (*Trans. e Soc. of Arts*, li. 66; also *Lond. Med. Gaz.* xviii. 650), may be thus ied:—Mix a small portion of the suspected liquid with some diluted huric acid (1 oil of vitriol and 7 water), and pour the mixture over e pieces of zinc previously introduced into a proper apparatus: bub-of gas immediately make their appearance. If no arsenious acid be ent, the evolved gas is hydrogen; but if the liquor hold arsenic in tion, arseniuretted hydrogen gas is formed. This gas is recognised he following characters: it has an alliaceous odour, and burns in the with a bluish white flame, and the deposition of black metallic nicum and white arsenious acid. If a plate of mica, or of common dow-glass, or of porcelain (as a white saucer), be held a short distance ve the flame, arsenious acid, in a finely pulverent state, is deposited it: if the plate be depressed so as to touch the flame, and thereby htly to impede the combustion of the gas, a blackish deposit of allic arsenicum is obtained. Or both these deposits may be readily ured by holding vertically over the flame a tube of glass, 9 or 10 es long, and a quarter or half an inch in diameter: the tube becomes d for the space of several inches with metallic arsenicum and arsenious acid, and the garlic odour can be detected at either end of t tube. To obtain solutions of the acid, let the flame successively pl beneath three or four drops of water plac on the under side of a plate of mica; th apply the liquid tests for arsenic before me tioned (Herapath, *Med. Gaz.* xviii. 889)

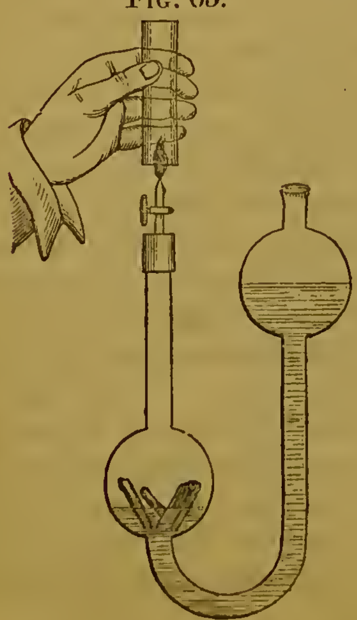
Fig. 62. & Fig. 61.



(*a*) A syphon tube.
(*b*) Stop-cock.
(*c*) Wooden block.
(*d*) The pillar.
(*ee*) Caoutchouc slips, to fasten the tube to the pillar.
(*f*) Place of mica or glass.

Fig. 62.—(*g*) Small glass bucket.

Fig. 63.



Various forms of apparatus may be us for this experiment. That employed Mr. Marsh is a simple glass tube, b like a syphon (fig. 61). A bit of glass r is dropped into the shorter leg, then piece of clean sheet zinc: the stop-co and jet are afterwards to be inserted. T suspected liquid, mixed with the dil acid before mentioned, is to be th poured into the long leg. Effervescen is produced, and after allowing the air be expelled, the stop-cock is to be clos and when a sufficient accumulation of g has taken place, it is again to be open and the gas ignited. Where the matt to be examined is very small in quanti Mr. Marsh puts the suspected liquid, t acid, and the zinc, in a little glass buck (fig. 62), attached to the stop-cock by platinum wire, and then introduces it in the short leg of the syphon, previous filled with common water. A modific tion (fig. 63) of Mr. Marsh's apparatus supplied with two bulbs, one in each l of the instrument, and presents some a vantages over the simple syphon tub thus it enables us to collect a larger qua tity of gas, while the bulb assists in chec ing the frothing by breaking the bubbl But the simplest, cheapest, and often t most useful form of apparatus, is a tw ounce wide-mouthed phial, with a co perforated by a glass tube or tobacco-pip as in fig. 64, p. 383, annexed. It presen this great advantage, that we can employ fresh apparatus for every experiment, a thus avoid all possibility of contamin tion from arsenical liquids used in pr vious experiments.

The *impediments* to the operation Marsh's test are, organic liquids (as port soup, contents of the stomach, &c.), whi occasion great frothing, and choke up t jet. The means of obviating this ar greasing or oiling the interior of the sho leg of the apparatus, putting a layer hol or oil on the surface of the liquid in the short limb, and placing ıpparatus aside for an hour or two, to allow the bubbles to burst.

he *fallacy* of the test is, that if a solution of emetic tartar be employed instead of an arsenical liquid, we obtain antimoniuretted hydrogen gas, which coincides in many of its properties with arseniuretted hydrogen (Mr. L. Thompson, *Lond. & Edinb. Phil. Mag.*, May 1837). Thus it has a peculiar odour, not very unlike that of arseniuretted hydrogen, and burns in the air with a pale bluish flame, and the deposition of metallic antimony and the white oxide (on mica or glass held over it), which resemble, in their general appearance, arsenicum and arsenious acid: moreover, the action of hydrosulphuric acid and of ammoniaco-sulphate of copper on the oxide of

FIG. 64.

mony, produces colours resembling those generated by the action of e tests on arsenious acid. The two metals may, however, be disuished by adding a drop of nitric acid to the crusts, and evaporat- to dryness: a white powder is left in each instance. A few drops of lute solution of the nitrate of silver being now added, and the whole osed to the fumes arising from a stopper moistened with ammonia, arsenical crust will give the well known canary-yellow flocculi (Mr. Thompson, *op. cit.*) Moreover, the greater volatility of arsenicum, its conversion into octahedral crystals of arsenious acid (Dr. E. Tur- s *Chemistry*, by W. Turner) may serve, in some cases, to distinguish om antimony. Furthermore, the solubility of the arsenious acid, and reaction of the before-mentioned liquid tests on the solution, will disuish it from oxide of antimony, which is insoluble.

ı performing Marsh's test great care must be taken that the apparatus erfectly clean, and that fresh zinc and acid liquor be used for every eriment. The experimenter should be fully alive to the possibility of acid, zinc, or even the brasswork of the apparatus, containing minute es of arsenic; hence the necessity of examining the qualities of the rogen flame before adding the suspected arsenical liquid. It has been vn by Mohr (*Journ. de Pharm.* xxiii. 563) that zinc which had been used, but afterwards carefully washed both in water and acid, retained cient arsenic to produce the usual effects on the hydrogen flame.

. *Of Arsenious Acid in Organic Mixtures.*—I shall confine elf to a brief notice of the modes of detecting arsenious acid when ed with the contents and tissues of the stomach, and must refer the ler to Dr. Christison *On Poisons*, and to his paper in the *Edinb. l. & Surg. Journ.* xxii. 60, as well as to Devergie's *Méd. Lég.* ii. 718, urther details, especially in reference to other organic mixtures.

Vhen the stomach is laid open we sometimes observe in it a white der or white particles; these are, of course, to be carefully removed; if they be arsenious acid, no difficulty will be experienced in recogug them by the tests already mentioned.

f no solid arsenious acid be observed, cut the stomach into small es, and boil it with the contents of this viscus for half an hour inilled water, to which a small quantity of liquor potassæ has been ed: then filter, first through muslin, and afterwards through paper. rin is insoluble in water, and, by boiling, albumen is coagulated, so that (with the exception of small portions of these principles held in solution by the alkali) the filtered liquor is free from both fibrin and albumen. A little acetic acid is now to be added, and the liquid boiled by which any caseum present will be coagulated, and got rid of by filtering a second time. Sometimes the liquor is now found sufficiently free from organic matters to enable us to detect the arsenious acid very readily by the ammoniaco-nitrate of silver. Dr. Christison says, that if this test act characteristically, that is, gives a copious yellow precipitate, the liquid is sufficiently free from foreign matter. If, however, it give no indication, or at least only imperfect ones of arsenious acid, evaporate to dryness by a gentle heat (as a water-bath), and boil the residue in repeated portions of distilled water. We thus obtain a solution of arsenious acid, which, after being acidulated with acetic or hydrochloric acid, is to be decomposed by passing a current of hydrosulphuric acid through it. The precipitated orpiment (sesquisulphuret of arsenicum) is to be collected, and reduced in the way already described (p. 378).

Arsenious acid in organic liquids may sometimes be readily detected by the developement of arseniuretted hydrogen when zinc and sulphuric acid are added to the suspected liquor (*vide* p. 381). But the frothing produced by the organic matter creates considerable difficulty. I have already pointed out the best methods of obviating it.

Composition.—The following is the composition of arsenious acid:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Mitscherlich.
Arsenicum	1	38	76	75·782	75·73
Oxygen	1½	12	24	24·218	24·27
Arsenious Acid	1	50	100	100·000	100·00

Purity.—Powdered arsenious acid is sometimes adulterated with chalk or sulphate of lime. The fraud is readily detected by heat, which volatilizes the acid, but leaves the impurities.

Physiological Effects. (*a.*) *On vegetables.*—The effects of arsenious acid on plants have been studied by Jäger (*Diss. Inaug.* Tubingæ, 1808, quoted by Marx in his *Die Lehre von den Giften*, ii. 99); Marcet, Macaire, *Mém. de la Soc. de Phys. et d'Hist. Nat. de Genève* t. iii.), and by others; and from their observations we learn that it is poisonous to all the higher and most of the lower families of plants. It appears that seeds which have been soaked in a solution of arsenious acid are incapable of germinating, and that buds which have been plunged in it are no longer capable of expanding. If roots or stems be immersed in this solution the plants perish; death being preceded by drooping and alteration of the colour of the leaves and petals. If the stem of the common barberry (*Berberis vulgaris*) be placed in dilute hydrocyanic acid, or in an aqueous solution of opium, the stamens lose their remarkable contractile power, but remain flexible. If, however, we employ a solution of arsenious acid, the plant equally dies, but the stamens become stiff, hard, and retracted, and on any attempts being made to alter their position, they readily break. These curious facts appear to prove that the effects produced by this acid on vegetables are very different from those caused by hydrocyanic acid and opium; for the latter seem to exhaust the irritability, while the former appear to give rise to a condition very analogous to the spasm of animals. Jäger has seen a small plant (supposed by Decandolle, in his *Phys. Vég.* p. 1329, to be *Mucor imperceptibilis*) grow in ter which contained $\frac{1}{32}$ of its weight of arsenic. And, more recently, genkrantz (*Journ. de Pharm.* xxiii. 38) says he has seen an algaceous nt, of the genus either *Leptomitus* or *Hygrocrocis*, develope itself in a ution of arsenic. These are most remarkable exceptions to the general cts of this poison on vegetables, and deserve further examination. er has shewn that arsenic is absorbed by plants: for he found that on ning vegetables destroyed by this poison he obtained a garlic odour.

b.) *On animals generally.*—Arsenious acid is poisonous to all classes nimals. No exceptions, I believe, are known to exist to this statent. The most extensive series of experiments on this subject are se performed by Jäger (*op. cit.*) From them we learn that in all nals, from the infusoria up to man, death from arsenic is invariably eded by inordinate actions and increased evacuations, especially from mucous membranes. In most animals the stools were frequent and d; and in those in which mucus is secreted on the surface, it was arkably increased. The power of voluntary motion and susceptibility external stimuli were decreased; and after death the muscles soon sed to be influenced by the galvanic agency. In animals which athe by lungs, respiration became difficult and laborious; and in m-blooded animals great thirst was experienced. In birds and mams convulsions came on, preceded by vomiting, except in those animals the rabbit) which cannot vomit. Enormous quantities of arsenious l have been sometimes administered to horses with impunity. Berthe *cueil de Méd. Vét.* Oct. 1825) gave 2 and afterwards 3 drachms to a e, for the cure of an obstinate skin disease, without any injurious cts. Beissenhirz (quoted by Wibmer, *die Wirkung*, &c. i. 317) gave cessively, on different days, 1, 4, 3, 2, and 8 drachms of arsenious acid horse: the animal did not die until the ninth day after taking the mentioned dose. Yet notwithstanding these and some other analo- facts, which seem to prove that arsenic has comparatively little effect horses, the best informed veterinarians agree in considering it an getic poison to these animals. (See the evidence of Mr. Bowles, in *Ed. Med. and Surg. Journ.* viii. 351.)

.) *On man.* α. *Of very small* or *therapeutical doses.*—In very small ntities (as $\frac{1}{16}$ or $\frac{1}{12}$ of a grain) no obvious effects are usually produced he use of arsenic, unless it be continued for a long period. Indeed writers (*e. g.* Vogt, *Pharmakodyn.*) go so far as to assert that it is a ngthening remedy, and that it improves the appetite, invigorates stion, promotes assimilation and secretion, excites the muscular and ous functions,—in a word, acts as a *tonic.* I cannot, however, sub- e to this doctrine, because I have never been able to see the effects asserted. It is, indeed, true that patients sometimes experience a porary increase of appetite from the use of small doses of arsenic; and also certain that this remedy is frequently beneficial in agues and r diseases in which tonics have been found efficacious. But the ogy between the action of arsenious acid and that of the vegetable s (as cinchona, to which Vogt compares it) stops here. I have ht in vain for other evidences of a tonic operation. I have seen minute doses of arsenic given to patients affected with lepra, and nued for many days, without being able to detect the least indication action on the system, except the amelioration of the disease. When the dose was slightly increased, the appetite in some cases appeared to be increased; but this effect was neither universal nor continued. Very shortly afterwards, a sensation of heat in the throat, œsophagus, and stomach, came on, occasionally with nausea, but seldom with vomiting; in a few cases with gastrodynia; a febrile condition of the body was set up; there were dryness of the skin, increased secretion of urine, relaxed bowels, sometimes with griping; the patients usually complained of great languor, inaptitude for employment, and want of sleep; and sometimes these symptoms were accompanied with, or followed by, redness of the eyes and certain swellings especially of the face, (*œdema arsenicalis*)—effects which are so different from those produced by the remedies called strengthening, that I cannot regard arsenic as a tonic. In proof of the beneficial effects of this substance, we are gravely told that the country people of Upper Styria, in Austria, use arsenic as a stomachic, and condiment for many kinds of food—for example, cheese; and a healthy peasant himself tells us that he was accustomed to take two grains of arsenic daily, without which, he assures us, he could not live! (*Med. Jahrb. d. österr. Staates.* 1822, i. 99, quoted from Wibmer.) In further proof of this strengthening action of arsenic, Vogt says that it promotes the appetite, the activity, and the power of old enfeebled horses, and mentions that Jäger noticed the same effects on a pigeon. To the first of these statements, namely, the beneficial effects from the use of arsenic as a condiment, I confess I do not give credence; and with respect to the action of arsenic on horses, every well-informed veterinarian knows that it operates on these animals as a virulent poison.

Dr. Fowler (*Med. Reports of the Effects of Arsenic*, p. 98) gives the following summary of the effects of the arsenical solution in more than 320 cases:—In about $\frac{1}{3}$ no operation: "somewhat more than $\frac{1}{3}$ were attended with nausea; and nearly $\frac{1}{3}$ with an open body; and about $\frac{1}{3}$ with griping. Vomiting, purgings, swellings, and anorexia, were but rare in comparison with the preceding effects, and their less frequent occurrence were generally found in the order in which they are here enumerated, swellings and anorexia being the seldomest. About $\frac{1}{5}$ of the cases attended with nausea, and $\frac{1}{4}$ of those attended with an open body, were unconnected with any other effects. Griping did not often occur alone; purging and anorexia seldom or never; and vomiting was always accompanied with more or less nausea." In some cases salivation has been produced by the medicinal use of arsenic, as will be noticed presently.

β. Of long-continued small doses, or of large medicinal doses (*slow or chronic poisoning.*)—If the use of small doses of arsenious acid be continued for a long period, it acts as a slow poison; and if persevered in, will ultimately occasion death. The same effects take place, in a shorter period, from the administration of large medicinal doses. Sometimes the digestive apparatus, at other times the nervous system, first shews symptoms of the poisonous operation of this agent.

Hahnemann (quoted by Dr. Christison) has graphically described the condition of slow poisoning by arsenic as "a gradual sinking of the powers of life, without any violent symptom; a nameless feeling of illness, failure of the strength, an aversion to food and drink, and all the other enjoyments of life."

On some occasions the first symptoms which I have observed of its poisonous operation have been thirst, redness of the conjunctiva and lids, followed by a cutaneous eruption. At other times irritation of nach is the leading symptom. In some cases ptyalism is brought on. rcus (*Ephemeriden*, 1809) noticed this effect: as also Dr. Ferriar *ed. Hist. and Refl.* iii. 306.) Mr. Furley (*Lond. Med. Gaz.* xvi.) has lished five illustrative cases of it. Trousseau and Pidoux (*Traité de rap.* ii. 148) also mention this symptom as produced by the long-tinued use of feeble doses of arsenic. This effect acquired some im-tance in the celebrated Bristol case of poisoning. (*Lond. Med. Gaz.* 519, and *Trans. Prov. Assoc.* iii. 432.)

he following is an abstract of the symptoms produced by the long-tinued employment of small doses of arsenious acid, but which are e or less modified in different cases:—Disorder of the digestive func-s, characterized by flatulence, sensation of warmth, or actual pain, in stomach and bowels; loss of appetite; thirst, nausea, and vomiting; ging, or at least a relaxed condition of the bowels, and griping; furred gue, with dryness and tightness of the mouth and throat, or with sali-on. The pulse is quick, small, and sometimes irregular; the respira-oppressed, and accompanied with a dry cough. The body wastes; the nach being frequently so irritable that no food can be retained in it. idache, giddiness, and want of sleep, are frequently observed. The s become painful, feeble, trembling, subject to convulsions; occa-ially benumbed, and ultimately paralyzed. The cutaneous system is, ome cases, affected, an eruption makes its appearance, and now and the hair and nails fall off. Swelling of the feet and of the face is unfrequently observed; and under these symptoms the patient gra-lly sinks, in some cases retaining his consciousness to the last, but at r times delirium or stupor supervening.

. *Of excessive or poisonous doses* (*acute poisoning.*)—The symptoms luced by the ingestion of a large dose of arsenious acid are not inva-ly alike, but put on three forms. In some cases the principal or ing ones are those indicating gastro-enteritis; the nervous sys-being not obviously, or at least only slightly, affected. In others, gastro-enteritic symptoms are absent, and the principal operation of poison is on the vascular and nervous systems. Lastly, there are r cases in which we have both gastro-enteritic symptoms with an ction of the nervous and vascular systems.

orm 1st: Acute poisoning with symptoms of gastro-enteritis.—In this of arsenical poisoning, nausea and vomiting come on soon after the on has been swallowed, and are attended with burning pain in the at and stomach, and which soon extends over the whole abdomen. and vomiting, however, are not invariably present. The matters ited vary in their nature and appearance; sometimes being bilious, ther times tinged with blood. Frequently there is a sense of heat, ess, tightness, and constriction of the throat, accompanied with ssant thirst, and occasionally with an almost hydrophobic difficulty wallowing. The lower part of the alimentary canal soon becomes cted, indicated by the burning pain, which is increased on pressure—he hard and tense condition of the abdomen—by the diarrhœa (the ls occasionally being bloody)—by the tenesmus—and by the occa-al heat and excoriation of the anus. When the lower part of the entary canal is powerfully irritated, the urino-genital apparatus be-es affected; and thus there may be difficulty in passing the water, burning pain in the genital organs. The constitutional symptoms are, in part, such as might be expected from this violent local disorder: thus the pulse is quick, but at the same time small, feeble, and irregular; there are cold clammy sweats; the action of the heart is irregular, giving rise to palpitation; the breathing is short, laborious, and often painful; the tongue is dry and furred; and the membrane lining the air-passages feels hot, and oftentimes painful.

Although, in this form of acute arsenical poisoning, the gastro-enteritis is the principal, and in some cases almost the only affection, yet there are generally observed some symptoms indicative of disorder of the cerebro-spinal system: sometimes in the form of tremblings or cramps of the limbs, or delirium, and even, in the last stage, insensibility. Occasionally, also, eruptions take place.

In this form of poisoning, death usually occurs in from twenty-four hours to three days after the administration of arsenic; but Dr. Christison says that Pyl has recorded a case where death occurred in three hours after swallowing the poison.

Form 2d: Acute poisoning with narcotism, without any remarkable symptoms of gastro-enteritis.—In some cases of poisoning, in both man and animals, the symptoms are those indicating disorder of the cerebro-spinal and vascular systems: abdominal pain, vomiting, and purging being either altogether absent or very slight. The symptoms are usually faintness, or perhaps actual syncope, convulsions, or paralysis; and sometimes, insensibility; at other times, delirium. These symptoms constitute the state called *narcotism.* Of this form of arsenical poisoning (which is somewhat rare) Dr. Christison has given an abstract of twelve recorded cases. In most of them the quantity of arsenious acid taken was very large; for example, half an ounce, or even an ounce.

Form 3d: Acute poisoning with symptoms of gastro-enteritis, followed by an affection of the cerebro-spinal system.—In this form of poisoning we have at first the usual gastro-enteritic symptoms, and which I have already described under the first form of poisoning. When, from the smallness of the dose, or from other circumstances, the patient recovers from the gastro-enteritis, symptoms of a cerebro-spinal affection sometimes make their appearance. The kind of disorder, however, varies considerably in different individuals. "The most formidable," says Dr. Christison, "is coma; the slightest, a peculiar imperfect palsy of the arms or legs, resembling what is occasioned by the poison of lead; and between these extremes have been observed epileptic fits, or tetanus, or an affection resembling hysteria, or madness."

In a medico-legal point of view it is important to determine *what is the smallest fatal dose of arsenious acid.* It is not easy, however, to give a positive answer to this question. Dr. Christison says, "the smallest actually fatal dose I have hitherto found recorded is $4\frac{1}{2}$ grains. The subject was a child four years old, and death occurred in six hours. In this instance, however, the poison was taken in solution." The powerful effects sometimes produced by $\frac{1}{8}$, $\frac{1}{4}$, or $\frac{1}{2}$ a grain, lead us to suspect that 1 grain *might* produce death; but we have no recorded case of this. Hahnemann says, 1 or 2 grains may prove fatal in a few days; and Dr. Christison remarks, that this statement cannot be very wide of the truth. Of course a *repetition* of much smaller quantities might cause death. However, under certain circumstances, enormous quantities have been swallowed with very trivial effects. Some years ago I opened the body of a man who destroyed himself by taking arsenic, and I was informed the friends that about a fortnight previous to his death, he made an empt to destroy himself by swallowing a quantity of powdered arsenic, ich they found, on inquiry at the druggists of whom it was purchased, ıave weighed half an ounce. It was taken immediately after dinner, l the only effect produced was violent vomiting. Here it is evident t the distension of the stomach with food saved the patient's life. is unfortunate individual repeated the attempt, and death was the result. other remarkable case of recovery, after the ingestion of half an ounce, been recorded by Dr. Skillman (*Lond. Med. Gaz.* xix. 238, from *Amer. rn. of Med. Sciences*, Aug. 1836).

MORBID APPEARANCES PRODUCED BY ARSENIOUS ACID.—When arseus acid kills by its narcotic operation (constituting the second form of enical poisoning), no morbid condition is observable after death. In er cases, however, various alterations are observed, which may be st conveniently arranged under the following heads :—

a.) *Morbid appearances of the alimentary canal.*—The alterations obred in the condition of the intestinal canal vary with the quantity of poison taken, and probably with other circumstances, but they are all icative of inflammation: thus we have redness as one symptom, somees accompanied with extravasations of blood into the tissue of the al; ulceration is also frequently observed, sometimes softening of the cous coat, effusion (of lymph or blood), and occasionally even ganıous spots.

b.) *Morbid appearances of the vascular system.*—The blood is somees, though not invariably, fluid after death, and dark coloured. The rt is mostly flabby, and it is asserted that on its inner surface (espely the carneæ columnæ and valves, particularly of the left side), bserved redness, sometimes diffused, sometimes in the form of spots, which penetrates a line in depth into the substance of the heart. pericardium usually contains serum.

.) *Morbid appearances of the respiratory system.*—These are neither remarkable nor constant, and principally consist in redness of the ıra, effusion of lymph or serum into the cavity of the pleura, red spots, occasional congestion of the lungs, and redness of the membrane ıg the air tubes.

d.) The *morbid appearances of other parts* deserve little attention. some cases inflammation, and even gangrene, of the *genital* organs been observed; the *conjunctiva* is sometimes very vascular, and ations are occasionally observed in the condition of the *skin*. Red-, extravasation of blood, and effusion of serum, are said to have been in the *brain*.

ı connexion with the morbid appearances produced by arsenic, the folng remarks, made by Orfila (*Dict. de Méd.* ed. 2, art. *Arsenic*) deserve ce. "Under certain circumstances the mucous membrane of the stoh and intestines is lined with a multitude of brilliant points, composed ıt and albumen: placed on burning coals these grains decrepitate on ng, and produce a noise which has been improperly denominated *nation:* they inflame as a fatty body when they contain a notable ıtity of fat, and exhale an odour of burned animal matter. These / and *albuminous* globules may be met with in the bodies of indivis who have not been poisoned, and require attentive examination in r to distinguish them from arsenious acid. The best method of avoiding this error is to digest these granular parts with water, and to apply the tests proper for demonstrating the existence of arsenious acid."

Influence of Arsenious Acid on the Putrefactive Process.—Until the commencement of the present century it was supposed that the bodies of animals poisoned by arsenious acid were unusually prone to putrefaction. This, however, has been satisfactorily disproved by the experiments and observations of Klank, Kelch, Hünefeld, and others (quoted by Wibmer, in his *Wirkung d. Arzneim. u. Gifte*; and by Dr. Christison in his *Treatise on Poisons*); and it appears, that when placed in contact with animal textures, it acts as an antiseptic. "I have kept a bit of ox's stomach four years in a solution of arsenic," says Dr. Christison, "and except slight shrivelling and whitening, I could not observe any change produced in it." This antiseptic property of arsenious acid, which has been, in my opinion, fully and satisfactorily proved, sufficiently accounts for the good state of preservation in which the alimentary canal has been frequently found some months after death in those poisoned by this acid where it was not evacuated by vomiting or purging.

But there is another effect said to be produced on the bodies of animals, which is not so easily accounted for: I mean their conversion into a kind of mummy-like or adipocirous matter. The following is an abstract of the phenomena, as deduced from numerous experiments and observations, several of which are recorded in Dr. Christison's invaluable *Treatise.* After death putrefaction commences, and is attended with the usual odour; but, instead of increasing in the customary manner, it seems for a time to be at a stand-still, and then a series of changes commences of a peculiar character: the soft parts become firmer and drier, at the same time retaining their structure; the putrid odour is frequently succeeded by one resembling garlic; the skin becomes brown and parchment-like; the muscular fibres and cellular tissue (especially of the abdominal parietes) are changed into a tallowy cheesy-like mass; the liver, spleen, and heart, become dry, while the bowels, lungs, and brain, form a greasy mass. During these processes it is said that the quantity of arsenic diminishes, probably by exhalation,—a circumstance very probable, when we bear in mind the garlic odour emitted by the body, and which has been observed by several writers. The diminution, however, must be exceedingly small. After some time the cheesy smell disappears, and the body becomes dry and hard. In some cases the alimentary tube has been found little changed or decomposed, although other parts of the body had been completely mummified.

I ought, however, to remark, that some writers do not ascribe these phenomena to the influence of arsenious acid, but to other causes. Jäger (quoted by Wibmer, *op. cit.* i. 305) tells us that in his experiments the putrefaction of the bodies of animals poisoned by arsenic seemed neither to be retarded nor hastened, whether they were buried or not; but he admits that parts in contact with an arsenical solution seem preserved from putrefaction. Seemann (quoted by Dr. Christison, *op. cit.* p. 32[illegible]; also Wibmer, *op. cit.* i. 322) likewise states, that the bodies of three dogs underwent the usual kind of putrefaction after death. However, that in many cases arsenic modifies the putrefactive process, can hardly, I think, be doubted by those who carefully examine the evidence adduced in favour of this opinion.

Does this mummifying process depend on the chemical influence of the

-nic, or ought we to refer it to a change effected by arsenic on the y, during life, causing "a different disposition and affinity among the mate elements of organized matter, and so altering the operation of sical laws in it?" The latter hypothesis, though advocated by Dr. istison, appears to me untenable; for, in the first place, there is no lence of any peculiar change of this kind during life; secondly, that does not take place appears probable, from the putrefactive process mencing after death as usual; and it would appear that the peculiar uence of the arsenic does not commence, or at least is not evident, l this process has existed for some time, and when a garlic odour is lved by the body. It is, indeed, true that the quantity of arsenic ich has been detected in the body after death, is, as Dr. Christison arks, "almost inappreciably small;" but it is probable that the ntity is much larger than chemists have yet been able to recognize; l it is not at all unlikely that the arsenious acid may enter into new ibinations while within the dead body, and in this way become dif-ed, probably in a gaseous state: the garlic odour which is evolved ours this notion, as well as the statement made by some, that the ntity of arsenic in the body diminishes during the progress of the mmifying process.

MODUS OPERANDI.—When we consider that arsenious acid operates as oison to whatever part of the body it be applied, the nerves and mus-ar fibres excepted; that the quickness with which it acts is in pro-tion to the absorbing powers of the part, and that the most soluble the most energetic preparations, we can have little difficulty in nitting that absorption into the blood-vessels is necessary to the action this potent agent. But the detection of arsenic in the solids and ds of the body has hitherto not been effected in a satisfactory manner. ssaigne (quoted by Wibmer, *op. cit.* i. 321) states, that he detected it the infiltrated pleura of a horse; and Fodéré (quoted by Dr. Chris-n) twice got indications of its presence in the urine: but Hardegg l Schubarth, on the other hand, failed to recognize it, and therefore her evidence of its existence in the body is necessary, to enable us to ce confidence in the results of Lassaigne and Fodéré. An acquaint-e of Beissenhirz (quoted by Wibmer, *op. cit.* i. 318) obtained nearly ee grains of metallic arsenic from the stomach, cœcum, lungs, liver, rt, and brain of a horse poisoned by six drachms of arsenious acid, en at divided doses: but the extraction of this substance from the mach and cœcum is no evidence of its absorption.

Arsenious acid appears to exercise a specific influence over several ts of the body, especially the alimentary canal, the heart, and the vous system. That the *alimentary canal* is specifically affected is wn by the inflammation of the stomach, induced by the application arsenic to wounds, and which, according to Sir B. Brodie (*Phil. ns.* for 1812, 205), is more violent, and more immediate, than when s poison is taken into the stomach itself. That the *heart* is also spe-cally acted on by arsenious acid is proved by the symptoms (the ciety at the præcordia, the quick irregular pulse, &c.), and by the post-rtem appearances (red spots in the substance of this viscus), and by diminished susceptibility to the galvanic influence. The specific ection of the *nervous system* is inferred from the symptoms: thus, the dache, giddiness, wandering pains, impaired sensibility of the extremities, and delirium or coma, are indications of the cerebral affection; while the feebleness, lassitude, trembling of the limbs, and the paralysis or tetanic symptoms, are evidences of the disordered condition of the true spinal or excito-motory system of Dr. Hall.

The alimentary canal, heart, and nervous system, are not the only parts on which this acid appears to exercise a specific influence: the lungs, the skin, the salivary glands, &c. are also specifically affected. The disorder of the *lungs* is inferred from the local pain, cough, and occasional inflammatory appearances after death. The eruptions and other altered appearances of the *skin*, and the falling off of the hair and nails (sometimes noticed), have led to the idea of the specific influence of arsenious acid on the cutaneous system,—an opinion which seems further supported by the fact of the remarkable influence it exercises in some cutaneous diseases, especially lepra. The salivation noticed by Marcus, Ferriar, Mr. Furley, Cazenave, and others, seems to shew that the *salivary* glands are sometimes specifically influenced. The swelling of the face, and the irritation and redness of the eyelids, also deserve notice in connexion with the specific effects of this poison.

Uses.—So powerful a poison as arsenic necessarily requires to be employed with great caution, and to have its effects carefully and attentively watched; for it has on more than one occasion proved fatal when used as a medicinal agent.

In *intermittent fevers and other periodical diseases*, arsenic has been employed with great success. For its introduction into practice in these cases in this country, we are indebted to the late Dr. Fowler, of Stafford (*Med. Rep. of the Effects of Arsenic*, 1786); but Lemery and Wepfer appear to have first mentioned its febrifuge property. Dr. Fowler was led to its use from the beneficial effects obtained by the use of the "*Tasteless Ague Drop*," and from the information of Mr. Hughes, that this patent medicine was a preparation of arsenic. The reports published by Dr. Fowler, of the good effects of arsenic in periodical diseases, as observed by himself, by Dr. Arnold, and by Dr. Withering, have been amply confirmed by the subsequent experience of the profession generally. No remedy has been more successful in the treatment of ague. It will not unfrequently put a stop to the disease, even when cinchona or the sulphate of quinia have failed. Dr. Brown (*Cyclopædia of Practical Medicine*, ii. 228) who has used it in many hundreds of cases, never saw any permanently ill effect arise from it: he considers it superior to crude bark, but inferior to quinia: over both it has the advantages of cheapness and tastelessness. It should be given three times a day. It is not necessary to intermit its use during the febrile paroxysm, for I have repeatedly seen it given with the best effects during the attack. In agues, accompanied with inflammatory conditions, in which cinchona and sulphate of quinia are apt to disagree, arsenic may, according to Dr. Brown, be sometimes administered with the best effects. It is also very successful in relapses after the use of the above remedies. Dr. Macculloch (*An Essay on the Remitt. and Intermitt. Diseases*, 1828) states that $\frac{1}{16}$ of a grain of white arsenic given three or four times a day will sometimes cure ague when the liquor potassæ arsenitis fails. A combination of arsenic and cinchona, or arsenic and sulphate of quinia, sometimes succeeds, where these agents used separately fail. When the stomach is very irritable, opium is occasionally advaneously conjoined with arsenic. If the bowels be confined during the : of the remedy, gentle laxatives should be employed. Arsenic has en beneficially employed in various other periodical diseases, as pe-lical headaches, intermittent neuralgias, &c.

In various *chronic affections of the skin*, particularly the scaly diseases ora and psoriasis), eczema, and impetigo, arsenic is one of our most uable agents. I can confidently recommend it in lepra, having seen a ge number of cases treated by it without a single failure. Frequently disease is relieved without any obvious constitutional effect: sometimes brile condition of the body is brought on, with a slight feeling of t in the throat, and thirst; occasionally with an augmentation of etite: the urine and cutaneous secretion often promoted; the bowels y be constipated or relaxed, and occasionally, as I have already iced, salivation takes place. If the patient complain of swelling and fness about the face, or itching of the eyelids, the use of the medicine ht to be immediately suspended. Ichthyosis and elephantiasis are l to have been benefited by the use of it. (For further information the use of arsenic in skin diseases, consult Rayer, *Treatise on eases of the Skin*, by Dr. Willis, p. 80.)

Various chronic affections of the nervous system have been treated by arsenious acid, and with occasional benefit: for example, neuralgia, lepsy, chorea (Dr. Gregory, *Med. Chirurg. Trans. of London*, xi. 299), . even tetanus. I have seen arsenic used in a considerable number of leptic cases, and in none was the disease cured. In some the fits urred less frequently, but I am not sure that this was the effect of medicine. In chorea, I have seen advantage now and then accrue n the use of this agent. It has also relieved angina pectoris.

In bites of venomous snakes and of rabid animals, arsenious acid has n recommended. In India, the Tanjore pill (the basis of which is nious acid) has long been celebrated for the cure of the bite of the ra di Capello, and other venomous serpents. Arsenic has been em-yed as an internal agent in various other diseases—as *chronic rheu-ism*, especially when attended with pains in the bones; *in diseases the bones*, particularly venereal nodes (Colhoun and Baer, *Amer. Med. ord.* iii. & iv.); *in syphilis; in passive dropsies;* in the last stage of *us* (Ferriar, *Med. Hist.* i. 84).

Arsenious acid has long been employed as an *external application*. withstanding that it has been applied and recommended by Sir A. per, Dupuytren, and other high authorities, some doubt may be fairly rtained as to the propriety of its use, especially as in most, if not in nstances, we may derive equal advantage by the employment of other dangerous applications. M. Roux, a celebrated surgeon at Paris, es (*Nouv. Elém. de Méd.*) that he amputated the breast of a girl 18 s of age, on account of a scirrhus of considerable magnitude. After cicatrix had been several days completed, ulceration commenced, mpanied with darting pains. To avoid frightening the girl by the of the actual cautery, he applied an arsenical paste over a surface of ut an inch in diameter. Colic, vomiting, and alteration of counte-ce, came on the next day, and in two days afterwards she died in ent convulsions. "I am convinced," says M. Roux, "that this girl l poisoned by arsenic." I could quote several other cases illustrative he same fact, but shall content myself with referring to Wibmer's work (*Die Wirkung.* &c.) for an account of them. The following case, related by Desgranges (Orfila's *Toxicol. Gén.*) shews the danger of applying arsenic externally, even when the skin is sound:—A chamber-maid rubbed her head with an arsenical ointment, to destroy vermin. Though the skin was perfectly sound, the head began to swell in six or seven days after; the ears became twice their natural size, and covered with scabs, as were also several parts of the head; the glands of the jaw and face enlarged; the face was tumefied, and almost erysipelatous. Her pulse was hard, tense, and febrile; the tongue parched, and the skin dry. To these were added excruciating pain, and a sensation of great heat. Vertigo, fainting, cardialgia, occasional vomiting, ardor urinæ, constipation, trembling of the limbs, and delirium, were also present. In a day or two after, the body, and especially the hands and feet, were covered with a considerable eruption of small pimples, with white heads. She finally recovered, but during her convalescence the hair fell off.

Though employed as a caustic, yet it produces no known chemical change in the animal tissues. Hence it is termed by some a *dynamical* caustic, in opposition to those acting obviously by chemical agencies. Mr. Blackadder (*Observ. on Phaged. Gangren.*) asserts that the danger of employing arsenic consists in not applying a sufficient quantity. A small quantity, he says, becomes absorbed, whereas a large quantity quickly destroys the organization of the part, and stops absorption.

Arsenic has been extolled as a remedy for *cancer*. Justamond esteemed it a specific. Various empirical compounds, which gained temporary notoriety in the treatment of this affection, owe their activity to either arsenious acid or the sesquisulphuret of arsenicum. But by the best surgeons of the present day it is never employed, because experience has fully shewn that it is incapable of curing genuine cancer, while it endangers the lives of the unfortunate patients. It cannot, however, be denied that diseases resembling cancer have been much relieved, if not cured, by it, and that the progress of cancer itself has occasionally been somewhat checked by its use.

In some forms of severe and unmanageable ulceration, especially *lupus* or *noli me tangere*, arsenical applications are employed with occasional benefit, where all other local remedies fail. In such cases arsenic is not to be regarded as a mere caustic, for other, and far more powerful agents of this kind, are generally useless. It must act by substitution: that is, it sets up a new action in the part incompatible with that of the disease. The late Baron Dupuytren employed an arsenical dusting powder (composed of 99 parts calomel and 1 part arsenious acid) in lupus, not as an escharotic, but rather as a specific. Mixed with gum-water or with fatty matters, it has been sometimes used as a paste or ointment. These applications are to be allowed to fall off spontaneously, and to be repeated five or six times. Sir A. Cooper (*Lancet*, i. 264) recommends an arsenical ointment (arsenious acid; sublimed sulphur, āā ʒj.; spermaceti cerate, ℥j) to be applied, on lint, for 24 hours, and then to be removed. When the slough comes away, the ulcer is to be dressed with simple ointment, and will generally heal in a short time. Cazenave says he has seen arsenical applications used by Biett, and has himself employed them many times without having met with one instance of injurious consequences. The arsenical paste (arsenious acid, cinnabar, and burnt leather, made into a paste with saliva or gum-water) is used where a powerful action uired: but, besides the danger of causing constitutional symptoms, which all arsenical compounds are liable, it is apt to occasion ery-elas.

Arsenious acid, or sesquisulphuret of arsenicum, is a constituent of st of the preparations sold as depilatories; as *Delcroix's Poudre Subtile,* iich, according to Dr. Paris, consists of quicklime, sulphuret of enic, and some vegetable powder. Such applications are exceedingly igerous.

ADMINISTRATION.—Arsenious acid may be administered, in substance, doses of from one-sixteenth to one-eighth of a grain, made into pills, h crumb of bread. In making a mass of pills, great care should be en that the arsenic be equally divided; for this purpose it should be ll rubbed in a mortar with some fine powder (as sugar) before adding bread crumb. A much safer mode of exhibition is to give this ent remedy, in the form of solution, with potash (as the *liquor potassæ enitis*). But I have already mentioned, that Dr. Macculloch found id arsenic more efficacious than this solution: and Dr. Physick, of the ited States, thinks "that they act differently, and cannot be substituted one another" (*United States Dispensatory*). Whether given in the id or liquid form, it is best to exhibit it immediately after a meal, en the stomach is filled with food; for when given on an empty sto-ch (as in the morning fasting), it is much more apt to occasion gastric order. It is sometimes advisable to conjoin opium, either to enable stomach to retain it, or to check purging. In debilitated constitu-ns, tonics may be usefully combined with it. An emetic (as ipeca-nha), or a laxative (as rhubarb), may be employed where the stomach overloaded, or the bowels confined. Its effects are to be carefully tched, and whenever any unpleasant symptoms (as vomiting, griping, rging, swelling or redness of the eyelids, dryness of throat, ptyalism, idache, or tremors) make their appearance, it will of course be advisable diminish the dose, or suspend for a few days the use of the remedy. leed, when none of these symptoms occur, it is not proper to continue use more than two weeks without intermitting its employment for a y or two, in order to guard against the occasional ill consequences ulting from the accumulation of the poison in the system.

1. ***Liquor Potassæ Arsenitis***, Ph. Lon. & U. S.; *solutio arsenicalis*, . Ed.; *Fowler's* or the *mineral solution* (arsenious acid, carbonate of tash, āā gr. lxxx.; compound tincture of lavender, ʒv.; water, ℥xx.) The senious acid and carbonate of potash are to be boiled, with the water, a glass vessel: arsenite of potash is formed, and carbonic acid evolved; t the quantity of carbonate of potash is not sufficient to saturate the id. The compound tincture of lavender, which is used as a colouring d flavouring ingredient, is to be added to the solution when cold, and erwards more distilled water, to make the whole amount exactly to a pint; e. twenty ounces). The dose of this solution is four or five minims, dually and cautiously increased. I have known 15 minims taken ee times a day for a week, without any ill effects. Dr. Mitchell, of io, has given from 15 to 20 drops, three times a day, in intermittents *nited States Dispensatory*). But as some persons are peculiarly sus-ptible of the influence of arsenic, we ought always to commence with iall doses. It has been given to children, and even pregnant women. . Dewees (*Philadelphia Journ. of Med. & Phys. Sc.* xiv. 187) adminis-

tered it successfully to a child only six weeks old, affected with a severe tertian ague. Dr. Fowler (*Med. Rep. of the Effects of Arsenic*) drew up the following table of doses for patients of different ages:—

Ages.	Doses.
From 2 to 4 years	from 2 or 3 to 5 drops.
5 — 7 „	„ 5 — 7 „
8 — 12 „	„ 7 — 10 „
13 — 18 „	„ 10 — 12 „
18, and upwards	12 „

But it may be remarked, that the quantities here indicated are larger than it will be safe, in most cases, to commence with.

The *liquor arsenicalis* of the Dublin Pharmacopœia is one-sixteenth weaker than the corresponding preparation of the London and Edinburgh Pharmacopœia.

2. *Ceratum Arsenici*, Ph. U. S. (arsenious acid, ℈j.; simple cerate, ℥j. M.) This preparation, which is used as a dressing to cancerous ulcers, should be employed with great circumspection.

Antidotes.—In cases of poisoning by arsenic, the first object is to expel the poison from the stomach. For this purpose the stomach-pump should be immediately applied. If this be not in readiness, and vomiting have not commenced, tickle the throat with a feather or the finger, and administer an emetic of sulphate of copper or sulphate of zinc. Promote vomiting by diluent and demulcent liquids; as milk, white of egg and water, flour and water, gruel, sugared water, and broths. Charcoal, magnesia, and other inert powders, when swallowed in large quantities, may be occasionally of service, by enveloping the particles of arsenic, and preventing their contact with the gastric surface. Olive oil, on which, according to Dr. Paris (*Pharmacologia*), the Cornish miners rely with confidence, can only act mechanically in the way just mentioned.

Hydrated sesquioxide of iron was proposed, in 1834, by MM. Bunsen and Berthold, as an effectual chemical antidote (*Journ. de Pharm.* xx. 567). Its efficacy was confirmed by the experiments of Souberain and Miquel (*Journ. de Chim. Méd.* i. 2e. Ser. p. 3); of Orfila and Lesueur (*ibid.* p. 45); of Bouley, jun. (*ibid.* 46); and of Borelli and Demaria (*ibid.* p. 393), as well as by some cases of arsenical poisoning in the human subject, in which this remedy was employed (*Journ. de Pharm.* xxi. 93 & 681; *Lond. Med. Gaz.* xv. 447; xvi. 832; and xix. 177). To be efficacious it must be given in very large doses; and when the poison has been swallowed in a solid form, 15 or 20 drops of liquor ammoniæ should be conjoined with each dose of the antidote, to transform the acid into a soluble arsenite, on which the oxide may act. It may also be exhibited in the form of enema. Hydrated sesquioxide of iron may be procured by adding ammonia or potash, or their carbonates, to a solution either of pernitrate of iron (obtained by dissolving iron in nitric acid over the fire in a pipkin), or of persulphate of iron (prepared by boiling a solution of the common sulphate of iron with nitric acid): the precipitate is to be washed with water, and swallowed undried. Mr. Brett (*Lond. Med. Gaz.* xv. 220) denies the efficacy of the antidote, and states, moreover, that carefully prepared arsenite of iron is poisonous.

The subsequent part of the treatment of poisoning by arsenic consists in neutralizing or counteracting its effects, and which is to be effected on general principles, as we have no counter-poison. When the gastro-

eritis is marked, our principal reliance must be on the usual antiphlo-
ic measures, particularly blood-letting, both general and local, and
ters to the abdomen. One drawback to the success of this treatment
he great depression of the vascular system, so that the patient cannot
port large evacuations of blood. Opium is a very valuable agent.
leed Jäger seems to regard it in the light of a counterpoison. How-
r, on this point he has probably taken a too exaggerated view of its
cacy; but it is undeniable that on many occasions it is of great
ice. If the stomach reject it, we may employ it in the form of
ters. If constipation and tenesmus be troublesome, mild laxatives,
ecially castor oil, should be exhibited.

Arsen'ici Io'didum.—I'odide of Arsen'icum.

This compound is prepared by gently heating, in a tubulated retort
ced in a sand-bath, a mixture of one part finely pulverized metallic
enicum and three parts of iodine: the iodide is afterwards to be su-
ned, to separate the excess of arsenicum. The compound thus obtained
an orange-red solid, volatile, and soluble in water. If the solution be
idly evaporated to dryness, we reprocure the iodide; but if we con-
trate, and then place the solution aside, white pearly plates are
ained, which by Plisson are regarded as a periodide of arsenicum, but
Serullas as a compound of oxide and iodide of arsenicum (Souberain,
uv. Traité de Pharm. ii. 613; and Serullas, *Journn. de Chim. Méd.* iii.
l). Iodide of arsenicum is probably composed of $1\frac{1}{2}$ eq. iodine = 187·5,
l 1 eq. arsenicum = 38. It has been employed by Biett in the form
ointment (composed of iodide of arsenicum, gr. iij.; lard, ℥j.) as an appli-
ion to corroding tubercular skin diseases (Magendie, *Formulaire*).

Order 17. Compounds of Antimony.

Antimo'nii Sesquisulphure'tum.—Sesquisul'phuret of An'timony.

History.—Black sulphuret of antimony was known in the most ancient
es, being used by the Asiatic and Greek ladies as a pigment for the
brows (2 *Kings*, ix. 30; *Ezekiel*, xxiii. 40; Pliny, *Hist. Nat.* xxxiii.)
was formerly called *stimmi* (στίμμι vel στίμμις, *stibium* (στίβι), or *platy-
thalmon* (πλατυόφθαλμον), Dioscorides, v. 99.) In the native state it
echnically termed *antimony ore*, and when fused out of its gangue, *crude
imony*, or *sulphuret of antimony*.

Natural History.—Sesquisulphuret of antimony is found native in
ious parts of the world, especially in Hungary, in the Hartz, in France,
Cornwall, and in Borneo. From the latter place it is imported into
s country by way of Singapore, being brought over as ballast to the
sels. In the years 1835-36, and 37, the quantities of ore imported
re respectively 645, 825, and 659 tons (*Trade List*, Jan. 10, 1837, and
ı. 9, 1838).

Preparation.—The old method of separating the sesquisulphuret
m its siliceous gangue was to melt it in a covered crucible or pot, in
bottom of which there are several holes, through which the fused sul-
uret passes into an inferior or receiving pot. According to Gensenne's
thod, the melting pots are placed in a circular reverberatory furnace,

and are connected by curved earthen tubes with the receiving pots which are on the outside of the furnace. At La Vendée neither vessels nor tubes are used: the ore is placed on the bed of a reverberatory furnace, in which is an aperture to allow of the passage of the fused sesquisulphuret which flows into a receiving vessel placed externally to the furnace (Dumas, *Traité de Chimie*, iv. 160.)

Properties.—The fused sesquisulphuret (called *common or crude antimony*) occurs in commerce in roundish masses, called loaves or cakes: these when broken present a striated crystalline appearance, a dark steel or lead grey colour, and a metallic brilliancy. The commercial sesquisulphuret is opaque, tasteless, odourless, brittle, easily pulverizable, and has a sp. gr. of about 4·6. Its powder is black, but that of pure sesquisulphuret is reddish black. It is a little less fusible than metallic antimony. It is volatile but cannot be distilled, and it appears to be partially decomposed by heat, for when heated in an earthen crucible for an hour it loses from 10 to 20 per cent. of its weight (Berthier, *Traité des Essais*, ii. 490). By roasting it is converted into *antimony-ash* or *cinis antimonii* (a mixture of antimonious acid and sesquioxide of antimony with more or less unburned sesquisulphuret: Liebig, *Handwörterb. d. Chemie*, i. 419) and sulphurous acid, the latter of which escapes. When reduced to a very fine powder by levigation and elutriation it constitutes the *antimonii sulphuretum præparatum* of the Edinburgh, Dublin, and United States Pharmacopœias.

Characteristics.—It fuses and is dissipated before the blow-pipe with the smell of sulphurous acid and the formation of a white smoke. Digested in hydrochloric acid it evolves hydrosulphuric acid, and forms a solution of sesquichloride of antimony, which produces a whitish precipitate (*powder of Algaroth*, or oxychloruret of antimony) with water and an orange red one with hydrosulphuric acid. If a current of hydrogen gas be passed over heated sesquisulphuret of antimony, metallic antimony and hydrosulphuric acid gas are obtained: the metal decomposes nitric acid and yields a white powder: it readily dissolves in nitro-hydrochloric acid.

Composition.—Sesquisulphuret of antimony has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Thomson.
Antimony	1	65	73	72·8	73·77
Sulphur	$1\frac{1}{2}$	24	27	27·2	26·23
Sesquisulphuret of Antimony	1	89	100	100·0	100·00

Impurities.—The crude antimony of commerce is rarely, if ever, quite pure. It frequently contains the sulphurets of iron, lead, arsenicum, and copper, and on this account is not adapted for medicinal use. When pure it is completely soluble in hydrochloric acid: but when mixed with sulphuret of arsenicum this remains undissolved, and may be detected by reducing it with a mixture of charcoal and carbonate of soda (*vide* p. 378). If the hydrochloric solution be diluted with water (so as to precipitate the greater part of the antimony), and filtered, the presence of lead, iron or copper, may be determined by the appropriate tests for these metals hereafter to be mentioned.

Physiological Effects. (*a.*) *On animals.*—Rayer (*Dict. de Méd. et Chir. Pratiq.* iii. 54) introduced half an ounce of it into the cellular ıe of the back of a dog; but no effects resulted from it. Fifteen grains ;ed in the peritoneal sac caused inflammation, and in 24 hours death, without any peculiar symptoms. Moiroud (*Pharm. Vétér.* 428) says, , given to horses, in doses of from 2 to 4 ounces, it acts as an itant, causing increased frequency of pulse and respiration, and softer ıls.

).) *On man.*—In most cases it produces no obvious effects, even when ·n in very large doses. Rayer (*op. cit.*) gave half an ounce of it in ·der, for several days, without the slightest effect. Cullen (*Treat. of t. Med.* ii. 482), however, has seen it cause nausea and vomiting in or two instances in which it was largely employed. Rayer says ; the decoction of the sesquisulphuret is much more active than an al quantity of the same preparation in powder. How are these facts ·e explained? Rayer ascribes the activity of the decoction to arse-ıs acid formed by boiling sulphuret of arsenicum (contained in the ınary crude antimony) with water; for Guibourt obtained in this way $\frac{1}{5}$ grs. of arsenious acid by boiling an ounce of crude antimony. But presence of arsenic is not necessary to explain the greater activity of decoction, since by long-continued boiling with water, the sesqui-)huret of antimony yields hydrosulphuric acid and sesquioxide of ımony (Geiger, *Handb. d. Pharm.*) The occasional nausea and vomit-may arise from the decomposition of the sulphuret by the fluids in alimentary canal.

Jses.—As a medicinal agent it is occasionally employed as a diapho-: and alterative in some skin diseases, especially lepra and scabies, in ›fula and glandular affections, and in rheumatism and gout.

ıs a pharmaceutical and chemical agent it is a most important sub-ıce, being the source from which the metal, and all its compounds, procured.

ıdministration.—The usual dose of it, when taken internally, is ı ten to thirty grains of the powder; but several drachms of it have ın taken without much effect. The *tisan de Feltz*, which is occasion-used in skin diseases, is prepared by boiling sarsaparilla, ℥j., and crude ımony (tied up in a bag) ℨj., in a pint and a half of water; then add glass, ℨiv., previously dissolved in water, and reduce the whole (by ing) to a pint, which is to be taken during the day (Rayer, *Treatise on eases of the Skin*, by Dr. Willis, 1223).

Antimo'nii Sesquichlo'ridum.—Sesquichlo'ride of An'timony.

History.—Basil Valentine was acquainted with this preparation, ch has had various appellations; such as *oil* or *butter of antimony um* seu *butyrum antimonii*), *muriate* or *hydrochlorate of antimony*.

Preparation.—The impure hydrated sesquichloride, sold in the shops)utter of antimony, is usually prepared by dissolving roasted sesqui-)huret of antimony (*cinis antimonii*) in hydrochloric acid, and adding ııitrate of iron to the solution as a colouring matter.

ın the Dublin Pharmacopœia an analogous compound is prepared (in manufacture of the *nitro-muriatic oxide of antimony*) by digesting, l afterwards boiling, 20 parts of sesquisulphuret of antimony in a xture of 100 parts hydrochloric acid and 1 part of nitric acid. One equivalent or 89 parts of sesquisulphuret of antimony require an equivalent and a half or 55·5 parts of hydrochloric acid for their complete decomposition: the products are, an equivalent and a half or 25·5 parts of hydrosulphuric acid, and one equivalent or 119 parts of sesquichloride of antimony. The nitric acid is employed to decompose the hydrosulphuric acid remaining in the liquor; this it does by converting the hydrogen into water, and precipitating the sulphur.

Pure sesquichloride of antimony is not used in medicine: its preparation need not, therefore, be described in this work.

PROPERTIES.—The butter of antimony of the shops is a transparent liquid, varying in its colour (which depends on the presence of iron) from yellow to deep red. Its specific gravity is 1·2 to 1·5. It fumes in the air (especially when ammonia is present), in consequence of containing an excess of hydrochloric acid. It reacts on vegetable colours as a powerful acid.

CHARACTERISTICS.—Mixed with water it throws down a yellowish white powder called *powder of Algaroth*, or *mercury of life* (oxychlorure of antimony). The hydrosulphurets produce an orange-red precipitate; alkalies a white precipitate (sesquioxide of antimony). Nitrate of silver occasions a white precipitate, composed of chloride of silver and sesquioxide of antimony: the latter is dissolved by digestion in hydrochloric acid.

COMPOSITION.—Sesquichloride of antimony is thus composed:—

	Eq.	Eq. Wt.	Per Cent.	Göbel.	H. Rose.
Antimony	1	65	54·62	54·98	53·27
Chlorine	$1\frac{1}{2}$	54	45·37	45·02	46·73
Sesquichloride Antimony	1	119	99·99	100·00	100·00

The butter of antimony of the shops contains *sesquichloride of antimony*, *free hydrochloric acid*, *water*, and *iron*. It may also contain other impurities derived from the sesquisulphuret from which it is directly or indirectly prepared. Serullas says he never found arsenic in it.

PHYSIOLOGICAL EFFECTS.—It acts as an energetic caustic, but I am not acquainted with any cases of poisoning by it. It cannot be diluted without undergoing decomposition.

USES.—In medicine it is employed only as a caustic. It usually acts without much pain or inflammation, and, after the separation of the eschar, produces a clean healthy surface. It is sometimes used as an application to parts bitten by rabid animals or venomous serpents: its liquidity enabling it to penetrate into all parts of the wound. It is also applied to ulcers to repress excessive granulations. Richter and Beer have employed it in staphyloma: the mode of applying it is as follows:—Dip a camel's hair pencil, or a point of lint, into the liquid, and apply it to the tumor until a whitish crust is perceived, when the whole is to be immediately washed away by means of a larger pencil dipped first into milk and afterwards into milk and water.

ANTIDOTES.—The treatment of poisoning by this preparation is the same as for the mineral acids (*vide* pp. 154 and 268.) After the use of antacids, vegetable astringents (tea and infusion of nutgalls) should be administered to neutralize the effect of the powder of Algaroth separated in the stomach. Gastro-enteritis is of course to be combated by the usual means.

Antimo'nii Oxysulphure'tum.—Oxysul'phuret of An'timony.

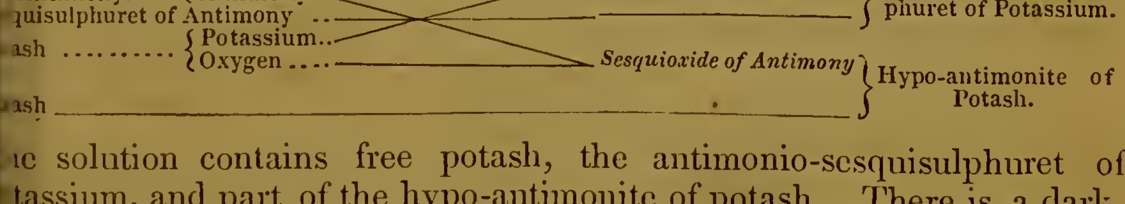
History.—Basil Valentine (*Triumphant Chariot of Antimony*, by irkringius, p. 131) was acquainted with this preparation; and probay also knew the substance called *Kermes mineral*, though he does not ention it in his writings. Glauber, in 1658, and Lemery, in 1707, are th said to be discoverers of the latter substance; but it is hardly ssible for Basil Valentine to have been unacquainted with it.

Natural History.—Kermes mineral, which is an oxysulphuret of itimony, though not identical with, yet nearly allied to, the preparation the Pharmacopœia, is found native in Saxony and other places: it is lled by mineralogists *red antimony* or *native kermes.*

Preparation.—If black or sesquisulphuret of antimony be boiled in alkaline liquid, a solution is obtained which, on cooling, deposits a ddish powder called *kermes mineral.* If a dilute mineral acid be added the filtered mother liquor, an orange red precipitate is produced, called e *golden sulphuret of antimony.* If the acid be added before the kermes s deposited, we obtain the orange red precipitate, called in the Pharicopœia *oxysulphuret of antimony.*

The oxysulphuret of antimony, Ph. L. is prepared by mixing together ounces of powdered sesquisulphuret of antimony, 4 pints of solution of tash, and 2 gallons of distilled water: boil for two hours, frequently rring, distilled water being often added, that it may fill the same meare. Strain the liquor, and gradually drop into it as much sulphuric id as may be sufficient to throw down the oxysulphuret: then wash away sulphate of potash with water, and dry what remains with a gentle at.

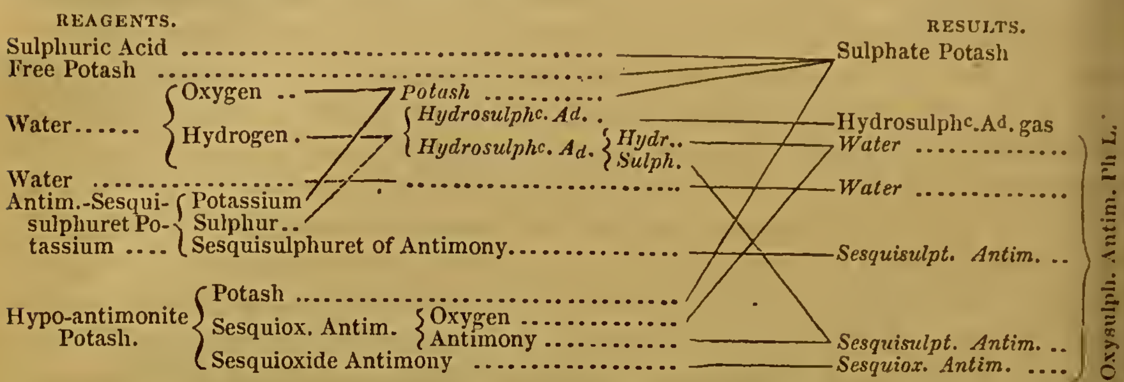
Theory of the Process.—When sesquisulphuret of antimony and tash are heated together, the latter gives oxygen to the antimony, and tassium to the sulphur of the sesquisulphuret; and thus sesquioxide of timony and sulphuret of potassium are produced. The sesquioxide mbines with some undecomposed potash, forming hypo-antimonite of tash, and the sulphuret of potassium with sesquisulphuret of antimony, ming a double sulphur salt (the antimonio-sesquisulphuret of potasm). These changes are explained in the subjoined diagram:—



e solution contains free potash, the antimonio-sesquisulphuret of tassium, and part of the hypo-antimonite of potash. There is a dark-l, undissolved residuum (similar to *crocus antimonii*) composed of hypotimonite of potash and oxysulphuret of antimony: this is got rid of by ering.

On the addition of sulphuric acid, sulphate of potash is produced by combination of the acid with free potash,—with some potash formed the union of the potassium of the sulphuret with the oxygen of some composed water,—and with the potash of the hypo-antimonite. By se changes sesquisulphuret and sesquioxide of antimony are set free:

the whole of the first, and part of the second, precipitate. The hydrogen of the decomposed water, with the sulphur of the sulphuret of potassium, forms hydrosulphuric acid, a portion of which escapes in a gaseous form, while the remainder, reacting on some sesquioxide of antimony, produces water and sesquisulphuret, which are precipitated along with some water of the solution. These changes will be better comprehended by reference to the following diagram :—



For further details respecting the theory of this process I must refer the student to Berzelius's *Traité de Chimie*, ii. 501, and Liebig and Poggendorf's *Handwörterb. d. Chemie*, i. 439.

PROPERTIES.—Oxysulphuret of antimony, Ph. L. is a bright red, odourless, almost tasteless powder. It is insoluble in cold water, and only slightly soluble in liquor ammoniæ. Boiled in nitro-hydrochloric acid, chloride of antimony is formed in solution, and some sulphur remains undissolved. Heated in the air it burns, evolves sulphurous acid, and leaves a greyish residuum.

CHARACTERISTICS.—When heated with concentrated hydrochloric acid it evolves hydrosulphuric acid, shewing it to be a sulphuret. From the other sulphurets or oxysulphurets of antimony it is to be distinguished partly by its colour. Its hydrochloric solution is shewn to contain antimony by the tests before mentioned for the sesquichloride of this metal (*vide* p. 400.) When boiled in a solution of bitartrate of potash we obtain a solution of emetic tartar, which may be recognized by the characters hereafter to be mentioned for this salt. It may be reduced by hydrogen and heat (*vide* p. 409.)

COMPOSITION.—When boiled in a solution of bitartrate of potash, it loses, according to Mr. Phillips (*Trans.* 3d ed. 203), 12 per cent.: the amount of sesquioxide that it contains. Its composition, according to the same authority, is as follows :—

	Eq.	Eq.Wt.	Per Cent.	Phillips.
Sesquioxide Antimony	1	77	13	12
Sesquisulphuret Antimony	5	445	75	76·5
Water	8	72	12	11·5
Oxysulphuret Antimony	1	594	100	100·0

But the sesquisulphuret and sesquioxide are probably only mechanically mixed.

The commercial oxysulphuret is of a brighter colour than that obtained according to the process of the Pharmacopœia. A manufacturer of it informs me it is prepared by boiling sulphur along with the sesquisulphuret of antimony and potash, and precipitating by an acid in the usual way.

Kermes antimonii consists of 2 equivalents of sesquisulphuret of antimony and 1 equivalent of sesquioxide of antimony (consequently it has the me composition as *red antimony ore*), and commonly contains also in 1 to $1\frac{1}{2}$ per cent. of alkali combined with sesquioxide of antimony. continued washing with water the hypo-antimonite of potash and squioxide of antimony may be extracted, leaving the sesquisulphuret ly. (Liebig, *Handwörterb. d. Chemie*, i. 427.) *Golden sulphuret of timony* is the persulphuret of antimony, and consists of 1 equivalent of imony and $2\frac{1}{2}$ equivalents of sulphur.

Purity.—Recently precipitated oxysulphuret of antimony is readily l completely soluble in liquor potassæ: but the oxysulphuret of the ps leaves a white residuum. Boiled in hydrochloric acid, it is disved with the evolution of hydrosulphuric acid gas: the solution is lescent or slightly milky, but becomes quite transparent on the addi- of a small quantity of nitric acid. It should not effervesce with ite sulphuric acid.

Physiological Effects.—The medicinal activity of this preparation principally or wholly owing to sesquioxide of antimony; and as the ntity of this is probably inconstant, the preparation is uncertain its operation. The obvious effects are precisely analogous to those emetic tartar; namely, vomiting, purging, and sweating. In small es it is employed as an alterative, expectorant, and diaphoretic: somewhat larger doses it causes nausea and sweating, and somees vomiting: in still larger quantities it excites both vomiting and ging. (For some experiments and observations on the action of *Kermes eral* and the *golden sulphuret*, consult Rayer, in *Dict. de Méd. et Chir. t.* iii. 57, *et seq.*)

Use.—It is principally employed as an *alterative* in chronic diseases, ticularly cutaneous affections, glandular enlargements, secondary hilis, rheumatism, and diseases of the liver. In these complaints it is ally associated with mercurials (especially calomel) and sometimes n guaiacum or narcotics. Kermes mineral has been employed as antiphlogistic in inflammatory affections of the respiratory organs, sometimes as an *emetic*.

Administration.—As an alterative the dose is from one to three grains: as an emetic from five grains to a scruple. It is a constit of the *pilulæ hydrargyri chloridi compositæ*, Ph. L. (chloride mer-; oxysulphuret of antimony, āā ℨii.; guaiacum resin, powdered, ℥ss.; ele, ℨii.) commonly termed *Plummer's pill*, the dose of which is from to ten grains.

Antidotes.—Vide Potassæ Antimonio-tartras.

Pul'vis Antimo'nii Compos'itus.—Com'pound Pow'der of An'timony.

History.—Dr. James, who died in 1776, prepared a celebrated nt medicine, long known as the *fever powder of Dr. James* (*pulvis ifugus Jacobi*), or *Dr. James's Powder* (*pulvis Jacobi*). The disry of it was subsequently claimed for a German of the name of wanberg (*Affidavits and Proceedings of W. Baker*, Lond. 1754). The ification which Dr. James lodged in the Court of Chancery is so iguously worded, that we cannot prepare his powder by it. Hence the present preparation has been introduced into the Pharmacopœia as a succedaneum for it. In preceding editions of the London Pharma-copœia it was termed *pulvis antimonialis* (*antimonial powder*); but in the edition for 1836 this name was unnecessarily (as I conceive) altered to *pulvis antimonii compositus.* In the Edinburgh Pharmacopœia it is denominated *oxydum antimonii cum calcis phosphate;* in the French Codex, *pulvis cum stibio compositus.*

Preparation.—In the London Pharmacopœia it is directed to be pre-pared by throwing a mixture of one pound of sesquisulphuret of anti-mony in powder, and two pounds of hartshorn shavings, into a crucible red hot in the fire, and stirring constantly until vapour no longer arises. Rub that which remains to powder, and put it into a proper crucible. Then apply fire, and increase it gradually, that it may be red hot for two hours. Rub the residue to a very fine powder.

The process of the Dublin Pharmacopœia is analogous to the above, as are also those of the Edinburgh Pharmacopœia and French Codex, with the exception that in the two latter works equal parts of sesquisul-phuret and hartshorn shavings are used.

Manufacturers usually substitute bone sawdust for hartshorn shavings.

The following is the *theory* of the process: the gelatinous matter of the horn (or bones) is decomposed and burned off, leaving behind the earthy matter (sub- or $\frac{2}{3}$, phosphate of lime, with a little calcareous carbonate). The sulphur of the sesquisulphuret is expelled in the form of sulphurous acid, while the antimony attracts oxygen from the air, forming antimonious acid, and a variable quantity of sesquioxide of anti-mony. By the subsequent heating the sesquioxide is, for the most part, converted into antimonious acid; but one portion is usually left unchanged, while another is volatilized. The carbonate of lime of the horn is decom-posed by the united agencies of heat and antimonious acid: carbonic acid is expelled, and a small quantity of antimonite of lime formed. The sides of the crucible in which the second stage of the process has been con-ducted, is found, at the end of the operation, to be lined with a yellow glaze, and frequently with yellow crystals of sesquioxide.

Properties.—Antimonial powder is white, gritty, tasteless, and odour-less. Boiling water extracts the antimonite (and superphosphate, *Dr. Maclagan*) of lime: the liquid becomes cloudy on cooling. Hydrochloric acid, digested in the residue, dissolves the subphosphate of lime, all the sesquioxide of antimony, and a portion of the antimonious acid.

Characteristics.—The solution obtained by boiling antimonial pow-der in distilled water occasions white precipitates, soluble in nitric acid, with oxalate of ammonia, nitrate of silver, and acetate of lead: hydro-sulphuric acid gas transmitted through the solution, produces an orange-red precipitate. If the portions of antimonial powder not dissolved in distilled water be digested in boiling liquid hydrochloric acid, a solution is obtained, which, on the addition of distilled water, becomes turbid, and deposits a white powder: at least I have found this to take place with several samples of antimonial powder which I have examined, and the same is noticed by Dr. Barker (*Observations on the Dublin Pharma-copœia*, 204); but neither Mr. Phillips (*Ann. Phil.* iv. N. S. 266) nor Dr. Maclagan (*Edinburgh Med. & Surg. Journ.* No. 135) have observed it. Hydrosulphuric acid gas, transmitted through the hydrochloric solution uses an orange red precipitate: if this be separated by filtering, and ; solution boiled to expel any traces of hydrosulphuric acid, a white ecipitate (phosphate of lime) is thrown down on the addition of caustic nmonia. That portion of antimonial powder which is not dissolved by drochloric acid is antimonious acid: if it be mixed with charcoal, d heated to redness, it is converted into sesquioxide, or metallic timony.

Composition.—*Dr. James's Powder* has been analysed by Dr. Pearson *hil. Trans.* lxxxi. for 1791, p. 317); by Mr. Phillips (*Ann. Phil.* N. S. 187); by Berzelius (*Traité de Chimie*, iv. 481); by M. Pully (*Ann. de im.* 1805, lv. 74); by Dr. D. Maclagan (*Edinb. Med. & Surg. Journ.* x. 462); and was imperfectly examined by Mr. Chenevix (*Phil. Trans.* 1801, p. 57). *Antimonial powder* has been analysed by Mr. Phillips *in. Phil.* N. S. iv. 266), and by Dr. D. Maclagan (*op. cit.*) Their ults are, for the most part, shown in the following table:—

	JAMES'S POWDER.					ANTIMONIAL POWDER.		
	Pearson	Phillips	Berzel.	Maclagan		Phillips		Maclagan
		Newbury's		Newbury's	Butler's	1st samp.	2d do.	
imonite of Lime [with me superphosphate, *aclagan*]	—	—	1	3·40	2·25	—	—	0·8
uioxide of Antimony	57	56·0	66	2·89	9·80	—	—	3·98
imonious Acid	43	42·2	33	43·47	34·21	35	38	50·09
phosphate of Lime	—	—	—	50·24	53·21	65	62	45·13
s [Sesquioxide of Antimony and impurity, *hillips*]	—	—	—	—	0·53	—	—	—
	100	100·0	100	100·00	100·0	100	100	100·00

Pully found sulphate of potash and hypo-antimonite of potash in nes's powder. Mr. Brande has found as much as .5 per cent. of sesoxide of antimony in the antimonial powder of the shops.

The *antimonite of lime* is obtained in solution by boiling antimonial vder in distilled water: the greater part of it deposits as the solution ls. The existence of *superphosphate* was inferred by Dr. Maclagan, n the precipitates produced with the salts of lead and nitrate of silver. Phillips assumed the non-existence of *sesquioxide of antimony*, ause the hydrochloric solution did not let fall any precipitate on the ition of water: an assumption which is certainly not correct, since a ll quantity of sesquioxide may be dissolved in this acid without our ng able to obtain any evidence of its presence by the action of water. Maclagan (*op. cit.*) has shown, that if hydrosulphuric acid gas be nsmitted through the solution, an orange red precipitate is obtained, ich he supposes to be an indication of the presence of sesquioxide. unless the antimonial powder be boiled *repeatedly* in water, to nove completely the antimonite of lime, this test cannot be relied on: if the least trace of this salt be present, an hydrated hydrochlorate antimonious acid is obtained, which, it is well known, not only proces an orange red precipitate with hydrosulphuric acid, but even ses a white precipitate on the addition of water (Gmelin, *Handb. der mie*, ii. 986).

Physiological Effects.—Antimonial powder is most unequal in its ration,—at one time possessing considerable activity, at another being t, or nearly so. This depends on the presence or absence of sesquioxide of antimony, which may be regarded as constituting its active principle, and which, when present, is found in uncertain and inconstant quantity. Moreover, this variation in the composition of antimonial powder cannot be regarded as the fault of the manufacturer, since it depends, as Mr. Brande (*Manual of Pharmacy*, 3d. ed. p. 292) has justly observed, "upon slight modifications in the process, which can scarcely be controlled."

Mr. Hawkins gave ℥j. morning and evening without any obvious effect; and the late Dr. Duncan, jun. administered ℈j. and ʒss. doses several times a-day, without inducing vomiting or purging (*Edinb. New Dispensat.* 11th ed.) Dr. Elliotson (*Cases illustrative of the Efficacy of the Hydrocyanic Acid*, p. 77) found even 120 grains nearly inert; nausea alone being in some of the cases produced. In these instances I presume it contained little or no sesquioxide.

But, on the other hand, a considerable number of practitioners have found it to possess activity. Dr. Paris (*Pharmacologia*) observes, that "it will be difficult for the chemist to persuade the physician that he can never have derived any benefit from the exhibition of antimonial powder." I have above stated that the experiments on which Mr. Phillips founds his assertion that this preparation contains no sesquioxide are inconclusive, as Dr. Maclagan (*op. cit.*) has shown. I am acquainted with one case in which it acted with great activity. A workman employed in the manufacture of this powder in the laboratory of an operative chemist in London, took a dose of it (which, from his account, I estimate at half a teaspoonful), and, to use his own words, "it nearly killed him." It occasioned violent vomiting, purging, and sweating.

Dr. James's powder, which some practitioners consider as more active and certain than our antimonial powder, appears to be equally inconstant in its operation. Dr. D. Monro (*Treatise on Med. & Pharm. Chem.* i. 367) who frequently used this powder, and saw Dr. James himself, as well as other practitioners, administer it, observes—"like other active preparations of antimony, it sometimes operates with great violence, even when given in small doses; at other times a large dose produces very little visible effects. I have seen three grains operate briskly, both upwards and downwards; and I was once called to a patient, to whom Dr. James had himself given five grains of it, and it purged and vomited the lady for twenty-four hours, and in that time gave her between twenty and thirty stools; at other times I have seen a scruple produce little or no visible effect." Dr. Cheyne (*Dubl. Hosp. Rep.* i. 315) thought highly of it in the apoplectic diathesis: but he used it in conjunction with bleeding, purgatives, and a strict antiphlogistic regimen.

The preceding facts seem to me to show the propriety of omitting the use of both antimonial and James's powder, and substituting for them some antimonial of known and uniform activity; as emetic tartar.

Uses.—Antimonial powder is employed as a sudorific in fevers and rheumatic affections. In the former it is given either alone or in combination with mercurials: in the latter it is frequently conjoined with opium as well as with calomel. In chronic skin diseases it is sometimes exhibited with alteratives.

Administration.—The usual dose of it is from 3 or 4 to 8 or 10 grains in the form of powder or bolus.

Potas'sæ Antimo'nio-Tar'tras.—An'timony-Tar'trate of Pot'ash.

History.—This salt was first publicly noticed in 1631, by Adrian Mynsicht (*Thesaurus Medico-Chymicus.*) It has been known by rious appellations, as *tartarized antimony* (*antimonium tartarizatum*), *etic tartar* (*tartarus emeticus*), *stibiated tartar* (*tartarus stibiatus*), and *tassio-tartrate of antimony* (*antimonii potassio-tartras*, Ph. L.)

Preparation.—Antimony-tartrate of potash is prepared by boiling tartrate of potash and sesquioxide of antimony (or some antimonial eparation which contains it, as the oxychloride or an oxysulphuret) th water: the sesquioxide combines with the bitartrate to form antiony-tartrate of potash.

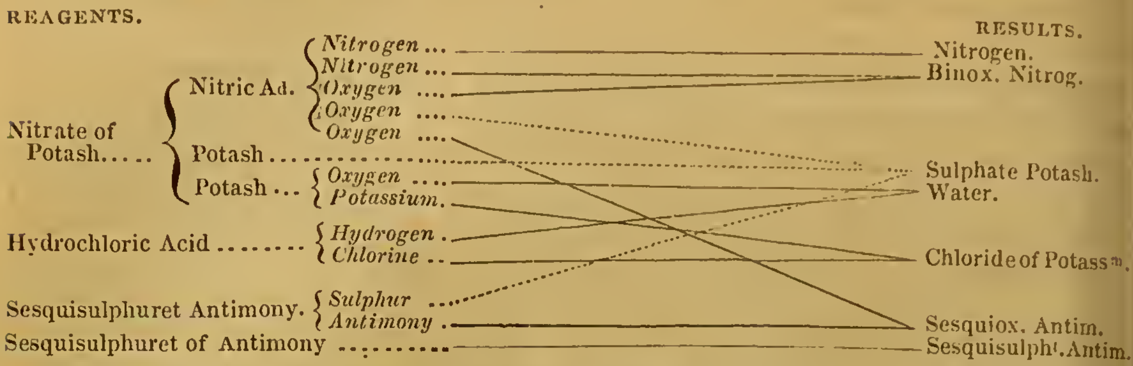
Antimony-ash (*cinis antimonii*), procured by roasting the sesquisulphu-, is employed to yield the sesquioxide in a manufactory in London. already stated (p. 398), this compound is a mixture of sesquioxide, timonious acid, and some undecomposed sesquisulphuret. The prortions of ash and bitartrate used vary according to the quality of the mer: the average being equal parts. This is the cheapest method of taining emetic tartar.

In the Dublin and United States Pharmacopœias the oxychloride *ydum antimonii nitro-muriaticum*, Ph. Dub.), commonly called Algah's powder, is employed. This is procured by pouring the sesquichloe (common butter of antimony, *vide* p. 399) into a large quantity of ter, and washing the precipitate. In the preparation of the sesquioride a small quantity of nitric acid should be employed to decompose hydro-sulphuric acid remaining in the liquor, and which would pair the colour of the precipitate.

n the London Pharmacopœia an oxysulphuret, very similar in compoon to the old *saffron of antimony* (*crocus antimonii*) is used. It is thus pared: two pounds of powdered sesquisulphuret of antimony are to be urately mixed with the like quantity of powdered nitrate of potash: r fluidounces of hydrochloric acid are then to be added, and the pow-, ignited, spread out on an iron plate. The residue is to be rubbed to ery fine powder, and, when cold, washed with boiling water until it is l of taste.

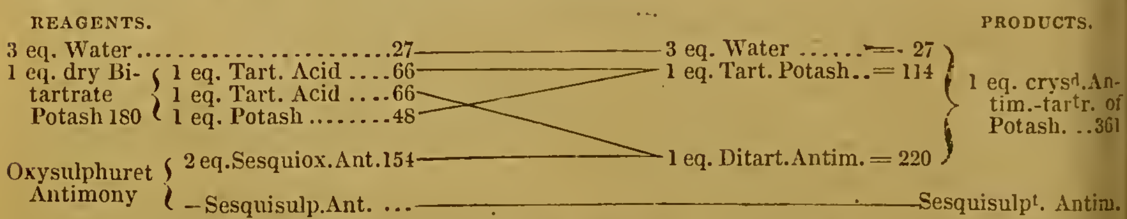
t is then to be boiled for half an hour with fourteen ounces of bitare of potash in a gallon of distilled water. The liquor is to be ined while hot, and set aside to form crystals.

The *theory* of the process is this: part of the sulphur and of the antiy are oxidized at the expense of the oxygen of the acid of the nitrate, which sulphuric acid and sesquioxide of antimony are formed, while ogen and binoxide of nitrogen escape. The sulphuric acid unites part of the potash of the nitrate. The hydrochloric acid reacts on ther portion of potash, and produces water and chloride of potassium. o hydrochloric acid had been employed, the potash would react on e undecomposed sesquisulphuret, and generate antimonio-sesquihuret of potassium and sesquioxide of antimony. The residuum of operation is, then, sulphate of potash, chloride of potassium, sesquile of antimony, and some undecomposed sesquisulphuret. By wash- the sulphate and chloride are got rid of. The following diagram, though imperfect, may perhaps assist the student in comprehending the foregoing changes:—



The reacting equivalents have been omitted in the above diagram: but the results may be explained by assuming that 6 equivalents of nitrate, 7 equivalents of sesquisulphuret, and $1\frac{1}{2}$ equivalents of hydrochloric acid, are employed. The products will be 6 eqs. of binoxide of nitrogen, $4\frac{1}{2}$ eqs. of sulphate of potash, $1\frac{1}{2}$ eqs. of water, $1\frac{1}{2}$ eqs. of chloride of potassium, 3 eqs. sesquioxide of antimony, and 4 eqs. sesquisulphuret.

The changes in the second stage of the process are readily comprehended: two equivalents or 154 parts of sesquioxide of antimony combine with one equivalent or 180 parts of dry bitartrate of potash, to form one equivalent or 334 parts of dry emetic tartar, which, in crystallizing, unite with three equivalents, or 27 parts of water. The sesquisulphuret is unacted on by the bitartrate of potash.

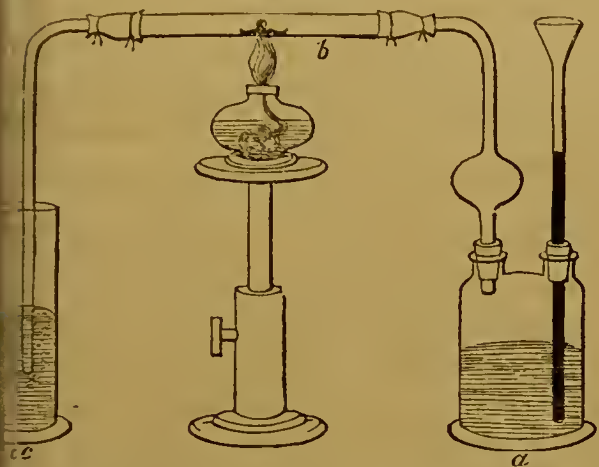


PROPERTIES.—Emetic tartar crystallizes in white, transparent, inodorous, rhombic octahedrons, whose lateral planes are striated. By exposure to the air they become opaque, probably by giving out an equivalent of water. Their taste is feebly sweetish, then styptic and metallic. They dissolve in 14 or 15 parts of water at 60° F. ($12\frac{65}{100}$ at 70°, Brandes),—and in 2 parts ($2\frac{78}{100}$ parts, Brandes) at 212°. Their aqueous solution slightly reddens litmus and undergoes decomposition by keeping, like that of tartaric acid and most tartrates. Alcohol will not dissolve this salt. By calcining emetic tartar in close vessels we obtain a pyrophoric alloy of antimony and potassium. They decrepitate in the fire.

CHARACTERISTICS.—Heated in a porcelain or glass capsule it chars: shewing it contains an organic substance (tartaric acid.) If the charred salt be heated in a glass tube by a blowpipe, globules of antimony are obtained.

If a stream of hydrosulphuric acid gas be transmitted through a watery solution of emetic tartar (*vide* fig. 65, p. 409), the latter becomes orange-red: if a small quantity of hydrochloric acid be then added, a flocculent orange-red precipitate (hydrated sesquisulphuret of antimony) takes place. This precipitate is to be collected and dried, and introduced into a green glass tube. Then transmit a current of hydrogen gas over it, and after a few minutes apply the heat of a spirit lamp to the sesquisulphuret: hydrosul-uric acid and metallic antimony are produced. A portion of the latter [spuriously ?] sublimed. The metal is known to be antimony by dis- lving it in nitro-hydrochloric acid : the solution forms a white precipi- te (powder of Algaroth) on the addition of water, and an orange-red one th hydrosulphuric acid gas, or hydrosulphate of ammonia. The mode reducing the sesquisulphuret will be readily understood by the accompanying diagram (fig 65). This process was proposed by the late Dr. E. Turner.

Fig. 65.



a) Vessel for generating hydrogen. (b) Re- ction tube. (c) Vessel containing solution of :tate of lead to detect the hydrosulphuric acid ich is formed.

A solution of emetic tartar forms *white* precipitates with oxalic and the strong mineral acids, the alkalies and their carbonates, and lime water: *greyish* or *yellowish white* (*tannate of antimony*), with infusion of nutgalls: and *reddish* with the soluble hydrosulphates. Their relative delicacy, as well as the delicacy of hydrosulphuric acid, has been thus determined by Devergie. (*Méd. Lég.* ii. 770.)

		Dilution of the Solution.
Hydrochloric acid does not form a precipitate at	. . . .	2,500
Sulphuric (or oxalic) acid ditto	. . . .	1,000
Tincture of nutgalls . . ditto	. . . . , .	1,000
Lime water . . . . stops at	. . . .	1,200
Potash (soda, ammonia, or carbonate of ammonia) stops at		2,000
Hydrosulphuric acid (or hydrosulphate of ammonia) ditto		100,000

ıe sesquioxide of antimony thrown down by the alkalies is soluble in excess of the precipitant. The precipitate formed by sulphuric or ric acid is the sesquioxide combined with a small quantity of the acid. :etic acid does not occasion any precipitate.

(Composition.—The following is the composition of this salt:—

	Eq.	Eq. Wt.	PerCt.	Wallquist.	R.Phill.	Thoms.
quioxide of Antimony	2	154	42·65	42·99	43·35	42·62
ash	1	48	13·29	13·26	49·25	57·38
taric Acid	2	132	36·56	38·61		
ter	3	27	7·47	5·14	7·40	
etic Tartar	1	361	99·97	100·00	100·00	100·00

or

	Eq.	Eq. Wt.	Per Cent.
Ditrartrate of Antimony	1	220	60·94
Tartrate Potash	1	114	31·57
Water	3	27	7·47
Antimonio-Tartrate of Potash	1	361	99·98

e regard this compound, then, as a double salt, in which the ditartrate of timony performs the function of the electro-negative or acid constituent, the tartrate of potash, the electro-positive or basic constituent.

Purity.—In the crystalline state the purity of this salt is easily deter- ned. The crystals should be well formed, perfectly colourless, trans- rent, or opaque, and when dropped into a solution of hydrosulphuric id have an orange-coloured deposit formed on them.

When pure the powder of this salt is perfectly white. Some ignorant uggists prefer a yellowish white powder, and I am informed by a nufacturer of this salt that he is obliged to keep two varieties (one white, the other yellowish white), to meet the demands of his customers! The yellow tint is owing to the presence of iron, which is readily detected in the salt by the blue colour immediately produced in its solution by adding first a few drops of dilute sulphuric acid, and then ferrocyanuret of potassium.

Emetic tartar is sometimes adulterated with bitartrate of potash. According to Mr. Hennell (Phillips's *Transl. of the Pharm.* 3d ed.) the antimonial salt may contain 10 per cent. of bitartrate, and yet the whole will dissolve in the proper quantity (14 or 15 parts) of water. In order to detect any uncombined bitartrate, he adds a few drops of a solution of carbonate of soda to a boiling solution of the antimonial salt, and if the precipitate formed be not dissolved, he concludes that there is no bitartrate of potash present.

A pure solution of emetic tartar should occasion no precipitate with chloride of barium: it produces a white precipitate (unless the solutions be very dilute) with nitrate of silver, soluble in excess of water.

Physiological Effects. (*a.*) *On vegetables.*—Emetic tartar acts as a poison to plants (*vide* the experiments of Schübler and Zeller, in *Schweigger's Journ. f. d. Chem.* 1827, B. 50, S. 54-66.)

(*b.*) *On animals.*—An extended examination of the effects of emetic tartar on the different classes of animals is still a desideratum. Hitherto experiments with it have been principally confined to dogs, rabbits, horses, oxen, sheep, and cats. Moiroud (*Pharm. Vétér.* 287) has given two drachms to horses, and gradually increased the dose to six ounces, without perceiving any remarkable and permanent derangement in the exercise of the principal functions. Gilbert (quoted by Moiroud) has exhibited ten drachms to a cow and four to a sheep without any remarkable effect: but six drachms killed an animal of the latter species. Magendie (in Orfila's *Toxicol. Gén.*) examined its effects on dogs. He found that from six to ten grains introduced into the stomach killed the animals in from two to three hours, when the gullet was tied: those who were able to get rid of it by vomiting took as much as a drachm without experiencing any bad effects, and in some cases half an ounce caused no ill effects. From his experiments it appears to operate locally and by absorption, its principal action being on the intestinal canal and lungs: for nausea, vomiting, alvine evacuations, difficulty of respiration, and accelerated respiration, were produced by injecting a solution of the salt into the veins, by introducing it into the stomach, as well as by applying it in the solid state to the cellular tissue. Traces of pneumonia, gastritis, and enteritis, were found after death. These experiments have been repeated by Rayer and Bonnet (*Dict. de Méd. et de Chir. Prat.* iii. [illegible]) on rabbits; but without obtaining the lesion of the lungs mentioned by Magendie: in some cases no appreciable lesion was observed in any organ. Dr. Campbell (quoted by Dr. Christison) found no pulmonary inflammation in a cat killed by this salt. According to Flourens (*Journ. de Chim. Méd.* ix. 21) emetic tartar injected into the veins of ruminants causes efforts to vomit, but not actual vomiting; of the four stomachs possessed by these animals, the *reed* or true stomach is the only one affected by it.

(*c.*) *On man.* *a. Local effects.*—Emetic tartar is a powerful local irritant, but not a caustic; that is, it does not exercise any known chemical influence over the parts with which it is placed in contact. Its irritant operties may be regarded as of a peculiar or specific kind, at least if are to judge from its well-known effects when applied to the epi-rmis. To observe these, we may sprinkle the powder over a plaster, employ the salt in the form of solution or of ointment. By any of ese modes of application we obtain an eruption of painful pustules, embling those of variola or ecthyma. The smaller ones are semiglo-lar; the larger ones, when at their height, are flattened, are surrounded th an inflammatory border, contain a pseudo-membranous deposit and ne purulent serum, and have a central dark point. When they have ained their greatest magnitude, the central brown spots become larger d darker, and, in a few days, desiccation takes place, and the crusts are own off. The largest are produced by using the powder sprinkled er a plaster; the smallest are developed by applying the solution. ey are usually very painful. I am acquainted with no pharmacological ent producing an eruption precisely similar. The facility with which s eruption is produced varies considerably in different individuals, and the same individual at different times.

In consequence of the internal use of it, a similar pustular eruption s been met with in the mouth, œsophagus, and small intestines, and ite aphthous spots have been observed on the velum and tonsils epelletier, *De l'Emploi du Tart. Stibié*, p. 171). But these effects rare.

We have further evidence of the local irritation produced by emetic tar, in its action on the stomach and intestines. When swallowed in l doses it gives rise to vomiting and purging, pain in the epigastric ion, and, after death, redness of the gastro-intestinal membrane has en found. However, it would appear from the experiments of agendie, before referred to, that part of this effect should be referred to specific influence which emetic tartar exerts over the stomach, inde-ndent of its direct local irritation, since the same symptoms have been uced by the application of this substance to wounds, or by its injec-n into the veins.

Occasionally constitutional effects (nausea, vomiting, and griping pains) e appeared to result from the application of emetic tartar to the skin *urn. de Chim. Méd.* iv. 478). In one instance death resulted from its ployment: the patient was an infant two years of age, and death urred in forty-eight hours (*Med. Repos.* xvi. 357). These effects, if lly produced by this salt, occur very rarely. I have applied to the skin etic tartar (in the form of solution, ointment, and plaster) in more than hundred cases, without having observed any constitutional effect; ugh I have occasionally fancied that it ameliorated pulmonary affec-ns, even when no eruption or redness was produced, and which might se from absorption.—(See some experiments on this subject in *Mem. of Med. Soc. of Lond.* vols. ii. iv. and v.)

3. *Remote* or *constitutional effects.*—Taken internally, *in small doses*, etic tartar increases secretion and exhalation of the gastro-enteritic mbrane, and of the liver and pancreas. Subsequently it acts power-y on other emunctories: thus it causes sweating, without any very rked vascular excitement; it renders the mucous membranes (espe-lly the aërian membrane) moister, and, when the skin is kept cool, motes the secretion of urine. These effects are produced more cer-nly and speedily by this salt than by any other antimonial preparation.

In somewhat larger doses it excites nausea, frequently with vomiting, disorders the digestive functions, gives rise to an uneasy sensation in the abdominal region, depresses the nervous functions, relaxes the tissues (especially the muscular fibres), and occasions a feeling of great feebleness and exhaustion. These symptoms are accompanied or followed by increased secretion and exhalation from the different emunctories, but especially from the skin, as above mentioned. Of all emetic substances this creates the most nausea and depression.

In excessive doses emetic tartar has, in a few instances, acted as an irritant poison, and even occasioned death. In one case a scruple, in another 27 grains, nearly proved fatal (Orfila, *Toxicol. Gén.*) In a third 40 grains caused death (*ibid.*) The symptoms in the latter case were vomiting, hypercatharsis, convulsions, epigastric pain and tumefaction, and delirium. Death occurred four days after the ingestion of the poison.

Were the above cases not well authenticated, we should be disposed to ascribe the dangerous symptoms, and death, to some other circumstance than the use of the above-mentioned quantities of emetic tartar; for of late years this salt has been extensively employed in enormous and repeated doses with perfect safety. Rasori (Bayle's *Bibliothèq. de Thérap.* i. 198) has given many drachms in twenty-four hours, and many ounces during the course of a disease, without occasioning either vomiting or abundant alvine evacuations. Laennec (*Treatise on Diseases of the Chest*, by Dr. Forbes, p. 249) has confirmed, to a certain extent, the statements of Rasori. He gave a scruple, two scruples, and even a drachm and a half within twenty-four hours (usually in doses of one, two, or three grains) without ever having seen any injurious consequences. The usual effects which I have observed from the continued use of one or two grain doses, are, nausea, vomiting, and purging, which in most cases are much diminished, or entirely cease, in a day or two. Perspiration I have found to be a frequent effect. In all the instances above referred to, in which these large doses were administered, the patients were affected with inflammatory diseases. Now it is to this morbid state, or *diathesis*, that, according to Rasori (*op. cit.*) we ought to ascribe the *tolerance* of, or capability or *aptitude* of bearing, these immense quantities of so powerful a medicine (*vide* p. 33, for some remarks on the Italian *theory of contra-stimulus*). Consequently, if the opinion be worth any thing, the susceptibility to the influence of the medicine should increase as the disease subsides; a circumstance which Rasori asserts really takes place. But in this the theoretical views of this distinguished Italian have probably led him to overlook the fact. "It is certainly true," observes Laennec (*op. cit.*), "that after the acute period of the disease [peripneumonia], the tolerance diminishes, or sometimes entirely ceases; but it is more common to find the patient become habituated to the medicine, insomuch that during convalescence, and when he has begun to use food as in health, he will take daily, without knowing it, six, nine, twelve, or even eighteen grains of the emetic tartar." Though I have seen this salt extensively employed in both public and private practice, I have never met any satisfactory cases supporting Rasori's assertion of the diminished tolerance when the patient becomes convalescent. Moreover, large doses have been taken by healthy individuals without any remarkable effects. Alibert (*Nouv. Elém. d. Thérap.* 5[me] éd.

259) saw, at the Hôpital St. Louis, a man who took a drachm of this alt, in order to poison himself, but suffered no remarkable inconvenience om it. Lebreton (Orfila's *Toxicol. Gén.*) reports the case of a girl who vallowed six drachms at once as a poison: oil was immediately given; omiting took place, and she soon recovered. Other published cases ight be brought forward in proof of the slight effects of large oses of this salt, but I must content myself with referring to the Iemoir of Magendie (*De l'influence de l'emetique*) for notices of em. I may add, however, that this distinguished physiologist conudes, that the comparative slightness of the effects arose from the evauation of the salt a few moments after its ingestion; but in several, at ast, of the cases, this was not proved; and in one it certainly did not appen—it was that of a man who swallowed 27 grains of this salt, and id not vomit.

The action of large doses of emetic tartar on the circulation and repiration is usually that of a sedative. This has been very frequently, ough not constantly observed. In one case of peripneumonia, the aily use of from six to eight grains of this salt reduced the pulse, in ine days, from 120 to 34 beats per minute, and diminished the number f inspirations from 50 to 18 (Bouneau et Constant, quoted by Lepeltier, *De l'emploi du Tart. Stib.* 84). In another the pulse descended, in ree days, from 72 to 44 beats per minute (Trousseau, quoted by epelletier).

MODUS OPERANDI.—Though emetic tartar has not hitherto been deected by its chemical characters in the solids or fluids of the body, yet nalogy is much in favour of Magendie's statement, that it gets into the irculation, and in this way produces its constitutional effects. M. Barré, quoted by Rayer, *Dict. de Méd. et de Chir. Prat.* iii. 69) has endeavoured o prove the reverse of this; namely, that emetic tartar cannot be aborbed by the healthy mucous membrane of the alimentary canal; but, n my opinion, neither his experiments nor his inferences are worth uch. A fact mentioned by Minaret (*Lond. Med. Gaz.* xiii. 496) strongly upports the common opinion of absorption. A young woman labouring nder pleuritis took emetic tartar, which operated on the child at her reast as well as on herself.

Several parts of the body are influenced by this salt. The specific ffection of the *alimentary canal* (especially of the stomach) is shown by e vomiting and sometimes purging produced, not only when the mediine is swallowed, but when it is injected into the veins or into the indpipe, or when applied to the serous coats of the intestines, or to the ellular tissue. If it purge or occasion sweating, it usually causes thirst, ut not commonly otherwise. The appetite and digestion are frequently nimpaired. After the use of it for some days, patients sometimes comlain of irritation in the mouth and throat, with a metallic taste: this as been considered a sign that the system is saturated with antiony, and that the use of it should be suspended. A pustular eruption as occasionally appeared in the mouth, as I have already mentioned p. 411).

Magendie ascribes to emetic tartar a specific power of causing ngorgement or inflammation of the *lungs;* for he found, on opening the odies of animals killed by it, that the lungs were of an orange red or iolet colour, incapable of crepitating, gorged with blood, and here and there hepatized. Moveover, it has been assumed that the same effects are produced in the human pulmonary organs; and in support of this opinion a case noticed by Jules Cloquet (Orfila, *Toxicol. Gén.*) has been referred to: it is that of a man who died of apoplexy, but who, within five days of his death, had taken 40 grains of tartar emetic. "In the lungs were observed blackish spots, very irregular, which extended more or less deep into the parenchyma of this organ." Furthermore, it is argued, unless we admit a specific influence of antimony over the lungs, we cannot well explain the beneficial effects of this remedy in peripneumonia. In opposition to this view, I would remark, that in cases of poisoning by this substance in the human subject, no mention is made of difficulty of breathing, cough, pain, or other symptom, which could lead to the suspicion that the lungs were suffering; and in the case of poisoning related by Recamier (Orfila, *op. cit.*) we are distinctly told that the thorax was sound. Besides, we should expect that if emetic tartar had a tendency to inflame the lungs, or at least to occasion pulmonary engorgement, that large doses of it would not be very beneficial in acute peripneumonia. It would even seem that this substance must have an influence over the human lungs of an opposite kind to that supposed by Magendie; for, as already related, it reduces the frequency of respiration in a considerable number of instances.

The sedative influence of emetic tartar over the *circulatory system* has been already noticed: it is, however, not always evident.

The great depression of the muscular power, the diminution of the frequency of the pulse and fainting, the epigastric pain sometimes experienced under circumstances that almost preclude the supposition of gastric inflammation, the cramps and convulsions, the delirium and insensibility, caused by emetic tartar in poisonous doses, are referrible to the influence of this substance over the *nervous system.*

The *absorbent system* is supposed to be stimulated to greater activity by emetic tartar, in consequence of the disappearance of serous and synovial effusions under its use. Moreover, Laennec (*op. cit.* p. 203) ascribed the efficacy of it in peripneumonia to the increased activity of the interstitial absorption.

The influence of it over the *secreting organs* has been before referred to. Every one is familiar with its diaphoretic properties. Its diuretic effect is best seen when the skin is kept cool, and when neither vomiting nor purging supervene. Magendie says, it augmented the secretion of saliva in dogs; and the same effect has been observed in man by Drs. Griffith and Jackson. The menstrual discharge is not checked by it; but occasionally has come on under its use.

Uses.—As an *emetic*, this salt is usually administered by the stomach; but it is sometimes used as an enema, and injected into the veins. When administered by the stomach, it is generally given in doses of one or two grains, frequently in combination with ten or fifteen grains of ipecacuanha. When our object is merely to evacuate the contents of the stomach, and with as little constitutional disorder as possible (as in cases of narcotic poisoning), other emetics (as the sulphates of zinc and copper) are to be preferred, since they occasion less nausea and depression of system, while they excite speedy vomiting. On the other hand, when we use vomiting as a means of making an impression on the system, and thereby of putting a sudden stop to the progress of a disease, emetic tartar is by far ır best vomit. It is with this view that it is sometimes employed in the ırly stages of fever, especially when accompanied by gastric or bilious ısorder. It is most efficacious when given at the very commencement ' the symptoms, and before the disease is fully formed. In such cases it ;casionally puts an entire stop to the progress of fever. But, unfortuıtely, the practitioner is not usually called in to see the patient until the roper period for the exhibition of an emetic has passed by,—that is, ıtil the disease is fully established. Emetic tartar is used as a vomit ith considerable success in the early stage of inflammatory diseases, ;pecially in croup, tonsillitis, swelled testicle, bubo, and ophthalmia. ıere also the success of the remedy is in proportion to its early applicaon. In croup it should be given to excite in the first instance vomiting, ıd afterwards prolonged nausea. Under this plan of treatment I have en two or three slight cases completely recover without the use of any her remedial agent. Dr. Copland (*Dict. of Pract. Med.* i. 467) also ears testimony to the success of the practice. In most cases it will be und advisable to precede the use of this medicine by blood-letting. Dr. heyne (*Essay on Cynanche Trachealis,* 1801) advises the employment of ıetic tartar in the second stage of croup, for the purpose of moderating ıscular action, and of promoting the separation of the adventitious mem-ane. But I am disposed to rely chiefly on calomel (given so as speedily occasion ptyalism) and blood-letting. Dr. Cheyne recommends half a ain of emetic tartar to be dissolved in a table-spoonful of water, and ven to a child two or three years of age, every half hour till sickness and omiting are produced; and in two hours after the last act of vomiting the me process is to be recommenced, and so repeated while the strength ill admit. Another disease which is relieved by the occasional use 'emetics is *hooping-cough.* They should be administered at the commenceent of the disease, every, or every other day. They diminish the violnce and length of the fits of spasmodic coughing, and promote expecration. Emetic tartar is particularly valuable in this disease in conseıence of being tasteless, and, therefore, peculiarly adapted for exhibition children. In derangements of the hepatic functions indicating the nployment of emetics, this salt is usually preferred to other vomiting ;ents, on account of its supposed influence in promoting the secretion bile.

Clysters containing emetic tartar have been employed to occasion omiting, but they are very uncertain in their operation. Rayer has freıently employed from 6 to 12 grains without producing either nausea vomiting.

It has been repeatedly *injected into the veins* to excite vomiting. The ual dose is two or three grains dissolved in two ounces of water; but in me cases six grains have been employed. The effects are unequal: hen vomiting does occur it is not always immediate; frequently it does ot take place at all (Dieffenbach, *Transf. d. Blut. u. d. Infus. d. Arzn.*)5.) In several cases of choking from the lodgment of pieces of meat the œsophagus, this remedy has been applied with great success: omiting was produced, and with it the expulsion of the meat. It has so been used in epilepsy and trismus: frequently with dangerous conquences (Dieffenbach, *op. cit.* 49.) Meckel employed it to restore ıimation in asphyxia by drowning (*ibid*).

As a *nauseant,* to reduce the force of the circulation and the muscular power, emetic tartar is frequently of considerable service. Thus in dislocations of the larger joints (the hip and shoulder, for example), blood-letting, and nauseating doses of emetic tartar, are employed to diminish the resistance of the muscles opposing the reduction.

Emetic tartar, in large doses, is a most powerful and valuable remedy in the treatment of inflammation, especially peripneumonia. As an emetic, nauseant, or diaphoretic, it has long been in use in this disease; having been employed by Riverius in the 17th century, and subsequently by Stoll, Brendel, Schroeder, and Richter, in Germany; by Pringle, Cullen, and Marryat, in England. But as a remedy for inflammation, independent of its evacuant effects, we are indebted for it to Rasori (see the French translation of his Memoir, in Bayle's *Biblioth. de Thérap.* i. 198), who first used it in the years 1799 and 1800, in an epidemic fever which raged at Genoa. Subsequently he exhibited it much more extensively, and in larger doses, in peripneumonia. This mode of treatment was tried and adopted in France, first by Laennec (*Treat. on Dis. of the Chest*, translated by Dr. Forbes); in this country by Dr. Balfour (*Illust. of the Power of Emet. Tart.* 2d edit. 1819). Its value as an antiphlogistic is now almost universally admitted. Practitioners, however, are not quite agreed as to the best method of using it. Rasori (*op. cit.*), Laennec (*op. cit.*), Recamier (*Gaz. Méd.* 1832, p. 503), Broussais (*Cours de Path. et de Thérap. gén.* ii. 521), Bouillaud (*Dict. de Méd. et de Chir. pratiq.* xiii. 395), Dr. Mackintosh (*Pract. of Phys.* i. 426), Drs. Graves and Stokes (*Dubl. Hosp. Rep.* v. p. 48), Dr. Davis (*Lect. on Dis. of the Lungs and Heart*, 188), and most practitioners of this country, employ blood-letting in peripneumonia, in conjunction with the use of emetic tartar. But by several continental physicians the abstraction of blood is considered both unnecessary and hurtful. Thus Peschier (Bayle, *Bibl. Thér.* i. 246) advises us on no account to draw blood: and Trousseau (*Dict. de Méd.* 2d edit. iii. 220) observes, that blood-letting, far from aiding the action of emetic tartar, as Rasori, Laennec, and most practitioners, imagine, is, on the contrary, singularly injurious to the antiphlogistic influence of this medicine. On these statements I would observe, that few practitioners in this country have ventured to trust to emetic tartar alone in the treatment of violent pulmonary inflammation. Of its efficacy when used alone, in several slight cases of pneumonia, I can bear testimony; but in severe cases I have invariably conjoined blood-letting, and I believe most British practitioners have done the same. Louis (*Rech. de la Saignée*) has published some numerical results of the treatment of inflammation of the lungs by blood-letting and by emetic tartar; from which it appears that this substance, given in large doses, where blood-letting appeared to have no effect, had a favourable action, and appeared to diminish the mortality (*op. cit.* p. 62). But he particularly states that blood-letting must not be omitted (p. 32).

Laennec's mode of using this salt, and which, with some slight modification, I believe to be the best, is the following:—Immediately after bleeding give one grain of emetic tartar, dissolved in two ounces and a half of some mild fluid [cold weak infusion of orange flowers], sweetened with half an ounce of syrup of marshmallows: this is to be repeated every two hours for six times, and then suspended for seven or eight hours, if the symptoms are not urgent, or if there be any inclination to sleep. But if the disease has already made progress, or if the oppression great, or the head affected, continue the medicine until amendment ;es place; and in severe cases increase the dose to two, or two and a half iins. The only modification in this plan, which I would venture to ppose, is, to begin with a somewhat smaller dose (say one-third or one-lf of a grain), and gradually increase it; for in consequence of the lent vomiting which one grain has sometimes produced, I have found tients positively refuse to continue the use of the medicine.

From my own experience I should say, that emetic tartar is nearly as viceable when it causes moderate sickness and slight purging, as when ccasions no evacuation: but many practitioners deny this. Laennec serves, that "in general the effect of emetic tartar is never more rapid, more efficient, than when it gives rise to no evacuation; sometimes, vever, its salutary operation is accompanied by a general perspiration. hough copious vomiting and purging are by no means desirable, on :ount of the debility and hurtful irritation of the intestinal canal which y may occasion, I have obtained remarkable cures in cases in which h evacuations had been very copious" (*op. cit.* p. 251). A few drops tincture of opium may be sometimes conjoined with the antimony, to ck its action on the alimentary canal.

The attempts which have been made to explain the *modus medendi* of etic tartar in pneumonia and other inflammatory diseases, are most satisfactory. Whilst almost every writer, even Broussais, admits its cacy in inflammation, scarcely two agree in the view taken of the de by which the good effects of this remedy are produced; as the fol-ing statement proves. Rasori explains its operation according to the nciples of the theory of contra-stimulus (*vide* p. 33), of which he may regarded as the founder. He considers emetic tartar endowed with power of directly diminishing the inflammatory stimulus; of destroy- the diathesis, and of being, therefore, a real contra-stimulus. Brous-s, Bouillaud, and Barbier, ascribe its curative powers to its revulsive or ivative action on the gastro-intestinal membrane. Laennec thinks t it acts by increasing the activity of interstitial absorption. Fonta-lles supposes that the antiphlogistic effect depends on alterations the composition of the blood. Eberle (*Mat. Méd.* i. 66) refers it to sedative effects, first, on the nervous system, and consecutively on the rt and arteries. Teallier thinks that, like many other therapeutic nts, it influences the organism by concealed curative properties. Macartney (*A Treatise on Inflammation*, 1838) regards it as a medi-e diminishing the force of the circulation, by the nausea which it asions. These examples are sufficient to show the unsatisfactory con-on of our present knowledge as to the mode by which emetic tartar duces its curative effects. But this is no argument against the exist-e of remedial powers. Shall we deny the efficacy of blood-letting nflammation, of mercury in syphilis, of cinchona in intermittents, of enic in lepra, of sulphur in scabies, of hydrocyanic acid in gastrodynia, l of a host of other remedies, simply because we cannot account for ir beneficial effects? The fact is, that in the present state of our owledge we cannot explain the *modus medendi* of a large number of best and most certain remedial means.

In *pleurisy* emetic tartar does not succeed so well as in inflammation of substance of the lungs. "It, indeed, reduces speedily the inflamma-y action," says Laennec (*op. cit.* p. 259); "but when the fever and pain have ceased, the effusion does not always disappear more rapidly under the use of tartar emetic than without it." I have sometimes conjoined opium (always after copious blood-letting) with advantage. In *bronchitis* (both acute and chronic) it may be most usefully employed, in conjunction with the usual antiphlogistic agents (*vide* also Dr. Kemp, *Lond. Med. Gaz.* xix. 300, and Mr. Ellis, *op. cit.* p. 369). In *rheumatism* (especially the kind called *articular*), next to peripneumonia, emetic tartar has been found by some practitioners (especially by Laennec, *op. cit.*) more efficacious than in any other inflammatory affection: the usual duration of the complaint, when treated by this remedy, was found by Laennec to be only seven or eight days (see also Bayle's *Bibl. Thérap.* i. 311, and Lepelletier, *De l'Emploi du Tart. Stib.* p. 220). In muscular rheumatism it succeeds less perfectly. Synovial effusions (whether rheumatic or otherwise) have, in some cases, given way rapidly to the use of emetic tartar (Laennec, *op. cit.* p. 263, and Gimelle, *Brit. & For. Med. Rev.* for July 1838, p. 224). My own experience of the use of this medicine in rheumatism is not so favourable to its employment as the above reports would lead us to expect. In *arachnitis*, Laennec has seen all the symptoms disappear, under the use of emetic tartar, in 48 hours. In three instances of acute hydrocephalus, all the symptoms disappeared in the same space of time. In *phlebitis* (Laennec, *op. cit.*); in *inflammation of the mammæ* occurring after delivery (Dr. E. Kennedy, Mr. Lever, and Dr. Ashwell, *Lond. Med. Gaz.* xx. 761); in *ophthalmia*, and various other inflammatory affections, emetic tartar has been successfully employed as an antiphlogistic.

In continued fever emetic tartar is of considerable service. Mild cases are benefited by the use of small doses (as from one-sixteenth to one-fourth of a grain), as a diaphoretic. In the more severe form of this disease, accompanied with much vascular excitement, emetic tartar, in the dose of half a grain or a grain, may be usefully administered as an antiphlogistic; but its use should, in general, be preceded by blood-letting. In the advanced stages of typhus fever, accompanied with intense cerebral excitement, manifested by loss of sleep, delirium, &c., Dr. Graves (*Lond. Med. Gaz.* xx. 538) has obtained most beneficial results from the use of emetic tartar and opium. The same combination has been employed with great success in delirium tremens, as well as in delirium of erysipelas, scarlatina, and measles, by Dr. Law (*Lond. Med. Gaz.* xviii. 538 & 694).

Emetic tartar is one of our most valuable sudorifics, being oftentimes available when other agents of this class are inadmissible: for example, in fevers and other diseases, where we are desirous of producing diaphoresis, but which are accompanied with preternatural vascular action about the head, the use of those sudorifics (the compound ipecacuanha powder, for example) which contain a narcotic substance, is objectionable; whereas emetic tartar may be employed with safety, since it has no tendency to increase disorder of the nervous system, but to reduce cerebral excitement. On the other hand, when much gastric or enteritic irritation is present, the narcotic sudorifics are generally to be preferred to antimony.

As an expectorant, in various pulmonary affections, small doses of this salt are frequently employed with advantage.

In some spasmodic complaints, the use of it has been followed, in the instances in which it has been tried, with good effects (*vide* Laennec, *cit.* p. 260; Jacobi, *Lond. Med. Gaz.* iii. 784; and Mr. Ackerley, *id. Med. Gaz.* xxi. 56). In *apoplexy* it has been employed to depress ebral vascular action, but its tendency to occasion vomiting renders it ectionable.

As a local irritant, applied to the skin, it may be employed in the form aqueous solution, ointment, or plaster. It is used in the same cases vesicatories, over which it has the advantage of not affecting the o-genital organs. When it is desirable to keep up long-continued irri- on, blisters are in some cases preferable. In *chronic diseases of the st* it is used with the greatest advantage. I have found it much more iceable than blisters, or any other kind of counter-irritant. I some- es order one part of the chest to be rubbed until the eruption is pro- ed; and then, after the interval of a day or two, apply it to another , thus keeping up irritation by a succession of applications to dif- nt parts of the chest for several months. In this way it is most ser- able in chronic catarrhs, peripneumonies, and pleurisies. Even in ering phthisis I have seen the cough and pain alleviated by the sional use of antimonial frictions. In *hooping-cough* it is also ser- able. Autenrieth recommended it as a means of diminishing the ency of the paroxysms and the violence of the cough. In *laryngitis* occasionally of great service: as also in various *affections of the joints*, cially chronic inflammation of the capsular ligament, or of the syno- membrane, hydrops articuli, particularly when connected with mmation, and tumors of various kinds about the joints. In *tic oureux* (Hausbrandt, *Brit. & For. Med. Rev.* Jan. 1837, 230) it has been employed with benefit.

stimulating wash, composed of one scruple of tartar emetic to an e of water, was proposed by the late Sir William Blizard, in the 1787, to cleanse foul ulcers, repress fungous growths and venereal s, and as an application to tinea capitis. A weak solution (as half a to the ounce of water) has been employed as a stimulant in chronic nalmia, and in spots on the cornea.

OMINISTRATION.—The dose of emetic tartar, in substance, is, as a noretic and expectorant, $\frac{1}{12}$ to $\frac{1}{6}$ of a grain; as a nauseant, from $\frac{1}{4}$ to rain; as an emetic, from 1 to 2 grains; as an antiphlogistic, from $\frac{1}{2}$ in to 3 or 4 grains. This salt is, however, rarely employed in ance. Sometimes a grain of it, mixed with ten or fifteen grains of lered ipecacuanha, is employed as an emetic. A mixture of one with sixteen grains of sulphate of potash may be employed, in doses m two to four grains, as a substitute for antimonial powder, to pro- diaphoresis.

solution, it is commonly employed, as an expectorant, diaphoretic, ant, or emetic, in the form of antimonial wine. When used as an hlogistic, an aqueous solution of greater strength may be admi- ed: it should be made with boiling distilled water in a glass vessel Florence flask.)

r external use, emetic tartar is employed in the form of liniment, ent, or plaster. A saturated solution is a very useful liniment: it is red by pouring an ounce and a half of boiling water over a drachm etic tartar, and allowing the solution to stand till cold. In many it will be found preferable to the ointment; being the mildest, least painful, and cleanest. Another mode of employing emetic tartar externall is by sprinkling from ten to thirty grains of the salt in fine powder over Burgundy pitch plaster.

1. *Vinum Antimonii Potassio-tartratis*, Ph. L.; *Vinum Anti monii*, Ph. U. S. (Emetic tartar, ℈ij.; Sherry wine, f℥xx.) *Liquor Tar tari Emetici* (emetic tartar, ℈j.; hot distilled water, f℥viij.; rectified spi rit, f℥ij.) The Edinburgh formula is essentially the same as that London. In all these formulæ the solution contains two grains of emeti tartar to one fluidounce of the liquid. It is important that Sherry, an not an inferior kind of wine, be employed: for the latter frequently co tains matters which precipitate the sesquioxide of antimony. If th wine be good, and the salt pure, no precipitate is formed in the solutio unless it be kept for a long period, when decomposition of the salt ensue The Dublin formula is objectionable on account of its want of colour.

Antimonial wine is used, as a diaphoretic or expectorant, in doses from ten to thirty drops frequently repeated; as a nauseant, from one t two fluidrachms; as an emetic, about half a fluidounce, or two flui drachms given at intervals of about ten minutes for four or five times, until the desired effect is produced; as an emetic for children, from thir drops to a fluidrachm; as an antiphlogistic in peripneumonia, from tw or three fluidrachms to an ounce; but for this purpose an extempor neous but carefully made aqueous solution is to be preferred.

2. *Unguentum Antimonii Potassio-Tartratis*, Ph. L. (Emet tartar, in fine powder, ℥j.; lard, ℥iv. M.) *Unguentum Tartari Emeti* Ph. Dub. (Half the strength of the London formula.) In the preparati of this ointment it is important that the emetic tartar be in the state of very fine powder, in order to avoid the irritation produced by rubbi gritty particles on the skin. A portion of ointment about the size of small nut is to be rubbed on the skin night and morning. After the use it for two or three times, the painful condition of the part thereby induc commonly prevents further employment of friction. It is sometim applied, spread on linen, without rubbing. By either of these method crop of painful pustules is produced: but the facility and rapidi with which they are developed varies considerably in different indi duals. Occasionally adventitious eruptions have appeared in ot parts of the body, which have been ascribed to absorption of antimo into the system (*Gaz. Méd.* 1832, p. 842.) But I believe with Ray (*Treat. on Diseases of the Skin*, by Dr. Willis, p. 540), that they ari from the inadvertent application of the ointment to these parts. Th ointment is used as a counter-irritant in various chronic maladies: thus is applied to the chest in pulmonary affections, and to the join in chronic diseases (whether rheumatic or otherwise). It sho only be applied to sound portions of skin, and, therefore, lee bites, the scarifications from cupping, wounds, &c. are to be carefu avoided: for severe inflammation and even gangrenous ulceration may produced by not attending to this caution. I have before mentio (p. 411) that in a very few cases severe and even fatal constitutional d order has appeared to have resulted from the use of antimonial ointm

Antidote.—Promote vomiting by tepid bland liquids. The antid is said to be tannic acid, and vegetable substances which contain it yellow bark, tea, nutgalls, &c.) Faure (*Lond. Med. Gaz.* xvi. 703) commends the decoction in preference to other preparations of yell

k. But though cinchona decomposes emetic tartar it does not destroy activity. Some years since, at the General Dispensary, I saw from 2 grains of this salt, mixed with either powder or decoction of yellow k, given by Dr. Clutterbuck to nearly 100 patients: and in almost ry instance nausea and vomiting occurred. The experience of Laen- (*Diseases of the Chest*, Forbes's Translation, 257), as well as of yer (*Dict. de Méd. et Chir. Prat.* iii. 57), is to the same effect. Opium most valuable agent for checking excessive evacuations. Venesec- and the warm bath are also important means of relieving the gastro eritis.

Order 18. Gold and its Compounds.

Au'rum.—Gold.

History.—Gold has been known from the most remote periods of antity. It was in common use 3,300 years since (*Exodus*, xi. 2), and was bably the first metal with which mankind was acquainted. The nymists termed it *Sol* or *Rex metallorum.*

Natural History.—It is found only in the metallic state; commonly yed with other metals, especially with silver, tellurium, copper, and i. It occurs in veins in primitive rocks; and is also found in alluvial osits in small lumps or particles called *gold dust.* It is found in seve- parts of Europe, Asia, and Africa, but principally in America, espe- ly the southern part.

Preparation.—The mode of extracting gold varies in different places, ncipally according to the nature of the gangue. The ore is freed as ch as possible from foreign matters, by mechanical processes (stamp-, washing, &c.); and sometimes by roasting; and is then smelted h some flux, as borax, to separate the stony matters. Or it is fused h lead, and afterwards submitted to cupellation: or amalgamated with cury, and, after straining, distilled.

The separation of gold from silver (*parting*) may be effected in the *way* by fusion, either with sulphur, by which metallic gold and sul-ret of silver are procured, or with sesquisulphuret of antimony, by ch sulphuret of silver and an alloy of gold and antimony are procured: last mentioned metal may be separated by heating the alloy in the as well as by other methods. Gold may also be freed from silver in *wet way* by the process of *quartation*: that is, by treating an alloy of e parts of silver and one of gold with nitric acid, which dissolves the er.

Properties.—The crystalline forms of native gold are the cube, the ular octahedron, and their modifications. Pure gold has a rich yellow our, a sp. gr. of 19·2 to 19·4, is soft, very ductile, and malleable, fuses t bright red heat (2016° F. according to Daniell) and in the liquid e has a brilliant greenish colour. Its equivalent is somewhat uncer-: Gmelin fixes on 66,—Thompson, 100,—Berzelius, 99·6,—Turner, 2,—and Brande, 200: I shall adopt the last.

Characteristics.—Gold is readily distinguished by its colour and ness, by its being unacted on by nitric acid, and by its ready solubi- in nitro-hydrochloric acid. The solution is yellow, stains organic ters (as the skin) purple, throws down, by the addition of protosulphate of iron, metallic gold in the finely divided state, by protochloride of tin a dirty purple precipitate (the *purple powder of Cassius*), and by protonitrate of mercury, a black precipitate: borax which has been touched with it acquires a pink or rose colour when fused with the blowpipe.

PHYSIOLOGICAL EFFECTS.—Gold, like other metals, has been frequently supposed to be inert while it retains its metallic condition, but in this as well as in some other instances the accuracy of the assumption has been denied. Both Chrestien (*Sur un Nouv. Remède dans le Traitm. des Mal. Vén.* Paris, 1811) and Niel (*Rech. et Observ. sur les Effets des Prép. d'Or*, Paris, 1821), as well as other writers, assert that finely divided metallic gold (*pulvis auri*) produces the same constitutional effects as those caused by the various preparations of this metal, but in a milder degree, while it excites little or no local irritation. It is said to promote the secretions of the skin, kidneys, and salivary glands.

USES.—It has been employed as an antivenereal and antiscrofulous remedy by Chrestien, Niel, and others, with considerable success. It is said to be preferable to the other preparations of this metal in delicate and nervous subjects, females, and infants. Gold leaf (*aurum foliatum seu lamellatum*) is used by dentists for filling decayed teeth, and formerly by apothecaries for covering pills (*ad inaurandas seu obducendas pilulas.*)

ADMINISTRATION.—It has been administered internally in doses of from a quarter of a grain to a grain three or four times a day. Chrestien used it by way of friction on the tongue and gums. Niel employed it endermically (that is, applied it to the skin deprived of the epidermis) in the form of ointment composed of one grain of gold and thirty grains of lard.

PULVIS AURI (Fr. Cod.) is prepared by rubbing leaf gold (*aurum in laminas exilissimas complanatum*) with sulphate of potash, sifting and washing with boiling water to remove the sulphate: or by adding protosulphate of iron to chloride of gold, and washing the precipitate, first with water, then with dilute nitric acid.

Au'ri Terchlo'ridum.—Terchlo'ride of Gold.

PREPARATION.—In the French Codex this is ordered to be prepared by dissolving, with the aid of heat, one part of gold in three parts of nitrohydrochloric acid. The solution is to be evaporated until vapours of chlorine begin to be disengaged, and then allowed to crystallize.

PROPERTIES AND COMPOSITION.—Chloride of gold is in the form of small crystalline needles, of an orange-red colour, inodorous, and having a strong, styptic, disagreeable taste. It is deliquescent, on which account it should be preserved in a well-stoppered bottle: it is soluble in water, alcohol, and ether. When heated it evolves chlorine, and is converted, first into protochloride, and then into metallic gold, which is left in the spongy state. It reddens litmus, stains the cuticle purple, is reduced by many metals (as iron, copper, tin, zinc, &c.), by several of the non-metallic elementary substances (as phosphorus), by some metallic salts (as protosulphate of iron), and by many organic bodies (as charcoal, sugar, gum, gallic acid, extractive, &c.), all of which, therefore, are incompatible with it. Nitrate of silver occasions a precipitate of chloride of silver and oxide of gold: hydrochloric acid removes the latter.—(For other characteristics, *vide* p. 422). Terchloride of gold consists of 1 eq. gold = 200 + 3 eqs. chlorine, 108. The before-mentioned crystals alıtain hydrochloric acid: hence they are regarded by some as consti- ing a double chloride of hydrogen and gold.

Physiological Effects. (*a.*) *On animals.*—Orfila (*Toxicol. Gén.*) amined the effects of the chloride of gold on animals, and infers from . experiments, that when introduced into the stomach it acts as a cor- ive, but with less energy than the bichloride of mercury, and destroys imals by the inflammation of the coats of the alimentary canal which ets up.

b.) *On man.*—On man its effects are analogous to those of bichloride mercury. In *small doses* it acts, according to Dr. Chrestien, more ergetically as a stimulant, though less powerfully as a sialogogue, than rosive sublimate. It promotes the secretions of the skin, the salivary nds, and the kidneys. Taken to the extent of one-tenth of a grain ly, it has occasioned violent fever. "This excitation," says Chrestien, regard as indispensably necessary for the cure of the diseases against ich I administer gold: restrained within proper limits, it is never companied with any remarkable or even sensible lesion of the func- ns. The mouth is good, the tongue moist, the appetite continues, the vels are not disordered, and there is ordinarily only augmentation of ne and transpiration: but if carried too far, we incur the risk of pro- cing general erethism, inflammation of this or that organ, according to predisposition of the patient, which will not only check the treat- nt, but may even induce a new disease, often more troublesome than original one. The suspension or modification of the remedy should governed by the unusual and sustained heat of skin." Cullerier, the hew (Magendie, *Formulaire*, 8me ed. p. 365), has seen one-fifteenth a grain excite, at the second dose, gastric irritation, dryness of the gue, redness of the throat, colic, and diarrhœa. When it promotes secretion of saliva it does not, as mercury, affect the teeth and gums rötzner, *Rust's Magaz.* B. 21, quoted by Wibmer). Magendie (*op.*) has seen violent gastritis, accompanied by nervous symptoms (cramps l pains in the limbs, agitation, and loss of sleep), and afterwards great at of skin, obstinate sleeplessness, and fatiguing erections. In *large es* it would probably occasion symptoms analogous to those produced the use of poisonous doses of bichloride of mercury.

Uses.—It has been employed, with variable success, as a substitute mercury in the treatment of the secondary symptoms of syphilis. A re extended experience of it is, however, necessary to enable us to ak of its remedial powers with confidence. In the hands of Chrestien *cit.*), Niel (*op. cit.*), Cullerier (*Dict. des Sciences Méd.* xxxvii. art.), Legrand (*De l'Or, de son emploi dans le Traitement de la Syphilis,* ris, 1832), and others, it has proved most successful.

t has also been used in scrofulous affections, bronchocele, chronic n diseases, scirrhous tumors, &c. Duportal (*Ann. de Chimie*, lxxviii. cured a case of obstinate ulceration of the face, regarded by him as cerous, and which had resisted all the ordinary methods of cure.

Legrand (*Lond. Med. Gaz.* xx. 414) has used chloride of gold, acidified h nitric acid, as a caustic, in syphilitic, scrofulous, and scorbutic ers, cancerous growths, and ulcerations of the neck of the uterus.

Administration.—Internally it has been given in doses of one- ntieth of a grain, made into pills with starch. But as organic matters decompose it, it is better to use it in solution in distilled water, or apply it by friction to the mouth, in quantities of one-sixteenth to one-sixth of a grain.

ANTIDOTE.—The same as for poisoning by bichloride of mercury.

So'dii Au'ro-Terchlo'ridum.—Au'ro-Terchlo'ride of So'dium.

In the French Codex this is ordered to be prepared by dissolving 85 parts by weight of terchloride of gold, and 16 parts of chloride of sodium, in a small quantity of distilled water: the solution is to be evaporated by a gentle heat until a pellicle forms, and then put aside to crystallize.

The auro-terchloride of sodium crystallizes in orange-coloured quadrangular, elongated prisms, which are permanent in the air; but when they contain any uncombined terchloride of gold, they are slightly deliquescent. They are soluble in water. When heated, chlorine is evolved, and a mixture of gold and chloride of sodium is left behind. They consist of 1 eq. terchloride of gold = 308; 1 eq. of chloride of sodium = 60, and 4 eqs. of water = 36.

Its effects and uses are analogous to the terchloride of gold, over which it has the advantages of being more constant and less costly; in consequence of which it is the most used of the auric preparations. It is exhibited internally in doses of one-twentieth to one-tenth of a grain, made into pills with starch or lycopodium. Mixed with twice its weight of orris powder or lycopodium, it may be used in frictions on the tongue and gum. An ointment (composed of one grain to thirty-six grains of lard) may be applied, endermically, to the skin, deprived of its epidermis by a blister.

Au'ri Terox'ydum.—Terox'ide of Gold.

This substance, sometimes called *peroxide of gold* or *auric acid*, is ordered, in the French Codex, to be prepared by boiling 4 parts calcined magnesia with 1 part terchloride of gold and 40 parts of water. Then wash, first with water, to remove the chloride of magnesium, afterwards with dilute nitric acid, to dissolve the excess of magnesia.

Teroxide of gold is brown; in the state of hydrate reddish yellow. It is reduced by heat and solar light. It is insoluble in water, but is soluble in hydrochloric acid (forming terchloride of gold), and in alkalies (forming aurates). It consists of 3 eqs. oxygen, 24 + 1 eq. gold = 200.

It is used internally, in venereal and scrofulous diseases, in doses of from one-tenth of a grain to a grain, made into the form of pills with extract of mezereon.

AURATE OF AMMONIA. Ammoniuret of teroxide of gold: fulminating gold.—This is prepared by adding ammonia to a solution of chloride of gold. It is a yellowish brown powder, which explodes when heated to 400°. It has been employed in the same cases as the preceding compounds, as well as in fevers, nervous affections, &c. In some cases it has produced very serious and even fatal results (Plenck, *Toxicologia*, ed 2nda. 230).

PURPURA MINERALIS CASSII. Purple of Cassius: Aurum Stannoparatum, Fr. Cod.—The nature of this compound is so imperfectly own, that it is impossible at present to assign to it its proper chemical ne. Its active principle is probably oxide of gold. There are several thods of preparing it: the simplest is to add a solution of protochlo-e of tin to a solution of chloride of gold, until a precipitate is no ger produced. Filter and dry the precipitate.

The purple of Cassius is soluble in ammonia, and does not form an algam with mercury: hence it does not appear to contain any metallic d. Its composition varies according to the mode of procuring it. Gold, gen, and tin, are its essential constituents.

This preparation is used in the same cases as the other preparations gold.

Au'ri Io'didum.—Io'dide of Gold.

This is ordered to be prepared, in the French Codex, by adding a solu-n of iodide of potassium to a solution of chloride of gold. Double composition takes place, and iodide of gold falls down. This is to be lected on a filter, and washed with alcohol, to remove the excess of ine which precipitates with it.

Iodide of gold is of a greenish yellow colour, insoluble in cold water, t slightly soluble in boiling water. Heated in a crucible it evolves ine vapour, and is converted into metallic gold. It is probably com-sed of 1 eq. iodine = 126, and 1 eq. gold = 200.

It has been employed internally, in venereal affections, in doses of from -fifteenth to one-tenth of a grain. Externally it has been applied in form of ointment to venereal ulcers (Pierquin, *Journ. de Progrès.*)

Au'ri Tercyan'idum.—Tercy'anide of Gold.

The directions for preparing this salt, in the French Codex, are some-at diffuse. The process consists essentially in very carefully adding olution of pure cyanide of potassium to a solution of chloride of gold, til a precipitate (cyanide of gold) ceases to be formed. The chloride gold, prior to solution, should be deprived of all excess of acid by ting it in a salt-water bath.

Cyanide of gold is a yellow powder, which is insoluble in water. It sists, probably, of 3 eqs. cyanogen = 78, and 1 eq. gold 200. It has n used in venereal and scrofulous affections, both externally and ernally. The dose is from one-fifteenth to one-tenth of a grain, made o a pill, with some inert powder.

Order 19. Silver and its Compounds.

Argen'tum.—Sil'ver.

History.—Silver, like gold, has been known from the most remote riods of antiquity, being mentioned in the earliest books of the Old stament (*Genesis*, xliv. 2; *Job*, xxii. 25). It was termed by the alchy-sts and astrologers, *Diana* or *Luna*.

Natural History.—It is found in the mineral kingdom in various tes; sometimes nearly pure; or alloyed with other metals (especially gold, antimony, tellurium, arsenicum, and copper); or combined with sulphur, selenium, iodine, or chlorine; or united to oxygen and carbonic acid. Of these, native silver and the sulphuret are by far the most abundant.

Preparation.—The processes followed for the extraction of silver vary in different places, according to the nature of the ore: they are principally *amalgation* and *cupellation*. At Freyberg the ore is mixed with common salt, and roasted, by which the sulphuret of silver is converted into the chloride of this metal: water and iron are then added, to remove the chlorine, and the disengaged silver is finally dissolved in mercury (*amalgamation*), and the solution submitted to distillation, by which the mercury is volatilized, and the silver left behind (J. H. Vivian, in Taylor's *Records of Mining*, p. 21). The process of amalgamation followed in America is somewhat different (Boussingault, *Ann. de Chim.* li. 337; also Ward, *Mexico in* 1827, vol. ii. 437).

Silver is obtained from argentiferous galena, as follows:—The ore is first roasted to expel the sulphur, and afterwards smelted with charcoal. The argentiferous lead is then submitted to cupellation, by which the lead becoming oxidized, is partly volatilized, and partly sinks into the cupel (*cineritium*), leaving the silver. (On the smelting processes of Hungary, Saxony, &c., consult Taylor's *Records of Mining*, p. 51).

Pure silver is obtained by immersing a copper rod in a solution of the nitrate. The precipitate is to be digested in caustic ammonia, to remove all traces of copper, and afterwards washed with water.

Properties.—In the native state, silver occurs crystallized in the cube and regular octahedron. When pure this metal is white, with a slight shade of yellow; inodorous and tasteless. It is moderately hard and elastic; very ductile and malleable: a single grain may be drawn out into 400 feet of wire, and leaf silver (*argentum in laminas extensum*, *argentum foliatum*) may be procured, whose thickness is only $\frac{1}{100000}$ of an inch. Its sp. gr. is 10·474. It melts at a bright red heat (1873° F. according to Daniell). When exposed to the air it does not oxidate, but readily tarnishes by sulphureous vapours. Its equivalent is 108.

Characteristics.—It is soluble in nitric acid: the solution thus obtained throws down a white precipitate—[see the properties of this chloride, p. 105]—with hydrochloric acid or the chlorides; white also with the alkaline carbonates, oxalates, and ferrocyanides; yellow with the phosphates and arsenites; red with the arseniates; olive-brown with the alkalies or lime water; metallic silver with phosphorus or copper; black with hydrosulphuric acid.

Purity.—The silver of the shops usually contains traces of gold and copper.

Physiological Effects.—Silver in the metallic state is totally inert.

Uses.—In pharmacy it is used for the preparation of the nitrate which is employed as a medicine and as a test.

Silver leaf is used for filling the hollows of decayed teeth, and was formerly employed to cover pills. An amalgam of silver is also used by some dentists for stopping teeth. It is objectionable on account of its blackening them.

Argen'ti Ni'tras.—Ni'trate of Sil'ver.

HISTORY.—Geber (*Invent. of Verity*, ch. xxi.) describes the method of eparing crystallized nitrate of silver. When this salt is fused, it is rmed *the infernal stone* (*lapis infernalis*) or *lunar caustic* (*causticum nare*).

PREPARATION.—In the London Pharmacopœia it is directed to be prered by dissolving one ounce and a half of silver in a mixture of one idounce of nitric acid and two fluidounces of distilled water. The lution is afterwards to be evaporated to dryness, and the dried nitrate sed and poured into proper moulds.

The fusion may be more readily and safely effected in a Berlin porcelain psule over a spirit or gas lamp, by means of Griffin's lamp furnace, than a crucible over a slow fire, as directed in the Pharmacopœia.

The *theory* of the process is readily comprehended. Three equivalents 324 parts of silver abstract three equivalents or 24 parts of oxygen om one equivalent or 54 parts of nitric acid, thereby disengaging one uivalent or 30 parts of binoxide of nitrogen, and forming three equivants or 348 parts of oxide of silver, which unite with three equivalents or 2 parts of nitric acid to form three equivalents or 510 parts of nitrate silver.

REAGENTS.			RESULTS.
. Nitric Acid 54	1eq.Binox.Nitrog. 30		1eq.Binox.Nitrog. 30
	3 eq. Oxygen 24	3eq.Ox.Silver 348	
q. Silver 324			
q. Nitric Acid 162			3eq.NitrateSilver 510

PROPERTIES.—Nitrate of silver forms transparent, colourless crystals, nose primary form is the right rhombic prism. Its taste is strongly etallic and bitter. When heated it fuses: if the temperature be ineased, decomposition ensues; nitric acid and oxygen are evolved, leavg metallic silver. It is soluble in both water and spirit. It does not liquesce: when exposed to the atmosphere and solar light it blackens, obably from the action of organic matter, hydrosulphuric acid, or water ntained in the atmosphere. Mr. Scanlan (*Athenæum*, Aug. 25, 1838) nds that nitrate of silver in a clean dry glass tube, hermetically sealed, idergoes no change of colour by exposure to solar light: the contact of ganic matter readily occasions it to become black.

CHARACTERISTICS.—It is known to be a nitrate by its deflagration hen heated on charcoal, and the evolution of nitrous fumes. Its characrs as a silver salt have been already described (p. 426.)

COMPOSITION.—Nitrate of silver is thus composed:—

	Eq.	Eq.Wt.	Per Cent.	Proust.
Oxide of Silver	1	116	68·23	69·5
Nitric Acid	1	54	31·76	30·5
Nitrate of Silver	1	170	99·99	100·0

PURITY.—Nitrate of silver should be white, and completely soluble in stilled water. By the action of organic matters it blackens from partial reduction. The presence of copper may be detected in its lution by the blue colour produced with caustic ammonia. The watery solution from which the silver has been thrown down by hydrochloric acid should be unchanged by the addition of hydrosulphuric acid, shewing the absence of lead and copper; and be completely volatilized by heat: if any saline residuum be obtained, the nitrate was adulterated. The white precipitate produced with either hydrochloric acid or chloride of sodium should be readily dissolved by caustic ammonia: if chloride of lead be present the effect will be otherwise.

Physiological Effects. (*a.*) *On animals.*—Orfila (*Toxicol. Gén.*) found that it acted on animals as a powerfully corrosive poison. When dogs were made to swallow it, gastro-enteritis was induced. No symptoms indicating its absorption were observed. Dissolved in water, and thrown into the jugular vein, it produced difficult respiration, convulsive movements, and speedy death.

(*b.*) *On man.*—The *local action* of nitrate of silver is that of a caustic or corrosive. This might be expected, from observing its action on albumen and fibrin—substances which form the principal part of the animal textures. If a solution of nitrate of silver be added to an albuminous liquid, a white curdy precipitate is formed, composed of nitrate of silver and albumen, insoluble in caustic ammonia; and after some time becoming coloured and ultimately blackish, from the partial or complete reduction of the silver: a soluble compound of albumen and nitrate of silver is formed simultaneously with the insoluble one. The action of nitrate of silver on fibrin is analogous to that on albumen: that is, a white compound of nitrate of silver and fibrin is at first formed, but gradually the metal is reduced. These facts assist us in comprehending the nature of the changes produced by the application of nitrate of silver to the different tissues.

Applied to the skin it produces first a white mark (owing to its union with the coagulated albumen of the cuticle): gradually this becomes bluish grey, purple, and ultimately black, owing to the partial reduction of the silver. If the integument be moistened, and the nitrate applied three or four times, it causes at the end of some hours vesication, which is attended with less pain than that produced by cantharides. In some cases it excites acute pain. In one instance in which I applied it freely to the scalp for a cutaneous affection, fever with delirium was produced, which endangered the life of the patient (a girl of six years.) This is deserving of notice, because in Mr. Higginbottom's work (*Essay on the Use of the Nitrate of Silver*, 2d ed. p. 198) we are told that nitrate of silver applied as a vesicant "causes scarcely any constitutional irritation, even in children." In a few days the black and destroyed cuticle cracks and falls off, without any destruction of the subjacent cutis vera.

Applied to the hair or nails the nitrate stains them black, as in the case of the cuticle; and, in consequence, it is one of the substances employed as a hair-dye. When recently applied, the black tint of the hair, and even of the cuticle, may be removed by washing with a solution of chloride of sodium, and then with ammonia-water, to dissolve the chloride of silver which is produced (*Journ. de Chim. Méd.* vii. 542.) To detect silver in stained hair, the latter is to be treated with chlorine, by which chloride of silver is produced, which is soluble in ammonia, and precipitable from its solution by nitric acid (Devergie, *Méd. Leg.* ii. 933.) Part of the black colour of the hair stained by the nitrate probably depends on the formation of sulphuret of silver.

When nitrate of silver is applied to an ulcer it produces a white film owing to its union with the albumen, and perhaps also with the chloride, of the secretion.) This film in a few hours assumes a dark colour, and ultimately forms a black eschar. This hardens, and in few days becomes corrugated, separates at the edges, and at length peels off altogether, leaving the surface of the sore beneath in a healed state (Higginbottom, *op. cit.* p. 10.) The intensity of the pain varies much in different cases; but it is, on the whole, very much less than might be imagined by those who have not tried this remedy.

When applied to mucous membranes, a similar white compound of the nitrate with the animal matter of the secreted mucus is formed, and this defends the living tissue from the action of the caustic, so that the effects are not so violent as might be expected. Thus the solid nitrate may be applied to the mucous surface of the vagina, and even to the os uteri, in cases of leucorrhœa and gonorrhœa, oftentimes without exciting any pain or inflammation: in some instances, however, it produces smarting pain, which lasts for several hours, but no serious effects have resulted from its use, even when, by accident, two drachms of nitrate have been left to dissolve in the vagina. (Dr. Hannay, *Lond. Med. Gaz.* xx. 185; also Mr. Bell, *ibid.* 473; and Dr. Jewel, *Prat. Observ. on Leucorrhœa.*)

Its chemical effects on the other mucous membranes are analogous to those just mentioned; but the pain which it produces varies with different membranes, and in the same membrane under different states. Its application to the conjunctiva is attended with acute pain, (especially when inflammation is going on) though in general it soon subsides. On all these surfaces it acts as an astringent.

The safety with which, in most cases, large doses of the nitrate are administered internally, must depend on the presence of the mucus which lines the internal coat of the stomach; the animal matter of which combining with the nitrate prevents its action on the living tissue. It is deserving of especial notice that larger doses may be exhibited without inconveniencing the stomach, in the form of pill, than in that of solution. Dr. Powell (*Med. Trans. of the College of Phys.* iv. 85) in some cases was enabled to give 15 grains at a dose in the form of pills, while he rarely found stomachs that could bear more than five grains in solution. Fouquier (*Dict. Mat. Méd.* i. 403) has also remarked the greater activity of the solution. If cautiously exhibited, beginning with small doses and gradually increasing them, it may be exhibited for a considerable period without producing any obvious changes in the corporeal functions, though it may be exercising a beneficial influence over the constitution, evinced by its amelioration of certain diseases, as epilepsy. In some cases it has caused an eruption (Sementini, *Quart. Journ. of Science*, xii. 189; Copland, *Dict. Pract. Med.* i. 68.) If the dose be too large it causes gastrodynia, sometimes nausea and vomiting, and occasionally purging. Taken in an excessive dose it acts as a corrosive poison; but cases of this kind are very rarely met with. Boerhaave mentions an instance in which it caused excruciating pain, gangrene, and sphacelus of the first passage.

All the above-mentioned symptoms are referrible to its local action, and from them we have no evidence of its absorption, or of the nature of its influence over the general system. But the discoloration of the skin, presently to be noticed, fully proves that absorption does take place when the medicine is exhibited in small but long-continued doses. It exercises a specific influence over the nervous system; at least I infer this partly from the effects observed by Orfila when it was injected into the veins of animals, and partly from its occasionally curative powers in affections of his system, as epilepsy and chorea.

The blueness, or slate colour, or bronze hue of the skin just alluded to has been produced in several patients who have continued the use of the nitrate during some months or years (*Medico-Chirurg. Trans.* vii. and ix.) In some of the cases the patients have been cured of the epilepsy for which they took the medicine; in others the remedy has failed (Rayer, *Treatise on Skin Diseases, by Willis*, 961). In one instance which fell under my notice, the patient, a highly respectable gentleman, residing in London, was obliged to give up business in consequence of the discoloration; for when he went into the street, the boys gathered around him, crying out "there goes the blue man." In this instance no perceptible diminution of the colour had occurred for several years, but in some cases it fades in intensity. The corion is the essential seat of it. Dr. Baddeley (*Med.-Chir. Trans.* ix. 238) found that blisters rose white,—a proof that in his patient the colouring matter was below the epidermis. But in some instances the cuticle and corpus mucosum of the face and hands participate in the tint. In one instance the mucous membrane of the stomach and intestines was similarly tinted. A case is mentioned by Wedemeyer (*Lond. Med. Gaz.* iii. 650) of an epileptic who was cured by nitrate of silver, but eventually died of diseased liver and dropsy: all the internal viscera were more or less blue, and Mr. Brande obtained metallic silver from the plexus choroides and pancreas. The discoloration of the skin is usually regarded as permanent and incurable; but I have been informed that in one instance washes of dilute nitric acid diminished it. If this observation be correct, I would suggest the exhibition of nitric acid internally, as well as its external use. Dr. A. T. Thomson (*Elem. of Mat. Med.* i. 715) suggests that if nitric acid were conjoined with nitrate of silver, the discoloration might be prevented; and the suggestion certainly deserves attention. But I would observe, that if the acid should prove efficacious, his hypothesis, that the colour depends on blackened chloride of silver, will be disproved; for nitric acid can neither prevent the action of the compounds of chlorine on the salts of silver, nor can it dissolve the white chloride or the black subchloride.

Uses.—Nitrate of silver has been employed *internally* in a very few cases only; and of these the principal and most important are epilepsy, chorea, and angina pectoris. Its liability to discolour the skin is a great drawback to its use; indeed, I conceive that a medical man is not justified in risking the production of this effect without previously informing his patient of the possible result.

In *epilepsy* it has occasionally, perhaps more frequently than any other remedy, proved successful. Dr. Sims (*Mem. of the Med. Soc. of Lond.* iv. 379), Drs. Baillie, R. Harrison, Roget, and J. Johnson (*Treat. on Nerv. Dis.* by J. Cooke, M.D. ii. Pt. 2, 147), have all borne testimony to its beneficial effects. Its *methodus medendi* is inexplicable. This, indeed, is to be expected, when it is considered that the pathology and causes of epilepsy are so little known, and that, as Dr. Sims has justly observed, every thing concerning this disease is involved in the greatest doubt and obscurity, if we except the descriptions of a single fit, and that it returns at uncertain intervals. In this state of ignorance, and with the alreadyıtioned facts before us, as to the curative powers of this salt, the ervation of Georget (*Physiol. du Système Nerv.* ii. 401), that he has ıt difficulty in conceiving how the blindest empiricism should have any one to attempt the cure of a diseased brain by cauterizing the nach, is, I conceive, most absurd, and unwarranted. The cases ch have been relieved by it are probably those termed by Dr. M. Hall *ct. on the Nerv. System*, p. 143) eccentric. In the few instances in ch I have seen this remedy tried, it has proved unsuccessful; but as not continued long, on account of the apprehended discoloration he skin.

n *chorea* it has been successfully employed by Dr. Powell (*Med. ns. of the College of Phys.* iv. 85), Dr. Uwins (*Ed. Med. and Surg. rn.* viii. 407), Dr. Crampton (*Trans. of the King and Queen's College Phys.* iv. 114), Lombard (*Rust's Magaz.* xl.), and others. In *angina toris* it has been administered in the intervals of the paroxysms with asional success by Dr. Cappe (*Duncan's Annals of Med.* iii.), and by Copland (*op. cit.*) *In chronic affections of the stomach* (especially bid sensibility of the gastric and intestinal nerves) it has been ourably spoken of by Antenreith (Dierbach's *Neust. Entdeck. in d. Mat. d.* 1837, i. 528), Dr. James Johnson (*On Indigestion*, 2[d] ed. p. 87), Rueff (Diebach, *op. cit.*; also *Americ. Journ. of Med. Scien.* May 7, p. 225). It has been employed to allay chronic vomiting connected ı disordered innervation, as well as with disease of the stomach rrhus and cancer), and to relieve gastrodynia. The foregoing are the t important of the diseases against which nitrate of silver has been ıinistered internally.

s an *external agent* its uses are far more valuable, while they free from the danger of staining the skin. It is employed some- s as a *caustic*, and as such it has some advantages over potassa fusa the liquid corrosives. Thus, it does not liquify by its application, hence its action is confined to the parts with which it is placed in ıtact. It is used to remove and repress spongy granulations in wounds ulcers, and to destroy warts, whether venereal or otherwise. It is lied to chancres on their first appearance, with the view of decom- ng the syphilitic poison, and thereby of stopping its absorption, and venting bubo or secondary symptoms. This practice has the sanction Ir. Hunter. I have several times seen it fail, perhaps because it was adopted sufficiently early. The nitrate should be scraped to a point, applied to every part of the ulcer. This mode of treating chancres been recently brought forward by Ratier (*Arch. Gén. de Méd.* xv. 47, xvi. 62) as if it were new, and as forming part of Bretonneau's *ectrotic rotica, ἐκτιτρώσκω, I abort,*) method of treating diseases!

he application of nitrate of silver to *punctured wounds* is often nded with most beneficial effects, as Mr. Higginbottom (*op. cit.*) has y proved. It prevents or subdues inflammatory action in a very rising manner. It is equally adapted for poisoned as for simple nds. To promote the healing of *ulcers* it is a most valuable remedy. arge indolent ulcers, particularly those of a fistulous or callous kind, ts as a most efficient stimulant. To small ulcers it may be applied s to cause an eschar, and when at length this peels off, the sore is ıd to be healed. Mr. Higginbottom (*op. cit.* p. 11,) asserts that "in y instance in which the eschar remains adherent from the first application, the wound or ulcer over which it is formed invariably heals. Dry lint will, in general, be found the best dressing for sores touched with the nitrate.

Nitrate of silver was proposed by Mr. Higginbottom as a topical remedy for external inflammation. It may be applied with great advantage to subdue the inflammatory action of erythema, of paronychia or whitlow, and of inflamed absorbents. In some cases it is merely necessary to blacken the cuticle; in others, Mr. Higginbottom recommends it to be used so as to induce vesication. In what way it subdues inflammation—in other words, its *methodus medendi*—is completely unknown.

Bretonneau and Serres (*Arch. Gén. de Méd.* viii. 220 and 427) recommend the *cauterization of variolous pustules* by nitrate of silver, in order to cut short their progress. It is principally useful as a means of preventing pitting, and should be employed on the first or second day of the eruption. The solid caustic is to be applied to each pustule after the apices have been removed. This etrotic method has also been employed in the treatment of *shingles* (herpes zoster): in one case the disease was cured in a few hours (*Arch. Gén. de Méd.* xviii. 439). Some good rules for its application have been laid down by Rayer (*Treatise on Skin Diseases*, by Willis, p. 260).

In some diseases of the eye nitrate of silver is a most valuable remedial agent. It is used in the solid state, in solution, and in ointment: the solution may be used as a wash or injection, or applied by a camel's hair pencil. In deep ulcers of the cornea, the solid nitrate should be applied,—in superficial ones, a solution (of from 4 to 10 grains of the salt to an ounce of distilled water) may be employed (Mackenzie, *On the Diseases of the Eye*, 2d ed. 578). There is one drawback to the use of this substance in ulcers of the cornea, as well as other affections of the eye; viz. the danger of producing dark specks in the cornea, or of staining the conjunctiva (Jacob, *Dubl. Hosp. Rep.* v. 365). In both acute and chronic ophthalmia, Mr. Guthrie (*Lond. Med. and Phys. Journ.* lx. 193, lxi. 1) employs this salt in the form of ointment (Arg. Nitr. gr. ij. ad gr. x.; Liq. Plumbi Subacet. gtt. xv.; Ung. Cetacei, ʒj.) Of this he directs a portion (varying in size from a large pin's head to that of a garden pea) to be introduced between the lids by the finger or a camel's hair pencil. It causes more or less pain, which sometimes lasts only half an hour, in others till next day. Warm anodyne fomentations are to be used; and the application of the ointment repeated every third day. In acute cases two or three applications will arrest the disease. With this treatment blood-letting, and the use of calomel and opium, are preceded or conjoined. (For some judicious remarks on this practice, consult the article *Ophthalmia*, by Dr. Jacob, in the *Cyclop. of Pract. Med.* iii. 201). While many surgeons hesitate to use nitrate of silver in the first stage of acute purulent ophthalmia, all are agreed as to its value in the second stage of the disease, as well as in chronic ophthalmia. Besides the diseases of the eye already mentioned, there are many others in which the oculist finds this salt of the greatest service, as a caustic, astringent, or stimulant. (Vide Dr. Mackenzie's *Treat. on Diseases of the Eye*; and Mr. Ryall's paper, in the *Trans. of the King and Queen's College of Phys.* v. 1).

In *inflammatory affections and ulcerations of the mucous membrane of the mouth and fauces*, nitrate of silver is sometimes a most valuable plication (Hunt, *Lond. Med. Gaz.* xiii. 129). When the fibrinous udation of croup commences on the surface of the tonsils and arches of palate, its further progress may be stopped, according to Mr. ackenzie (*Edin. Med. and Surg. Journ.* xxiii. 294), by the application a solution composed of a scruple of nitrate of silver and an ounce of tilled water. The solid nitrate has been introduced through an aper- e in the trachea, and applied to ulcers on the inner surface of the ynx, in a case of phthisis laryngea, with apparent benefit, (Liston, *ments of Surgery*, part ii. p. 256).

In some forms of *leucorrhœa* the application of nitrate of silver, either the solid state or in solution, is attended with beneficial effects. This actice was first recommended by Dr. Jewel (*Pract. Observ. on ucorrhœa*, 1830). It is, I believe, most successful in cases dependent local irritation or subacute inflammation, and not arising from consti- ional debility. The solution may be applied by a piece of lint or onge, or may be injected by means of a syringe with a curved pipe. strength must vary according to circumstances. Dr. Jewel generally ploys three grains of the nitrate to an ounce of water; but in the Lock spital, solutions are sometimes used containing half a drachm or even scruples to the ounce. In some cases the solid nitrate has been plied to the cervix uteri and vagina by means of a silver tube. In *orrhœa of the female* a solution of nitrate of silver, or even this caustic the solid state, has been used with the best effects. It was first ployed by Dr. Jewel, but subsequently, and on a much more extended le, by Dr. Hannay (*Lond. Med. Gaz.* xx. 185), and without any urious consequences. In many cases the discharge ceased, never to urn, in twenty-four hours. The fear of ill effects has prevented the neral adoption of this practice. In *gonorrhœa of the male*, the intro- ction of a bougie, smeared with an ointment of nitrate of silver, is, occa- nally, a most effectual cure: but the practice is dangerous. In one e I saw acute and nearly fatal urethritis brought on by its employ- nt. The individual was a dresser at one of the London hospitals, and l practised this mode of treatment in many instances on the hospital ients with the happiest results. An aqueous solution of the salt has n successfully used in chronic gonorrhœa (Rognetta, *Lancette Fran- se*, Mar. 31, 1836).

n *fissured or excoriated nipples* the application of the solid nitrate of er is of great service. It should be insinuated into all the chaps or cks, and the nipple afterwards washed with tepid milk and water. *nd. Med. Gaz.* v. 207; xiv. 674, 719, and 754).

The application of solid nitrate of silver is a most effectual remedy for different forms of *porrigo* which affect the heads of children. The stic should be well rubbed into the parts. I have never known the ctice to fail, or to cause the loss of hair. Where the greater portion of scalp is involved, the different spots should be cauterized successively intervals of some days; for, as already mentioned, I have seen fever l delirium produced in a child from the too extensive use of the edy. In *psoriasis* the same medicine was found by Dr. Graves *nd. Med. Gaz.* vii. 520) most effectual. An aqueous solution of the rate is also valuable as an astringent wash in other skin diseases, as *etigo*. The solid nitrate is sometimes employed to stop the progress irritative or erysipelatous inflammation, by applying it in a circular form around, and at a little distance from, the inflamed portion; but I have frequently observed the inflammation extend beyond the cauterized part. Mr. Higginbottom (*op. cit.*) reports favourably of the effects of applying the nitrate to *burns* and *scalds;* and his observations have been confirmed by those of Mr. Cox (*Lond. Med. Gaz.* x. 672).

In strictures of the urethra and œsophagus, bougies armed with lunar caustic in their points (*the caustic* or *armed bougie*) are occasionally employed with great advantage, at least in urethral stricture. When the common bougie (*cereolus simplex*) is formed, the point of it should be heated with a conical piercer, and the caustic introduced while the composition is quite soft. The point of the bougie should then be rubbed smooth on a piece of polished marble till no inequality in the size of it appear (Dr. Andrews, *Observ. on the Applic. of Lunar Caustic to Strictures*, 1807, p. 126.) Notwithstanding that the application of nitrate of silver to stricture of the urethra has been advocated by Mr. Hunter, Sir E. Home, Mr. Wilson, Dr. Andrews, and others, it is now but little employed; yet of its efficacy and safety in many obstinate cases, where the simple bougie fails, I am assured by repeated observation. It is commonly supposed that it acts by burning or destroying the stricture; such is not the fact. It induces some change in the vital actions of the part, which is followed by relaxation of the narrowed portion of the canal, but which change is as difficult to explain as is the subduction of external inflammatory action by the application of this salt. Of the use of the caustic bougie in stricture of the œsophagus I have no experience.

Administration.—Nitrate of silver may be exhibited in doses of $\frac{1}{6}$ of a grain, gradually increased to three or four grains, three times a day. As before mentioned, Dr. Powell has augmented the dose to fifteen grains. The usual mode of administering it is in the form of pills made of bread-crumb; but the chloride of sodium, which this contains, renders it objectionable: some mild vegetable powder with mucilage is preferable. Common salt or salted foods should not be taken either immediately before or after swallowing these pills. Dr. Johnson (*Essay on Morbid Sensibility of the Stomach and Bowels*, 2d ed. p. 90), asserts "that there is no instance on record where the complexion has been affected by the medicine when restricted to three months' administration." It is advisable, however, not to continue the use of it beyond a month or six weeks at a time.

For external use an aqueous solution is employed of strengths varying from a quarter of a grain to two scruples, in an ounce of distilled water. The formula for Mr. Guthrie's ointment has already been given.

Liquor Argentum Nitratis, Ph. Lond. (Nitrate of silver, ℈j. distilled water, f℥j. dissolve and strain. The solution is to be preserved from the light in a well-closed vessel.) It has been introduced into the Pharmacopœia merely as a test.

Antidote.—The antidote for nitrate of silver is common salt (chloride of sodium.) When this comes in contact with lunar caustic, nitrate of soda and chloride of silver are produced: the latter compound is, according to the experiments of Orfila (*Toxicol. Gén.*), innocuous; though it has been said to possess antisyphilitic powers (Serre, *Lond. Med. Gaz.* xvi. 703). The contents of the stomach should be removed, and the inflammatory symptoms combated by demulcents, bloodletting, and the usual antiphlogistic means.

When the local use of nitrate of silver causes excessive pain, relief ıy be gained by washing the parts with a solution of common salt. eces of caustic have been left in the vagina and urethra without un-easant consequences resulting. Injections of a solution of common lt are the best means of preventing bad effects.

To diminish the slate-coloured tint of the skin arising from nitrate of ver, acids or the super-salts offer the most probable means of success. ıe external and internal use of dilute nitric acid, or the internal employ-nt of bitartrate of potash, may be tried: the discoloration is said to ve yielded to a steady course of the last-mentioned substance (*United ates Dispensatory*).

Argen'ti Cyan'idum.—Cy'anide of Sil'ver.

History.—This compound, sometimes called *hydrocyanate, cyanuret, cyanodide of silver*, or *argentum zootinicum*, has been studied by heele, Ittner, and Gay-Lussac.

Preparation.—In the London Pharmacopœia this compound is ected to be prepared by adding a pint (f℥xx.) of diluted hydrocyanic d to a solution of two ounces and two drachms of nitrate silver in a ıt of distilled water. The precipitate is to be washed with distilled ter, and dried.

In this process one equivalent, or 27 parts of hydrocyanic acid react one equivalent, or 170 parts of nitrate of silver: thereby generating e equivalent, or 134 parts of cyanide of silver, and one equivalent, or parts of water, and setting free one equivalent, or 54 parts of nitric acid.

REAGENTS.			RESULTS.	
ı. Nitrate Silver 170	1 eq. Nitric Acid . .	54	1 eq. Nitric Acid .	54
	1 eq. Oxygen	8	1 eq. Water	9
	1 eq. Silver	108		
ı. Hydrocy^{c}. Acid 27	1 eq. Hydrogen . .	1		
	1 eq. Cyanogen . . .	26	1 eq. Cyanide Silver	134

Properties.—When first thrown down it is a white curdy precipitate, ich by drying becomes pulverent. It is insipid, insoluble in water, t dissolves in caustic ammonia. It is decomposed by hydrochloric l hydrosulphuric acid, both of which develope with it hydrocyanic d. It combines with other metallic cyanides to form the *argento-mides*. By exposure to the atmosphere and solar rays it assumes a let tint. It is not decomposed by mixture with neutral vegetable ostances (*Journ. de Chim. Med.* 2nde Ser. iii. 407.)

Characteristics.—It is insoluble in cold nitric acid, but soluble in boiling acid. When carefully dried and then heated in a glass tube ields cyanogen gas (which is readily known by its combustibility and bluish-red colour of its flame) and a residuum of metallic silver. The ter is recognised by the before-mentioned tests for this metal.

Composition.—The following is the composition of this substance:—

	Eq.	Eq.Wt.	Per Cent.
Silver	1	108	80·60
Cyanogen . . .	1	26	19·40
Cyanide of Silver .	1	134	100·00

Physiological Effects and Uses.—I am unacquainted with any periments made to determine its effects on man or animals. Serre, of

Montpellier (*Journ. de Chim. Méd.* 2nde Ser. iii. 408) gave it in syphilitic maladies, in doses of one-tenth and even of one-eighth of a grain, without the least inconvenience. It has been introduced into the London Pharmacopœia, at the suggestion of Mr. Everitt, as a source of hydrocyanic acid (*vide* p. 237.)

ORDER 20. MERCURY AND ITS COMPOUNDS.

Hydrar'gyrum.—Mer'cury or *Quick'silver.*

HISTORY.—No mention is made of quicksilver in the Old Testament nor does Herodotus allude to it. From this we might infer that both the ancient Hebrews and Egyptians were unacquainted with it. But we are told on the authority of an Oriental writer, that the Egyptian magicians in their attempts to imitate the miracles of Moses, employed wands and cords containing mercury, which under the influence of the solar heat imitated the motion of serpents (D'Herbelot, *Bibliothèque Orient.* art. *Moussa*). Both Aristotle and Theophrastus (*De Lapidibus*) mention ἄργυρος χυτὸς, (*argentum liquidum*) : and the first of these naturalists says that Dædalus (who is supposed to have lived about 1300 years before Christ) communicated a power of motion to a wooden Venus by pouring quicksilver into it. We are also told that Dædalus was taught this art by the priests of Memphis. Pliny (*Hist. Nat.* lib. xxxiii.) and Dioscorides (lib. v. cap. cx.) also speak of mercury, and the latter writer describes the method of obtaining it from cinnabar.

Mercury was first employed medicinally by the Arabian physicians Avicenna and Rhazes ; but they only ventured to use it externally against vermin and cutaneous diseases. We are indebted to that renowned empiric Paracelsus for its administration internally.

SYNONYMES.—The names by which this metal has been distinguished are numerous. Some have reference to its silvery appearance and liquid form; as ὑδράργυρος, *hydrargyrus* and *hydrargyrum*, (from ὕδωρ, *aqua*, and ἄργυρος, *silver*) ; others to its mobility and liquidity, as well as its similarity to silver, such as *argentum vivum*, *aqua argentea*, *aqua metallorum*, and *quicksilver*. It has been called *Mercury*, after the messenger of the gods, on account of its volatility.

NATURAL HISTORY.—Mercury is comparatively a rare substance. It is found in the metallic state, either pure (*native* or *virgin mercury*), in the form of globules, in the cavities of the other ores of this metal, or combined with silver (*native amalgam*). Bisulphuret of mercury (*native cinnabar*) is the most important of the quicksilver ores, since the metal of commerce is chiefly obtained from it. The principal mines of it are those of Idria in Carniola, and Almaden in Spain. The latter yielded 10,000 lbs. of cinnabar annually to Rome in the time of Pliny (*Hist. Nat.* xxxiii.) Protochloride of mercury (*mercurial horn ore* or *corneous mercury*) is another of the ores of mercury. Traces of this metal have also been met with in common salt, during its distillation with sulphuric acid by Rouelle, Proust, Westrumb, and Wurzer (Gmelin, *Handb. d. Chemie*, i. 1282).

PREPARATION.—The extraction of quicksilver is very simple. In some places (as in the Palatinate and the duchy of Deux-Ponts) the native cinnabar is mixed with caustic lime, and distilled in iron retorts. In is process the lime abstracts the sulphur (forming sulphuret of calcium), ıd the disengaged mercury distils over. At Almaden the ore is roasted, · which the sulphur is converted into sulphurous acid, and the mercury latilized. At Idria a modification of this process is followed (Dumas, *·aité de Chimie*, iv. 305).

Commerce. — Quicksilver is imported in cylindrical, wrought-iron ttles (holding from 60lbs. to 1 cwt.), the mouth of each being closed an iron screw; and also in goat-skins, two or three times doubled. ıe quantities imported in the years 1827 and 1830, and the places ·m which the metal was brought, are thus stated in the parliamentary pers (*Statement of Imports and Exports*, for 1827 and 1830).

	1827.	1830.
Spain and the Balearic Islands	653,374	1,675,652
Gibraltar	121,320	—
Italy and the Italian Islands	108,567	331,416
	883,261	2,007,068

Properties.—At ordinary temperatures quicksilver is an odourless, steless, liquid metal, having a whitish colour, like silver or tin. Its . gr. is 13·5 or 13·6. When intimately mixed with pulverent or fatty dies, it loses its liquid character, and it is then said to be *killed*, *extin-ished*, or *mortified*. When cooled down to −38·66° F. it freezes, and ystallizes in needles and regular octahedrons. In this state it is duc-e, malleable, and tenacious. At 656° F. it boils, and produces an invi-ble elastic vapour, whose sp. gr. is 6·976. Mr. Faraday (*Quart. Journ. Science*, x. 354) has shown, that at common temperatures, and even ıen the air is present, mercury is always surrounded by a mercurial nosphere; and, according to Stromeyer, at from 140° F. to 160° F. ercury, when mixed with water, is volatilized in considerable quantities. ıemists are not agreed as to the equivalent or atomic weight of this tal. Thus Dr. Thomson assumes 100; Gmelin, 101; Berzelius, 1·43; Brande, 200; Turner and Phillips, 202. I shall adopt the ter.

Characteristics. (*a.*) *Of metallic mercury.*—In its metallic state ercury is distinguished by its liquidity at common temperatures, and its volatility. When invisible to the naked eye, and in a finely divided ıte, it may be readily detected by the white stain (called by workmen *ickening*) communicated to gold and silver. Mercurial vapour may be tected by exposing gold or silver to its influence. If mercury be in mbination with other metals, and the tests now mentioned be not plicable, we may dissolve the suspected substance in nitric acid, and oceed as for the mercurial salts.

(*b.*) *Of mercurial compounds.*—When heated with potash or soda, or ir carbonates, globules of metallic mercury are obtained, which may recognised by the properties already described. Solutions of the rcurial salts, placed for some time in contact with a piece of bright pper, and afterwards rubbed off with paper, leave a silvery stain be-ıd, which disappears when heated to redness. Those compounds ich are of themselves insoluble in water may be dissolved by digesting em with nitric acid; and the copper test may then be applied. In this ıy the mercury contained in calomel, vermilion, subsulphate and iodide of mercury, may be readily recognised. Sulphuretted hydrogen produces, with mercurial solutions, a black precipitate.

Solutions of the protosalts of mercury yield, with caustic potash or soda, a grey or black precipitate; and, with iodide of potassium, a greenish or yellow precipitate.

Solutions of the persalts yield, with caustic potash or soda, a yellow or reddish precipitate; and, with iodide of potassium, a scarlet one.

PURITY.—The purity of this metal is ascertained by its brilliancy and great mobility. Mechanical impurities—such as adhering dirt or dust—are instantly detected, and may be separated by straining through flannel, or by filtering through a small hole in the apex of an inverted cone of paper. The presence of lead, tin, zinc, or bismuth, may be suspected by the rapidity with which the metal tarnishes in the air, and by its small parts *tailing*, instead of preserving a spherical form. These impurities may be got rid of by distillation in an earthen retort.

PHYSIOLOGICAL EFFECTS. 1. *OF METALLIC MERCURY.* (*a.*) *On vegetables.*—Mercurial vapours are fatal to plants (Decandolle, *Phys. Vég.* 1332).

(*b.*) *On animals.*—From the experiments of Moulin (*Phil. Trans.* for 1691, No. 192), Haighton (Beddoes, *On Pulmonary Consumption*, 1799), Viborg (quoted by Wibmer, *Wirkung d. Arzneim*, iii. 88), and Gaspard (Magendie, *Journ. de Physiol.* i.), it appears that when *injected into the veins*, mercury collects in the small vessels of the neighbouring organs, and acts as a mechanical irritant. Thus, if thrown into the jugular vein, peripneumonia is excited; and, on examination after death, little abscesses and tubercles have been found in the lungs, in each of which was a globule of quicksilver as the nucleus.

(*c.*) *On man.*—Some difference of opinion exists as to the *effects of liquid mercury when swallowed;* one party asserting that it is poisonous, another that is innocuous. The truth I believe to be this: so long as it retains the metallic state it is inert; but it sometimes combines with oxygen in the alimentary canal, and in this way acquires activity. Avicenna, Fallopius, and Brasavola, declared it harmless; Sue (*Mém. de la Facult. Méd. d'Emulat.* 4th year, p. 252) states that a patient took for a long time two pounds daily without injury; and I could refer to the experience of many others who have seen it employed in obstructions of the bowels, without proving noxious; but the fact is so generally known and admitted, as to require no further notice. In some instances, however, it has acted powerfully, more especially where it has been retained in the bowels for a considerable time; no doubt from becoming oxidized. Thus Zwinger (*Miscell. Curiosa Decur.* 2nda. Ann. 6, 1688) states that four ounces brought on profuse salivation four days after swallowing it. Laborde (*Journ. de Méd.* i. 3) also tells us, that a man who retained seven ounces in his body for fourteen days, was attacked with profuse salivation, ulceration of the mouth, and paralysis of the extremities; and other cases of a similar kind might be quoted.

Dr. Christison considers the question set at rest by the Berlin College of Physicians, and that the metal is innocuous.

Applied externally, liquid mercury has sometimes produced bad effects. Dr. Scheel has related a fatal case, attended with salivation, brought on from wearing at the breast during six years a leathern bag, containing a

.v drachms of liquid mercury, as a prophylactic for itch and vermin .ichter, *Ausführ. Arzneim.* Supplem. Bd. 615).

The injurious effects of *mercurial vapours,* when inhaled or otherwise plied to the body, have been long known. They are observed in water lders, looking-glass silverers, barometer-makers, workmen employed in uicksilver mines, and in others exposed to mercurial emanations. In ɔst instances an affection of the nervous system is brought on, and uich is indicated by the *shaking palsy* or *tremblement mercuriel* (*tremor rcurialis*), which is sometimes attended with stammering (*psellismus tallicus*), vertigo, loss of memory, and other cerebral disorders, which quently terminate fatally. The first symptom of shaking palsy is unadiness of the arm, succeeded by a kind of quivering of the muscles, uich increases until the movements become of a convulsive character. all the cases (about five or six in number) which have fallen under my tice, the shaking ceased during sleep. I have not seen the least benefit tained by remedial means, although various modes of treatment were ed. This is not in accordance with the experience of Dr. Christison, no says the tremors "are cured easily though slowly." If the individual ntinue his business, other more dangerous symptoms come on, such as lirium or epilepsy, or apoplexy (*apoplexia mercurialis*); and ultimately ath takes place.

In some instances salivation, ulceration of the mouth, and hæmoptysis, produced by the vapour of mercury. The following remarkable case an instance in point. In 1810, the Triumph man-of-war, and Phipps looner, received on board several tons of quicksilver, saved from the eck of a vessel near Cadiz. In consequence of the rotting of the bags mercury escaped, and the whole of the crews became more or less ected. In the space of three weeks 200 men were salivated, two died, d all the animals, cats, dogs, sheep, goats, fowls, a canary bird,—nay, en the rats, mice, and cock-roaches, were destroyed (*Ed. Med. and rg. Journ.* xxvi. 29).

As metallic mercury in the liquid state is not active, it has been thought ut mercurial vapour must also be inactive. Thus Dr. Christison thinks ut the activity of the emanations arises from the oxidation of the metal fore it is inhaled. I believe, however, with Buchner (*Toxicologie*), fila (*Toxicol. Gén.*), and others, that metallic mercury, in the finely ided state in which it must exist as vapour, is itself poisonous.

2. *Of Mercurial Compounds.*—Probably all the mercurial comunds are more or less noxious. The only doubtful exception to this is the case of the sulphurets of this metal, which, according to Orfila rch. Gén. de Méd. xix. 330), are inert.

(*a.*) *Local effects.*—For the most part, the local action of the mercul compounds may be regarded as alterative, and more or less irritant. iny of the preparations (as the bichloride, the nitrates, &c.) are energetic istics. The protoxide and protochloride (calomel) are very slightly itant only: indeed, Mr. Annesley (*Diseases of India*) asserts, from his periments on dogs, and his experience with it in the human subject, ut the latter substance is the reverse of an irritant; in other words, ut when applied to the gastro-intestinal membrane it diminishes its scularity. But I suspect some error of observation here.

(*b.*) *Remote effects.*—In *small* and *repeated doses,* the first obvious ect of mercurials is an increased activity in the secreting and exhaling apparatus. This is particularly observed in the digestive organs; the quantity of intestinal mucus, of bile, of saliva, of mucus of the mouth, and probably of pancreatic liquid, being augmented. The alvine discharges become more liquid, and contain a larger proportion of bile. The operation of the medicine does not stop here: the pulmonary, urino-genital, and conjunctival membranes, become moister, the urine is increased in quantity, the catamenial discharge is sometimes brought on, the skin becomes damper and at the same time warmer. The absorbent or lymphatic system seems also to be stimulated to increased activity; for we frequently observe that the accumulations of fluid in the shut sacs (as the pleura, the peritoneum, the arachnoid, and synovial membranes) diminish in quantity, and in some cases rapidly disappear. At the same time, also, glandular swellings and indurations of various kinds are dispersed. These are the cases in which the mercurials are called *alteratives*—that is, they indirectly induce healthy action in a very slow, gradual, and incomprehensible manner.

When our object is to obtain the *sialogogue* operation of mercurials, we give them in *somewhat larger doses.* To a certain extent the effects are the same as those already mentioned, but more intense. Of all the secretions, none are so uniformly and remarkably augmented as those of the mucous follicles of the mouth and the salivary glands; and the increased secretion of these parts is accompanied with more or less tenderness and inflammation, the whole constituting what is termed *salivation* or *ptyalism* (*salivatio*, *ptyalismus*, *sialismus*). The first symptoms of this affection are slight tenderness and tumefaction of the gums, which acquire a pale rose colour, except at the edges surrounding the teeth, where they are deep red. Gradually the mouth becomes exceedingly sore, and the tongue much swollen; a coppery taste is perceived, and the breath acquires a remarkable fœtidity. The salivary glands soon become tender and swollen; the saliva and mucus of the mouth flow abundantly, sometimes to the extent of several pints in the twenty-four hours. During this state, the fat is rapidly absorbed, and the patient becomes exceedingly emaciated. The blood when drawn from a vein puts on the same appearance as it does in inflammatory diseases.

The quantity of saliva and buccal mucus discharged by patients under the influence of mercury, varies according to the quantity of the medicine employed, the susceptibility of the patient, &c. Formerly salivation was carried to a much greater extent than it is at the present day. Thus Boerhaave (*Aphorismi*) considers a patient should spit three or four pounds in twenty-four hours; and Turner (*Pract. Dissert. on the Ven. Disease*, 1737) says from two to three quarts are "a good and sufficient discharge." Modern experience has shewn that all the good effects of mercurials may be gained by a very slight affection of the mouth. Several analyses have been made of saliva from patients under the influence of mercury. Fourcroy, Thomson, Bostock, and Devergie, failed to detect the least trace of mercury in it. But some other persons have been more successful, as will be hereafter mentioned. The following are the constituents of saliva during mercurial ptyalism, according to Dr. Thomson (*Annal. of Phil.* vi. 397):—

Coagulated Albumen	0·257
Mucus, with a little Albumen	0·367
Chloride of Sodium	0·090
Water	99·286
	100·000

t was an opal fluid, having a sp. gr. of 1·0038, and by standing osited flakes of coagulated albumen. The nitrates of lead and cury produced copious precipitates with it; but the ferrocyanuret of assium and infusion of galls had no effect on it. Dr. Bostock *edico-Chirurg. Trans.* xiii. 73) found the saliva discharged under the uence of mercury to differ from that of the healthy state, in being less id, and in containing a substance analogous to coagulated albumen, h as it exists in the serum of the blood; so that it would seem the curial action alters the secretion of the salivary glands, and makes it re analogous to the exhaled fluids of the serous membranes.

The effects of mercury hitherto described are such as are occasionally duced for the cure of diseases; but occasionally other phenomena sent themselves in individuals who have been subjected to the influ- e of this metal, and which have been considered as constituting a uliar malady, to which the name of *mercurial disease* (*morbus mercu- lis, hydrargyriasis* seu *hydrargyrosis, cachexia mercurialis,* &c.) has n given. The *pseudo-syphilis,* or *cachexia sypholoidea* of some writers, upposed to be syphilis, more or less modified by the mercurial disease. following are the ill effects which have been ascribed to this metal, which Dieterich (*Die Merkurialkrankheit,* 1837) regards as so many ns of the mercurial disease:—

Mercurial fever (*febris mercurialis,* Dieter.)—Under this name Dieterich has uded two febrile states. One of these (*febris erethica; f. salivosa*) comes on a days after the use of large doses of mercury, and is characterized by great rest- ness, dryness of the mouth, headache, loss of appetite, nausea, hot and dry skin, quick e, red gums, swollen tongue, &c.: it usually terminates in a critical discharge (as use salivation, purging, or sweating), or an eruption makes its appearance. The tion which Mr. Pearson (*Observ. on the Effects of various Articles of the Mat. l.* p. 131) denominated *mercurial erethism* (*erethismus mercurialis*), is regarded by terich as an adynamic mercurial fever (*febris adynamica*). It is characterized by t depression of strength, a sense of anxiety about the præcordia, frequent sighing, bling, partial or universal, a small quick pulse, sometimes vomiting, a pale con- ted countenance, a sense of coldness; but the tongue is seldom furred, nor are the l or natural functions much disordered. When these symptoms are present, a sudden violent exertion of the animal power will occasionally prove fatal.

Excessive salivation (*ptyalismus stomachalis mercurialis,* Dieter. *stomatis*).—I already noticed mercurial salivation as far as it is ever purposely induced for the of diseases. But it sometimes happens, either from the inordinate employment of cury, or from some peculiarity in the constitution of the patient, that the mouth mes violently affected: the gums are tumefied and ulcerated; the tongue is swollen ch an extent, that it hangs out of the mouth, incapacitating the patient from either ng or speaking; the salivary glands are enlarged and most painful, and the saliva s most copiously from the mouth. In one instance sixteen pounds are said to have evacuated in twenty-four hours. In some cases (Dieterich, *op. cit.*) the gums gh, the teeth loosen and drop out, and occasionally necrosis of the alveolar process s place. During this time the system becomes extremely debilitated and ema- d; and, if no intermission be given to the use of mercury, involuntary actions of muscular system come on, and the patient ultimately dies of exhaustion.

n some cases, active inflammation, succeeded by ulceration and sloughing of the ces takes place (*angina mercurialis*). In one instance, which fell under my notice, condition was brought on by the use of a few grains of blue pill, taken for a liver plaint. Recovery took place, but the contraction of the mucous membrane in the hbourhood of the anterior arches of the palate was so great, that the patient was unable to open her mouth wider than half an inch. Several operations were performed by different surgeons, to remedy this, but the relief was only temporary.

Salivation is occasionally induced by other substances (hydrocyanic, nitric, or arsenious acids, emetic tartar, foxglove, iodine, &c.), and sometimes occurs spontaneously. The peculiar odour of the breath, the brassy or coppery taste, and the sponginess of the gums, are usually considered to be characteristic of mercurial salivation. But in some cases these symptoms are insufficient to enable us to distinguish it. I have seen about a dozen instances of apparently spontaneous salivation, yet presenting the characters of ptyalism from mercury. They occurred in Dispensary patients, and mostly in females. The greater part of them had not (according to their own account) taken medicine of any kind for months. Sloughing phagedena of the mouth (*stomacace gangrænosa*) cannot, in some cases, be distinguished from the sloughing produced by mercury (*stomacace mercurialis*). A remarkable case, in proof, I have recorded in the *London Medical Gazette* (vol. xviii. 389).

3. *Mercurial purging* (*diarrhœa mercurialis*).—Violent purging is a very frequent consequence of the use of mercury. It is frequently attended with griping, and sometimes with sanguineous evacuations. In some cases there is fullness of the left hypochondrium, burning pain and tenderness of the region of the pancreas, and the evacuations are frothy, whitish, tough, and often greenish, at least in the commencement from the intermixed bile. These symptoms may fairly be referred to an affection of the pancreas, analogous to that of the salivary glands. Dieterich (*op. cit.*) terms it *ptyalismus pancreaticus mercurialis* (*diarrhœa salivalis, sialorrhœa alvina, ptyalismus abdominalis*).

4. *Urorrhœa mercurialis.*—Excessive secretion of urine, from the use of mercury, is very rare. Two cases only are recorded, both by Schlichting (*Ephemerid.* A.C.L. Nuremburgæ, 1748, tom. viii. Obs. viii. p. 25, quoted by Dieterich, *op. cit.*)

5. *Hidrosis mercurialis.*—Profuse sweating is another occasional effect of mercury.

6. *Skin diseases.*—Several forms of skin diseases, both acute and chronic, have been regarded as part of the ill effects of mercury.

(*a.*) *Eczema mercuriale*, Pearson; (*erythema mercuriale*, Spens and Mullins; *lepra mercurialis*, Stokes and Moriarty; *hydrargyria*, Alley, Rayer; *erysipelas mercuriale*, Cullerier, Lagneau; *spilosis mercurialis*, Schmalz).—This disease appears occasionally during the progress of a mercurial course. Some writers have frequently met with it:—thus, Alley (*Observ. on the Hydrargyria*, 1810) saw forty-three cases in ten years, and of this number eight terminated fatally. Rayer confesses, that in twenty years he never saw but three instances of it. During the ten years that I was connected with the General Dispensary, I saw only two cases of it. The disease consists of innumerable, minute, and pellucid vesicles, which have been mistaken for papulæ. These give the appearance of a diffused redness to the skin, and a sensation of roughness to the touch. Sometimes it is preceded, and attended by febrile disorder. In two or three days the vesicles attain the size of a pin's head, and the included serum becomes opaque and milky. It soon extends over the body, and is accompanied by tumefaction, tenderness, and itching. It usually terminates by desquamation: but in some cases a copious discharge takes place from the excoriated and tender surface; and when this ceases, the epidermis comes off in large flakes: in some instances the hair and nails fall off, and the eyes and eyebrows become entirely denuded. There is usually some affection of the respiratory organs, indicated by dry cough and tightness of the præcordia.

(*b.*) *Miliaria mercurialis.*—A miliary eruption has been observed by both Peter Frank and Dieterich, apparently as a consequence of the use of mercury.

(*c.*) *Chronic skin diseases* (*herpes*, *psydracia*, and *impetigo*).—These are doubtful consequences of the use of mercury. They have occurred after the employment of this metal; but considerable doubt exists, as to whether they ought to be regarded as the effect of the remedy, or of the disease for which they have been exhibited, or of some other condition of system. *Herpes præputialis* has been ascribed, by Mr. Pearson, to the previous use of mercury (Bateman, *Pract. Synopsis of Cutaneous Diseases*, 6th ed.) and his opinion has been adopted by Dieterich (*op. cit.*); but it certainly now and then occurs, when no mercury has been exhibited. The *psydracia mercurialis* and *impetigo mercurialis* of Dieterich (*op. cit.*) are still more doubtful effects of mercury.

7. *Inflammation of the eye, fauces, and periosteum*, have been ascribed by some writers to the use of mercury; but by others the power of this agent to produce these diseases is denied. That they have followed the use of mercury cannot be doubted, but *post hoc* is not *ergo propter hoc*. Dieterich regards the maladies referred to as states of congestion, not of inflammation, and therefore calls them *symphoreses* (from συμφόρησις, a

imulation). The inflammation of the conjunctiva (*conjunctivitis mercurialis; sym-resis conjunctivæ oculi mercurialis*, Dieter.), ascribed by Von Ammon (*Rust's Maga-* 1830) to the use of mercury, should probably be referred to some other cause. He s it is characterized by a lilac tint around the cornea; that it sometimes precedes vation, disappearing when this is established, and is commonly regarded as a rrhal symptom. The mercurial iritis (*iritis mercurialis: symphoresis ireos mercu-is*, Dieter.; *iritis rheumatico-mercurialis*, Jaeger), described by Mr. Travers *rgical Essays*, i. 59), was, in all probability, an iritis arising from some other cause ı mercury (Mackenzie, *On Diseases of the Eye*, 2d edit. p. 496). The so-called mer-al retinitis (*symphoresis retinæ oculi mercurialis*, Dieter.) may be explained in the e way. An inflammation of the fauces sometimes occurs after the use of mercury *jina mercurialis; symphoresis faucium mercurialis*, Dieter.) It may come on in five six days after the use of mercury, and assume an acute form, with a tendency to ıgh (Colles, *Pract. Observ. on the Vener. Disease*, p. 45); or it may appear after the ›loyment of mercury for five or six weeks, and take on a chronic form (Dieterich, *cit.* p. 273). Inflammation of the bone or periosteum, and the consequent produc- of nodes (*symphoresis periostei mercurialis*, Dieter.), has been ascribed to mercury. the disease is rarely or never seen after the use of this mineral, except when it has ı given for the cure of a venereal affection, to which, in fact, it ought with more pro-ty to be referred (Mr. Lawrence, *Lect. on Surg. in Med. Gaz.* v. 805; Colles, *op.* p. 189).

. *Hypertrophies* (*Hypertrophiæ*, Dieter.).—Enlargement of the inguinal, axillary, mesenteric absorbent glands (*adenophyma inguinale mercuriale; ad. axillare merc.; meseraicum merc.* Dieter.), as well as of some of the secreting glands, viz. the ›tid glands, the pancreas, the testicles, and liver (*adenophyma parotideum merc.; ad. creaticum merc.; ad. testiculi merc.; hepatophyma merc.*), and condyloma and glion (*condyloma et ganglion mercuriale*, Dieter.), have been ascribed by some ıthias, *op. cit.* and Dieterich, *op. cit.*) to the use of mercury, but, as I believe, on in-icient grounds.

. *Ulceration and sloughing.*—Ulceration of the mouth is a well-known effect of cury. Ulceration of the throat is likewise a consequence of the use of this mineral *rcurial ulcerated throat*, Mathias; *mercurial sore throat*, Bacot, in *Med. Gaz.* iii.). Sloughing of the same parts may also be induced. It is well known that ereal sores (especially those called phagedenic) at times assume a sloughing dispo-›n, in consequence of the improper use of mercury (Sir A. Cooper, *Lectures on Sur-/*, in *Lancet*, iv. 42; Carmichael, *On Venereal Diseases*, p. 165, et seq. 2nd. ed.) eration of the fibrous membranes (*ulcus membranæ fibrosæ mercuriale*), and ulceration he absorbent glands (*ulcus glandularum mercuriale*), has been ascribed to the use of cury (Dieterich, *op. cit.* p. 376).

0. *Neuroses mercuriales.*—Various symptoms indicating a disordered condition of nervous system, are met with in persons who have been exposed to the baneful in-nce of mercury: such as wandering pains (*neuralgia mercurialis*); a tremulous lition of the muscular system (*tremor mercurialis*), sometimes accompanied with mering (*psellismus metallicus*), and occasionally terminating in paralysis (*paralysis curialis*), epilepsy or apoplexy (*apoplexia mercurialis*). To these, Dieterich (*op. cit.*) s asthma (*asthma mercurialis*), of which he only saw one case, amaurosis (*amaurosis curialis*), and hypochondriasis (*hypochondriasis mercurialis*).

›f these, the best known is the shaking palsy (*tremor mercurialis; tremblement mer-el*), a remarkable affection which occurs among workmen exposed to the action of the our of mercury, such as miners, gilders, barometer-makers, looking-glass silverers, The first symptom of it is unsteadiness of the arm, succeeded by a kind of quiver- of the muscles, which increases until the movements become of a convulsive charac- In all the cases which I have seen, the movements were suspended during sleep.

1. *Cachexia* (*cachexia mercurialis*).—This condition is characterized by disorder of digestive organs, loss of appetite, wasting, incapability of much exertion, with in-ısed secretion from all the organs, especially from the salivary glands.

The foregoing are the most important of the ill effects ascribed to the of mercury. As I have already stated, some of them ought probably ›e referred to other causes, and not to the use of this mineral; but as ıbt must necessarily be entertained on this point, I have thought nore advisable to mention them. The student will find some pertinent ›ervations concerning them, in a paper by Dr. Musgrave (*Edin. Med.*

and Surg. Journ. vol. xxviii.), and in Dr. Currie's pamphlet (*Examination of the Prejudice commonly entertained against Mercury*).

In excessive doses: acute poisoning.—When *large doses* of some of the soluble salts of mercury have been swallowed, *gastro-enteritis* is observed. The patient complains of an acrid styptic taste in the mouth, and of a feeling of burning and tightness in the throat; the face is usually flushed and sometimes swelled, violent vomiting and purging (frequently of bloody matters) soon come on, the vomiting being increased by every thing taken into the stomach; oftentimes there is irritation of the urinary passages, and sometimes even suppression of urine; the pulse is small, frequent, and contracted; the respiration difficult; the extremities cold. In some cases *salivation* is produced: this seldom comes on during the first 24 hours; and in those instances in which it does occur, is seldom delayed beyond the fourth day. Towards the termination of the case, some indications of *disorder of the cerebro-spinal system* come on, such as slight drowsiness or stupor, or even coma, tremors and twitchings of the muscles, and sometimes even violent convulsions; in some cases paraplegia. These symptoms terminate in death. Post-mortem examination discovers inflammation, and its consequences, of the gastro-intestinal membrane.

Theory of the Action of Mercury. — There are many disputed points connected with the action of mercurials, which it will be convenient to examine under this head.

1. *Absorption of mercury.*—By the external or internal use of mercury, this metal becomes absorbed (in what state has not been ascertained), and is subsequently either deposited in some of the solids of the body, or thrown out of the system by some of the excretories.

The accuracy of this statement is proved by the following facts:—

(*a.*) *Mercury has been detected in the blood* by Zeller, Buchner, Schubarth (quoted by Dr. Christison, *On Poisons*, 3rd. ed. p. 366), Colson (*Arch. Gén.* xii. 68), and Dieterich (*op. cit.*). It appears to be in such intimate combination with this vital fluid that it cannot be recognised by the ordinary tests. Destructive distillation is in most cases necessary for its detection.

(*b.*) *Mercury has been found in the secretions*, viz. in the perspiration, the saliva, the gastro-intestinal secretion, the bile, the urine, and the fluid of ulcers (Christison, Colson, and Dieterich, *op. cit.*) The blackening of the skin, mentioned both by Harrold (*Meckel's Archiv.* iii. 532) and Rigby (*Lond. Med. Rep.* April 1837), as having occurred in consequence of the use of mercury subsequent to the employment of sulphur, establishes the existence of mercury in the cutaneous transpiration. The sulphur and the mercury were thrown out of the system by the skin, and immediately they were out of the sphere of the vital powers, they entered into union and formed the black sulphuret of mercury, which was deposited on the integument in a pulverent form.

(*c.*) *Mercury has been found in the reguline state in the organic solids*, viz. in the bones, brain, synovial capsules, the pleura, the humours of the eye, the cellular tissue, the lungs, &c. (Christison, *op. cit.*; Wibmer, *Wirkung d. Arzneim.* iii. 85; Colson and Dieterich, *op. cit.*) In what part of the system reduction is effected, has not been made out.

2. *The constitutional effects of mercury are consequences of its absorption.* For, in the *first* place, mercurials affect the general system to

atever part of the body they be applied, whether to the mucous nbranes, the cutaneous system, or the cellular tissue, or injected into veins. *Secondly*, the action of mercurials on the system is assisted by use of bloodletting and emetics;—agents which promote absorption. *rdly*, when mercurials are administered by the stomach, and excite ging, they rarely affect the general system, apparently in consequence he function of absorption being suspended.

. *After absorption, mercury effects changes in the qualities of the d, and in the action of the whole organism, but especially the appa-us of organic life.*—Soon after salivation has been established, the od exhibits an inflammatory crust. At a later period its colour pens, and its coagulability is diminished: the proportion of clot, and efore of fibrin, to serum becomes smaller. "The formation of albu-n and mucus," says Dieterich (*op. cit.* 80), "sinks to that of serum; whole organic formation of the patient is less consistent and cohe-." The same authority also tells us, that under the influence of cury the electrical condition of the blood changes from the negative lthy) state to that of positive. The evacuations from all the secreting exhaling organs, especially from the mucous follicles and salivary ıds, is much increased. The secretion of bile is also promoted. Dr. lson Philip (*On the Influence of Minute Doses of Mercury*, p. 14) s, "mercury has a specific operation on the liver,—a power not merely xciting its functions, but of correcting the various derangements of that ction in a way which it does not possess with respect to any other organ, which no other medicine possesses with respect to the liver." I confess n not acquainted with any facts warranting this assertion. The pur-ive effects of mercury arise partly from the increased secretion of bile, partly from the stimulus given to the mucous lining of the alimentary e; more particularly to its follicular apparatus. The *nervous system* ears also to be specifically affected by mercurials. This is to be in-ed partly from the effects produced in those who are subjected to the ours of this metal, such as the shaking palsy, &c. and partly from the cts of the soluble salts, when given in enormous doses. The *heart* and *gs* are, in some cases, remarkably affected. This was particularly erved by Sir Benjamin Brodie (*Phil. Trans.* for 1812) in his experi-its on animals with corrosive sublimate; as also by Smith, Orfila, Gaspard. The affection of the *urinary organs* in poisoning by cor-ve sublimate is also not to be forgotten.

. *The nature of the influence exercised by mercury over the organism* been a fertile source of discussion. One class of writers has regarded s mechanical, a second as chemical, a third as dynamical.

a.) *Mechanical hypothesis.*—Astruc (*De Morb. Ven.* ii. 149) and Barry *d. Trans.* i. 25) fancied that mercury acted by its weight, its divisi-ty, and its mobility; and thus getting into the blood separated its ɔules, rendered it more fluid and fit for secretion, made the lymph iner, and overcame any existing obstructions.

b.) *Chemical hypotheses.*—Some have advocated the chemical opera-of mercurials, and have endeavoured to explain their curative ersion the venereal disease by reference to their chemical properties, without success. Thus Mitié, Pressavin (quoted by Richter, *Ausführ. neim.* iv. 305), and Swediaur (*Prac. Observ. on Venereal Complaints*), umed that mercury acted chemically on the syphilitic poison, as acids and alkalies do on each other; while Girtanner (*Abhandl. ü. d. Vener. Krankh.*) supposed that the efficacy of mercurials depended on the oxygen they contain. To both hypotheses the same objection applies: if they were true, the larger the quantity of mercury used, the more effectually would the venereal disease be cured. Now this is not found to be the case. Dr. Cullen (*Treat. of the Mat. Med.* ii. 446) endeavoured to account for the action of mercury on the salivary glands, in preference to other organs, by assuming that it has a particular disposition to unite with ammoniacal salts, with which it passes off by the various excretions; and as the saliva was supposed to contain more of these salts than other secretions, he thus accounted for the larger quantity of mercury which passed off by these glands, and which being in this way applied to the excretories, occasioned salivation. But the whole hypothesis falls to the ground, when it is known that mercury has no "particular disposition" to unite with the ammoniacal salts; and that, even if it had, other secretions are as abundantly supplied with these salts as the saliva. Dr. John Murray substituted another hypothesis, but equally objectionable:—mercury, says he, cannot pass off by the urine, because of the phosphoric acid contained in this fluid, and which would form, with the mercury, an insoluble compound. It must, therefore, be thrown out of the system by other secretions, particularly by the saliva, which facilitates this transmission by the affinity which the muriatic acid, the soda, and the ammonia of the secretion, have for the oxide of mercury, and by which a compound soluble in water is formed. The answer to this hypothesis is, that mercury *is* thrown out of the system by the urine, and probably in larger quantity than by the saliva; secondly, the saliva also contains phosphatic salts, according to Tiedemann and Gmelin.

(*c.*) *Dynamical hypotheses.*—Some writers have principally directed their attention to the quality of the effects induced by mercury, and have termed this mineral stimulant, sedative, both stimulant and sedative, tonic or alterative. Those who assume mercury to be a *stimulant* or *excitant* are not agreed as to whether particular parts or the whole system are stimulated, and, if particular parts, what these are. Thus Hecker fixes on the lymphatic system, Schöne on the arterial capillary system, Reil on the nerves (Richter, *op. cit.* v. 306). The simple answer to all of them is, that other stimulants are not capable of producing the same effects on the constitution as mercury; nay, are frequently hurtful in the very cases in which this metal is beneficial.

On the other hand, Conradi, Bertele, and Horn (quoted by Richter, *op. cit.* v. 307), considered it to be a *weakening agent*, or *sedative*. Hence those who adopt this hypothesis must assume that the diseases in which mercury is beneficial are of a phlogistic or hypersthenic character; and that syphilis, therefore, is of this kind,—an explanation not at all satisfactory, nor consistent with facts. Of late years, the sedative operation of some of the mercurial preparations (calomel and mercurial ointment) has been assumed (particularly by our countrymen practising in the East), from the circumstance that these agents allay vomiting and diarrhœa in yellow fever, cholera, and other dangerous diseases. But even admitting that mercurials do produce these effects, this is hardly a sufficient ground for denominating them sedatives.

Some think that mercurials, in *small* or moderate doses, are *stimulants*, but in *excessive* doses, *sedatives;* and that this sedative operation is mon to all substances when employed in large quantities. This is the nion of Dr. Wilson Philip (*op. cit.*)

Dr. Murray (*Syst. of Mat. Med.*) calls mercury a tonic; Vogt (*Pharmamik*) terms it an alterative resolvent; Sundelin (*Heilmittellehre*) ces it among the resolvent alteratives, under the designation of liqueent (*verflüssigende*). Mr. Hunter (*Treatise on the Venereal Disease*) ounts for its beneficial effects in syphilis, by saying it produces an ation of a different kind from that caused by the venereal disease, and it counteracts the latter by destroying the diseased action of the g parts.

Uses. 1. *Of Metallic Mercury.*—Liquid mercury has been l as a *chemical* agent, to dissolve silver coin which may have been acntally swallowed; *secondly*, as a *mechanical* agent, to remove obctions of the bowels; for example, intus-susception, or intestinal gination. But neither theory nor experience seem favourable to its ; for in the greater number of cases the intus-susception is progres-—that is, the superior portion of the gut is insinuated into the lower ion, and, therefore, the pressure of the metal on the sides of the intes- cannot give relief; and even in cases of retrograde intus-susception, hat is where the lower portion of the bowels passes into the upper, cury, instead of pressing the intus-suscepted portion back, might n it further on, by getting into the angle of reflection between the aining and inverted gut (Hunter, *Trans. of a Society for the Improvet of Med. and Chir. Knowledge*, i. 103). *Lastly*, water, which had n boiled with mercury (*aqua mercurialis cocta*), was at one time used an anthelmintic; but if the metal be pure, the water takes up no reciable quantity of it. Moreover, it would appear that mercury has particular anthelmintic powers; for persons who were salivated have been freed from their worms, and Scopoli very frequently found rides in the workers of the quicksilver mines of Idria (Bremser, *les Vers. Intest.* 428).

dministration.—When taken internally it has been administered in ous doses, from an ounce to a pound or more.

Of the Preparations of Mercury.—As *errhines* or *tics*, mercurials are never resorted to now, though formerly the *subhate* was used for these purposes.

s *alteratives*, they are given in small doses in various chronic ases; such, for example, as dyspepsia, gout, chronic skin diseases, fula, &c. Calomel is said to be less beneficial as an alterative than blue on account of its more irritating action on the bowels. The *hydram cum cretâ* is an excellent alterative, especially for children.

ertain preparations of mercury (as blue pill, calomel, and the *hydram cum cretâ*) are employed as *purgatives*. They promote secre- from the mucous follicles of the intestines, from the liver, and the reas. They are rarely, however, used alone; being, in general, er combined with or followed by other cathartics (as jalap, senna, cynth, or the saline purgatives). Thus it is a common practice to bit a blue or calomel pill at night, and an aperient draught the folng morning, the object being to allow the pill to remain as long as ible in the bowels, in order that it may the more effectually act on iver. Mercurial purgatives are administered for various purposes, etimes as anthelmintics, sometimes to assist in evacuating the contents of the alimentary canal; but more commonly with the view of promoting the secretions, particularly of the liver, or of producing counter-irritation, and thereby to relieve affections of other organs, as the skin or head.

The great value of mercurials is as SIALOGOGUES. Formerly it was supposed, that the beneficial effects of mercury were proportionate to the degree of ptyalism, and thus to eradicate particular affections it was thought necessary to cause the evacuation of a given quantity of saliva. "I have heard," says Dr. Wilson Philip (*op. cit.* p. 19), the late Dr. Monro, of Edinburgh, state the quantity of saliva which must be discharged daily, to eradicate particular affections." Modern experience has proved the incorrectness of this notion; and we now rarely find it necessary to excite a high degree of salivation; indeed, frequently it would be prejudicial, but we sometimes find it requisite to keep up this effect for several weeks, particularly in diseases of a chronic character.

Production of sore mouth and salivation.—One of the most efficacious methods of putting the system under the influence of mercury is *friction* with the *unguentum hydrargyri*; but the troublesome and unpleasant nature of the process is a strong objection to it in practice, more especially in venereal diseases, in which patients usually desire secresy. Full directions for its employment will be given hereafter (vide *Ung. Hydrargyri*). In the year 1779, Mr. Clare (*Essay on the Cure of Abscesses by Caustic, also a New Method of introducing Mercury into the Circulation*, 1779) proposed a new method of causing salivation by friction, and which consists in rubbing two or three grains of calomel, or of the protoxide of mercury, on the inner surface of the cheeks and gums. It is said that the metal quickly becomes absorbed, and causes salivation; and if care be taken not to swallow the saliva, diarrhœa does not occur. Notwithstanding that Hunter, Cruikshank, and others, have tried this plan, and reported favourably of it, and that it is free from the objections made to the use of mercurial ointment, it has never been a popular remedy. *Fumigation*, as a means of affecting the general system, is an old method of treating venereal diseases. Turner (*On the Venereal Disease*) employed for this purpose cinnabar; Lalouette (*Nouv. Method. de traiter les Malad. Vénér.* 1776) calomel; and the late Mr. Abernethy (*Surgical and Phys. Essays*) the protoxide. Mr. Colles (*op. cit.* p. 58) has frequently seen fumigation fail in exciting salivation. He says an easy mode of fumigating any part is by using mercurial candles (composed of cinnabar or oxide of mercury mixed with melted wax, with a wick, and burnt under a curved glass funnel). Baumé used *mercurial pediluvia* to excite salivation, composed of half a grain of corrosive sublimate dissolved in a pint of distilled water; and in a solution of this strength the patient immersed his feet for the space of two hours; several objections, however, exist to the practice, which has been rarely followed. Upon the whole, the most convenient method of producing salivation is by the *internal use of mercurials*, particularly of those preparations which are mild in their local action, as blue pill, calomel, and the *hydrargyrum cum cretâ*.

Treatment before and during salivation.—Formerly the use of mercurials was preceded by antiphlogistic measures, such as blood-letting, purging, warm bathing, and low diet, but they are now rarely resorted to, though useful, by facilitating absorption. Mr. Colles (*Practical* *bservations on the Venereal Disease*, p. 28) thinks that these preparatory easures have been improperly omitted, and that the want of them s, of late years, contributed to bring this valuable remedy into much srepute—in which opinion I am disposed to join him. Occasionally eat difficulty is experienced in affecting the mouth, a circumstance nich may arise from the irritable condition of the bowels; and when is is the case, inunction should be resorted to, or opium or vegetable tringents conjoined. Sometimes, however, the system appears insus- ptible to the influence of mercury, and this may arise from idiosyncrasy, from the presence of some disease, particularly fever. Emetics and ood-letting are useful in these cases, as they promote absorption; and the influence of the former depends on the state of nausea produced, rtar emetic will be the best vomit, since it is the most powerful nau- int. Varying the mode of administering the mercury will also some- nes facilitate its operation on the system: thus, if it have been employed ernally, inunction should be tried, and *vice versâ*.

During the time that the patient's mouth is sore, he should, if possible, nfine himself to the house, use warm clothing, avoid exposure to cold, e light but nourishing food, and regulate the state of his stomach and wels. Mr. Hunter thought that during a mercurial course the manner living need not be altered: but Mr. Colles (*op. cit.* p. 34) has operly, I think, objected to this. If the discharge become exces- e, or ulceration of the gums take place, the further use of mer- ry is of course to be stopped; and, in order to moderate the effect eady produced, the patient should be freely exposed to a cool but dry , use purgatives and opium, and wash his mouth with some astringent d stimulating liquid. I have generally employed, as a gargle, a solu- n of the chloride of soda or of lime; but in the absence of these, a ution of alum, or of sulphate of copper, may be used. With regard internal remedies, I have no confidence in any as having a specific wer of stopping salivation, though iodine, sulphur, nitre, and other bstances, have been strongly recommended. Sometimes sulphate of inia is administered with advantage.

Accidents during salivation.—Occasionally, during salivation, certain ects result from mercury, which are in no way necessary or useful in a rapeutical point of view: on the contrary, some of them are highly ejudicial. Thus, sometimes, *excessive salivation, with ulceration of the ms*, takes place, as already noticed: not unfrequently *gastro-intestinal itation* (or actual inflammation) comes on, and which may require the spension of the use of mercury, or its employment by way of inunc- n, or its combination with opium or vegetable astringents. I have eady noticed *fever*, *eczema mercuriale*, *mercurial erethysm* of Pearson, . as other occasional effects. In feeble and irritable habits, mercury netimes disposes sores to *slough*. Occasionally a kind of *metastasis* of mercurial irritation is observed: thus, swallowing a large quantity of ld water, or exposing the body to cold and moisture, has caused a tem- rary cessation of salivation, attended with violent pains or convulsions, great irritability of stomach.

Curative action of salivation.—Though no surgeon ascribes the cura- e action of mercury to the salivation, yet, without this effect, the rative influence is not usually observed. Hence, though the one can- t be considered to stand to the other in the relation of cause and effect, yet the two are usually contemporaneous: so that when we fail to induce some affection of the mouth, we do not observe the beneficial effects of mercury. (On this subject consult Colles, *op. cit.* p. 31).

Diseases for which salivation is employed.—Having offered these general remarks on salivation as a remedial agent, I proceed to notice its use in particular diseases.

(*a.*) *Fever.*—It has been said that salivation diminishes the susceptibility to the contagion of fever, whether common or specific; but that it is not an absolute preventive is shown by the fact, that patients under the full influence of mercury have caught fever, and died of it, as will be found noticed by my friend, Dr. Clutterbuck, in his *Inquiry into the Seat and Nature of Fever.* I have several times used mercurials as sialogogues in fever; I believe, for the most part, with advantage. I have only used them when there was some marked local determination or inflammatory condition. I have seen three fatal cases of fever in which mercurials were used profusely, without having any effect on the mouth; but in other instances, in which the mouth became affected, recovery took place. My experience, therefore, agrees with that of Dr. Copland (*Dict. of Pract. Med.* i. 929), namely, that death, after salivation has been established, is very rare. Whether the recovery was the consequence of the mercurial action, or the salivation the result of the mitigation of the disorder, as Dr. Bancroft (*On Yellow Fever*) and Dr. Graves (*Lond. Med. Gaz.* xx. 147) assert, cannot be positively proved, though I think the first more probable. Dr. Graves (*op. cit.*) declares the use of mercury in fever to be both injudicious and unnecessary, unless inflammation of some organ be set up. In this opinion I cannot agree with him. Dr. Macartney (*Treatise on Inflammation*, p. 162), on the other hand, says, "In no single instance have I known it [mercury] fail in arresting the progress of the disease, provided the fever be not combined with visceral affections, or characterized from the beginning with unusual prostration of strength." The great indisposition of the system, in fever, to take on the mercurial action, is frequently a most annoying circumstance. It may sometimes be overcome by the employment of mercurials both internally and externally. Mr. Lempriere (*Pract. Observ. on Diseases of the Army of Jamaica*), who practised in Jamaica, finding that calomel was often exhibited in immense quantities, without exciting any apparent action, was induced to employ corrosive sublimate in doses of the eighth part of a grain, with the addition of ten drops of laudanum, and this quantity was repeated every hour until some affection of the mouth was observed, or until the more alarming symptoms had considerably abated.

The beneficial influence of mercurials has been more particularly experienced in the fevers of warm climates, especially those of the East Indies (Johnson, *On Diseases of Tropical Climates*, pp. 32, 96, 97, 122, &c. &c. 3d. ed.; Annesley, *On the Diseases of India*, p. 391, 2d. ed.) It has been said by several writers (Johnson, *op. cit.* p. 37; Bancroft, *On Yellow Fever*; Musgrave, *Edinb. Med. & Surg. Journ.* xxviii. 40), that in the yellow fever of the West Indies its beneficial effects are not equally evident.

(*b.*) *Inflammation.*—Of late years various forms of inflammation have been most successfully combated by the use of mercury. Hence this mineral is termed an *antiphlogistic.* We are principally indebted to Dr.

[H]amilton (Duncan's *Med. Comm.* vol. ix.), Dr. Yeats (Duncan's *Ann. of* [M]*ed.* vol. vii.), Dr. Wright (*Med. Facts & Observ.* vol. vii.), and Rambach [(]*Dissert. Usus Mercurii in Morb. Inflamm.* 1794) for its introduction into [u]se in this form of disease. Its influence is that of a profoundly acting [a]lterative (*vide* p. 10). Its curative power is not satisfactorily accounted [fo]r by the equalization of the circulation, the augmentation of the secre[ti]ons, or the increased activity of the absorbents caused by mercury.

Mercury is not equally serviceable in all inflammations, but it is exceed[in]gly difficult to generalize; that is, to point out in what circumstances [th]ose inflammations agree which are benefited by it. It appears, how[ev]er, that the *nature of the tissue*, the *structure of the organ affected*, [an]d the *quality* or *kind* of inflammation, are points of considerable im[po]rtance as affecting its use.

Thus it appears that inflammations of *membranous tissues* are those [pr]incipally benefited by a mercurial plan of treatment; and more espe[ci]ally those in which there is a tendency to the exudation of coagulable [ly]mph or of serous fluid—as meningitis, pleuritis, pericarditis, and peri[to]nitis (particularly of puerperal women). In inflammation of the lining [m]embrane of the air-tube, but more especially in croup, or, as it is some[ti]mes termed, plastic inflammation of the larynx, mercury is one of our [m]ost valuable remedies; and as this disease is one which terminates [ra]pidly, no time should be lost in getting a sufficient quantity of mercury [in]to the system. Calomel is usually employed; but when the bowels are [ve]ry irritable, the *hydrargyrum cum cretâ*, or even mercurial inunction, [m]ay be resorted to. In inflammation of the tunics of the eye, particu[la]rly iritis, mercury (next to blood-letting) is the only remedy on which [m]uch confidence can be placed; and we use it not merely with a view of [pu]tting a stop to the inflammatory action, but also in order to cause the [ab]sorption of the effused lymph (Lawrence, *Lectures on Diseases of the* [E]*ye*, in *Lancet*, vol. x. p. 198; Mackenzie, *On Diseases of the Eye*, [2]d. ed. pp. 389, 394, 503). In inflammation of the synovial membranes, [m]ercury has been employed, and in some cases with manifest advantage. [I]n dysentery, mercury has been extensively used, especially in warm [cl]imates. By some, calomel has been employed merely as a purgative [(J]ackson, Ballinghall, Bampfield, and Annesley); by others, to produce [it]s sialogogue effects (Johnson and Cunningham).

The *structure of the organ* influences the effect of mercury: at least [it] is well known that this mineral is more beneficial in inflammation of [ce]rtain organs (especially those of a glandular structure, as the liver) [th]an of others; and we refer it to some peculiarity in the structure of the [pa]rt affected. In hepatitis of either temperate or tropical climates (par[tic]ularly of the latter), mercury is advantageously employed (Sir James [M]'Grigor, *Medical Sketches*; Johnson, *On Tropical Climates*; Annesley, [O]*n Diseases of India*). Blood-letting, however, should be premised, par[tic]ularly in the disease as usually met with in this country. In peri[pn]eumonia, more especially when hepatization has taken place, the best [eff]ects have sometimes resulted from its use; of course after the employ[me]nt of blood-letting. When hepatization has taken place, Dr. Davies [(L]*ect. on the Diseases of the Lungs*, &c. p. 191) recommends the use of [bl]ue pill and opium. In inflammation of the substance of the brain, [al]so, mercury may be advantageously resorted to, after the usual [de]pletives.

The *nature* or *quality of the inflammation* also influences the effects, and thereby the uses, of mercury. Thus, in syphilitic inflammation, mercurials are of the greatest utility; less so in rheumatic inflammation; still less in scrofulous ; and most decidedly objectionable in cancerous or scorbutic diseases. The treatment of rheumatism by calomel and opium was proposed by Dr. Hamilton (*op. cit.*), and has found many supporters (*vide* Dr. Hope, *Lond. Med. Gaz.* xix. 815); and, undoubtedly, when the febrile action does not run too high, or when the pericardium becomes affected, calomel and opium, preceded by blood-letting, will be found serviceable. It appears to be best adapted to the fibrous or diffuse form of the disease, and to fail in the synovial (Dr. Macleod, *Lond. Med. Gaz.* xxi. 361). The scrofulous habit is, for the most part, unfavourable to the use of mercury given as a sialogogue, but there are cases in which it is not only admissible but serviceable—as scrofulous ophthalmia, when of an acute kind. In all maladies of a malignant character (as cancer, fungoid disease, &c.) mercurials are highly objectionable.

(*c.*) *Venereal diseases.*—It was formerly the opinion of surgeons that the symptoms of venereal diseases were progressive, and never disappeared until mercury was administered; but it has, of late years, been clearly proved that this notion is erroneous: and we are indebted to some of our army surgeons—namely, to Messrs. Ferguson, Rose, Guthrie, (*Med. Chirurg. Trans.* vols. iv. and viii.), Hennen (*Military Surgery*), and Bacot (*On Syphilis*, 1821), and to Dr. Thomson (*Ed. Med. and Surg. Journ.* xiv.)—for showing that the venereal disease, in all its forms, *may* be cured without an atom of mercury. Moreover, it is fully established by the experience of almost every surgeon, that while in some instances mercury exercises a beneficial influence hardly to be observed with respect to any other disease or any other remedy, yet, that in some cases it acts most injuriously; and it is generally supposed that many of the bad venereal cases formerly met with, arose, in great part, from the improper use of mercury. It is a point, therefore, of considerable importance, to determine what cases are best adapted for a mercurial, and what for a non-mercurial, method of treatment; for in admitting the *possibility* of a cure without this agent, it is not to be inferred that the method is either *eligible* or *expedient;* nay, the very persons who have proved this possibility, admit that in some cases this mineral, given so as to excite moderate salivation, is advisable. One fact is, I think, now tolerably well established—viz. that the cure of venereal diseases without the aid of mercury is much slower and less secure against relapses than by a mercurial treatment (vide Colles, *Pract. Observ. on the Vener. Disease*, p. 318). It is not easy to lay down rules to guide us in the selection of the one or the other of these methods of treatment. Mr. Carmichael (*On Venereal Diseases*, 2d ed. 1825) relies principally on the eruption, and, next to this, on the appearance of the primary ulcer; and of the four forms of the venereal disease which he has described, namely, the *papular*, the *pustular*, the *phagedenic*, and the *scaly*, full courses of mercury are required, he says, in one only—namely, the scaly; in which the primary sore is the Hunterian chancre or callous ulcer, and the eruption partakes of the characters of lepra or psoriasis. But it has been satisfactorily proved by experiments made in the military hospitals, that even this scaly form of the disease may get well without mercury; and, on the other hand, in the pustular and papular forms, mercury is often a

›st valuable agent. Hennen, Rose, Guthrie, and Thomson, advise the ıployment of moderate quantities of mercury whenever the disease does t readily subside under the use of ordinary methods of treatment. But less some special circumstances contra-indicate the use of mercury, it I think, advisable to affect the mouth slightly in most forms of the ›ease.

The circumstances which deserve attention, as affecting the use of mer- ry, are numerous. The following are the principal:—

a. Scrofula.—Some of the worst and most intractable forms of the ıereal disease occur in scrofulous subjects; and in such, mercury is in ıeral prejudical. I have seen numerous instances of its injurious ects. One case which fell under my notice was that of a medical stu- ıt, who, after three years' suffering, died; having been made much ›rse on two occasions by what I conceived to be the improper use of rcury, once by his own act, and a second time by the advice of the geon of his family. Mr. Colles (*op. cit.* p. 236), however, denies the neful influence of mercury in scrofula, and advises its use for the cure syphilis in scrofulous subjects; but he admits that the profession gene- ly entertain a contrary opinion.

β. Condition of the primary ulcer.—Another point deserving attention deciding on the use of mercury, is the condition of the primary sore: it be much inflamed, or of an irritable nature—if it be of the kind led phagedenic, or at all disposed to slough—mercury must be most efully avoided, as it increases the disposition to sloughing. In one e that fell under my notice, a gentleman lost his penis by the impro- : use of mercury, under the circumstances just mentioned.

γ. Extreme debility with hectic fever.—This condition is usually be- ved to contra-indicate the employment of mercury. But Mr. Colles . *cit.* p. 206) asserts, "that a patient affected with secondary symp- ıs, even though extremely attenuated, and, as it were, melting away ler the effects of hectic, can with perfect safety and advantage at once nmence a course of mercury; by which not only shall his venereal nptoms be removed, but at the same time his general health be re- ablished."

(*d.*) *Cholera.*—Writers on the spasmodic cholera, both of this country l of India, speak for the most part favourably of the effects of mercury, ›ecially in the form of calomel. I may refer to the works of Drs. ınson, Venables, and Hamett, and of Messrs. Annesley, Orton, and ırle, in proof. I have met with no writers who attribute ill effects to Unfortunately those who advocate its use are not agreed as to the ›e, or frequency of repetition; some advising it as a purgative; some a sedative, in combination with opium; others, lastly, using it as a logogue. It is deserving of especial notice, that when salivation takes ce, the patient in general recovers. Dr. Griffin (*Lond. Med. Gaz.* xxi. 882), however, has shown that this is not invariably the case. (For fur- r information on the use of mercurials in cholera, vide HYDRARGYRI LORIDUM).

(*e.*) *Dropsy.*—In this disease, mercurials may do either good or harm. us when the dropsical effusion depends on inflammation, they may be ployed with the best effects, as when hydrocephalus arises from menin- is, or hydrothorax from pleuritis. When ascites is occasioned by an arged liver, which compresses the vena portæ, and thereby gives rise to effusion, mercurials are sometimes beneficial. On the contrary, when dropsy occurs in old subjects, and when it depends on, or is accompanied by, general debility, salivation is almost always hurtful. Moreover, when the effusion arises from mechanical causes not removable by mercury, as obliteration of any of the venous trunks, or pressure of malignant tumors, salivation is injurious. Occasionally dropsical effusion takes place without any appreciable cause, and then, of course, if mercury be employed, it must be in part on speculation. In such cases calomel is not unfrequently employed in combination with squills or foxglove.

(*f.*) *In chronic diseases of the viscera*, especially those arising from or connected with inflammation, mercury is frequently serviceable. Thus, in enlargement or induration of the liver, in hepatization of the lungs, &c. In those diseases commonly termed malignant, as cancer and fungus hæmatodes, and also in diseases of a non-malignant character, but occurring in debilitated subjects, mercurials, given so as to excite salivation, are objectionable.

(*g.*) *In chronic diseases of the nervous system.*—Mercury has been recommended in paralysis, and on some occasions has proved exceedingly efficacious. I have seen hemiplegia, with impaired vision and hearing, headache, and cramps of the extremities, recover under the use of mercury, after blood-letting, purgatives, &c. had failed. The patient (a young man) was kept under the influence of the medicine for two months. Mr. Colles (*op. cit.* p. 327) has likewise found it most efficacious in paralysis. In tetanus, mania, epilepsy, hysteria, tic douloureux, and other affections of the nervous system, mercury has been used with occasional benefit.

The foregoing are some of the more important diseases against which mercurials have been successfully administered as sialogogues.

Hydrar'gyrum cum Cre'tâ.—Mer'cury with Chalk.

History.—This compound (called also *mercurius alcalisatus*, or *æthiops absorbens*) is first mentioned, I believe, by Burton, in 1738.

Preparation.—It is prepared by rubbing three ounces of mercury with five ounces of chalk, until globules are no longer visible. On account of the tediousness of the process, the friction is usually effected by steam.

If this powder be digested in acetic acid, the lime of the chalk is dissolved, and the carbonic acid escapes; but the greater part, if not the whole of the mercury, is insoluble in the acid, and hence is not the protoxide. If examined by a lens, the residuum is found to consist of minute separate globules, which readily whiten silver and gold, showing they are in the metallic state. Hence it is probable that the quicksilver is, for the most part, mechanically divided only, but a small portion may perhaps be oxidized.

Properties and Characteristics.—It is a greyish powder, which effervesces on the addition of acetic acid, yielding a solution of lime, which may be distinguished by the tests for the calcareous salts already mentioned. By digestion in nitric acid, we obtain a solution known to contain mercury by the characters already detailed for the mercurial preparations generally. By heat the mercury is volatilized, leaving the chalk.

Composition.—It consists of mercury and chalk, with perhaps a little otoxide of mercury. It contains three parts of mercury and five of alk.

Physiological Effects.—It is an exceedingly mild but valuable ercurial. In full doses it acts as a gentle laxative, promoting the cretion of bile and intestinal mucus, but sometimes creating a little kness. The chalk renders it antacid. By repeated use it occasions e constitutional effects of mercury already described.

Uses.—It is a valuable remedy in *syphilis infantum.* It is frequently ployed to promote and improve the secretions of the liver, pancreas, d bowels, in various disordered conditions of the digestive organs, companied by clay-coloured stools or purging. In strumous affecns of children (especially enlarged mesenteric glands), and other ronic maladies, it is administered with great advantage as an erative.

Administration.—To adults it is given in doses of from five grains to scruple, or half a drachm. For children the dose is two or three ains. Rhubarb, carbonate of soda, or, in some cases, Dover's powder, ay be conjoined with it.

Hydrar'gyrum cum Magne'siâ.—Mer'cury with Magne'sia.

Under this name there is a compound in the Dublin Pharmacopœia, epared by rubbing two parts of mercury with two parts of manna until e globules disappear, and then washing out the manna with water, and ding eight parts of subcarbonate of magnesia. Its effects and uses are alogous to the preparation just described.

Pil'ulæ Hydrar'gyri.—Pills of Mer'cury.

History.—The oldest formula for mercurial pills is that of Barbarossa t one time admiral of the Turkish fleet, and afterwards governor or ng of Algiers), and which was communicated by him to Francis the irst, king of Franconia, who made it public. The common name for is preparation is *blue pill*, or *pilulæ cæruleæ.*

Preparation.—In the London Pharmacopœia it is ordered to be preared by rubbing two drachms of purified mercury with three drachms confection of roses, until globules are no longer visible, and then lding a drachm of powdered liquorice-root. In the Dublin Pharmacoeia extract of liquorice is substituted for the root. In the Edinburgh harmacopœia one part of mercury, one of confection of roses, and two starch, are employed. The friction is usually effected by steam power. y trituration the metal is reduced to a finely-divided state, and becomes timately mixed with the confection and liquorice powder.

Properties.—It is a soft mass, of a convenient consistence for making to pills, and has a dark blue colour. When rubbed on paper, or glass, ought to present no globules; but applied to gold it communicates a lvery stain.

Composition.—Three grains of this pill contain one grain of mercury.

Impurity.—If any sulphuric acid should have been added to the onfection to brighten its colour, some subsulphate of mercury will be rmed—a compound which possesses very energetic properties.

Physiological Effects.—In full doses (as fifteen grains) it frequently acts as a purgative. In small doses it is alterative, and, by repetition, produces the before-mentioned constitutional effects of mercurials.

Uses.—The practice of giving a blue pill at night, and a senna draught the following morning, has become somewhat popular, in consequence of its being recommended by the late Mr. Abernethy, in various disorders of the chylopoietic viscera. As an alterative, in doses of two or three grains, blue pill is frequently resorted to. Lastly, it is one of the best internal agents for exciting salivation, in the various diseases for which mercury is adapted.

Administration.—The usual mode of exhibiting it is in the form of pill, in the doses already mentioned; but it may also be administered when suspended in a thick mucilaginous liquid. If the object be to excite salivation, we may give five grains in the morning, and from five to ten in the evening; and to prevent purging, opium may be conjoined.

Unguen'tum Hydrar'gyri.—Oint'ment of Mer'cury.

History.—Mercurial ointment was known to, and employed by, the ancient Arabian physicians—for example, Abhenguefith, Rhazes, and Avicenna: so that it has been in use certainly 1000 years. However, Gilbertus Anglicus, who lived about the commencement of the thirteenth century, was the first who gave a detailed account of the method of extinguishing mercury by fatty matters. Besides its more common appellation of *mercurial ointment,* it was formerly termed *blue* or *Neapolitan ointment.*

Preparation.—In the London, Dublin, Edinburgh, and United States Pharmacopœias, the *unguentum hydrargyri fortius* is prepared by rubbing two pounds of mercury with an ounce of suet and twenty-three ounces of lard, until globules are no longer visible. To promote the extinction of the mercury, the metal should be previously triturated with some old mercurial ointment. Rancid lard also assists the extinction of the globules.

Some assert that the mercury is in a finely-divided metallic state, though, if well prepared, there are no appearances of globules when the ointment is examined by a lens. In favour of this view Guibourt (*Pharm. Raisonnée,* ii. 140) states, that by digesting ether on mercurial ointment, the fatty matter may be dissolved and liquid mercury obtained in equal weight to that used in making the ointment. Now it is unlikely, if the mercury had been previously oxidized, that the ether could deoxidize it; and therefore, this experiment (supposing the results to be those mentioned) appears almost decisive that the mercury is in the metallic state; but on repetition of the experiment, I have not obtained the results stated by M. Guibourt. Mr. Donovan, however, thinks that part of the mercury attracts oxygen, and that the oxide thus formed unites with the fatty matter. I have seen no satisfactory explanation of the efficacy of old mercurial ointment in extinguishing the mercury; Guibourt offers the following:—By trituration, both lard and mercury assume oppositely electrical states, the lard becoming negative, the mercury positive; these states, he supposes, determine a more intimate mixture of the particles, and a greater division of the mercury. Now ıcid lard and old mercurial ointment, having attracted oxygen from the ., more readily take on the negative condition, and hence their efficacy promoting the extinction of the mercurial globules. Guibourt also serts, that mortars of marble or wood are better adapted for making s ointment than those of metal, on account of their power of concting electricity being less.

PROPERTIES.—It is an unctuous fatty body of a bluish grey colour, l if properly prepared, gives no traces of globules when rubbed on per, and examined by a microscope; but when rubbed on gold, it ickens it.

COMPOSITION.—This compound contains half its weight of mercury.

PHYSIOLOGICAL EFFECTS.—Mercurial ointment possesses very little wer of irritating the parts to which it is applied; but when either allowed or rubbed into the integuments, readily produces the constitunal effects of mercury. Thus Cullerier says, that three or four pills, ntaining each two grains of this ointment, and taken successively, have en sufficed to excite violent salivation. He also tells us, that if the eet be to produce ptyalism, in a very short space of time, we may et it by giving half a drachm of the ointment in the space of twentyr hours.

When rubbed on the surface of the body, it produces the same constiional effects as the other preparations of mercury; but if the lard ich it contains be not rancid, no obvious local effect is usually proced. Applied to ulcerated surfaces, mercurial ointment is a stimulant, l in syphilitic sores is oftentimes a very useful and beneficial appliion.

USES.—It is rarely or never administered *internally* in this country, . has been much used on the continent, and with great success. certainly well deserves a trial where the system appears insustible to the influence of mercury; for Cullerier says, the difficulty h him has been rather to check than to excite salivation by it.

Applied *externally*, it is employed either as a local or constitutional iedy. Thus as a *local* agent it is used as a dressing to syphilitic s, or rubbed into tumors of various kinds (not those of a malignant ure, as cancer and fungus hæmatodes), with the view of exciting the on of the lymphatic vessels. Sometimes, also, it is employed to troy parasitic animals on the skin. As a *means of affecting the conution* we use mercurial inunctions in syphilis, in inflammatory diss, and, in fact, in all the cases (already noticed) in which our object set up the mercurial action in the system, more especially when the able condition of the digestive organs offers an objection to the rnal employment of mercurials. It may be laid down as a general , that mercury may be used with more safety by the skin than by the nach; but reasons of convenience, which I have already alluded to, uently lead us to its internal use.

ADMINISTRATION.—*Internally*, it is given in doses of from two to five ns, made into pills, with either soap or some mild powder, as liquo-. *Externally*, when the object is to excite very speedy salivation, a drachm may be rubbed into the skin every hour, washing the part time, and varying the seat of application. If, however, it be desirable or necessary to produce such a speedy effect, half a hm or a drachm, rubbed in night and morning, will be sufficient.

During the whole course of inunction the patient should wear the same drawers night and day.

When the friction is performed by a second person, the hand should be enveloped with soft oiled pig's bladder, turned inside out (Colles, *op. cit.* p. 42). In making use of mercurial frictions, it is to be recollected they ought not to be violent, but long continued, and had better be carried on near a fire, in order to promote the liquefaction and absorption of the ointment. In syphilis, and other diseases in which our sole object is the constitutional affection, it matters little to what part of the body the ointment is applied, provided the cuticle be thin (for this inorganized layer offers an impediment to absorption in proportion to its thickness). The internal parts of the thighs are usually, therefore, selected. However, in liver complaints, the inunctions are made in the region of the organ affected. The occasional use of the warm bath promotes absorption when the ointment is applied to the skin.

Unguentum Hydrargyri Mitius (Ph. Lond. & Dublin).—This is prepared by mixing a pound of strong mercurial ointment with two pounds of lard. It contains a sixth part of its weight of mercury. This preparation is applied as a dressing to ulcers and cutaneous diseases.

Ceratum Hydrargyri Compositum (Ph. Lond.: stronger ointment of mercury; soap cerate, āā ℥iv.; camphor, ʒj. M.)—Its uses are similar to those of the following preparation:—

Linimentum Hydrargyri Compositum (Ph. Lond.: stronger ointment of mercury; lard, of each, ℥iv.; camphor, ʒj.; rectified spirit, f.ʒj.; solution of ammonia, f.℥iv. M.)—It is used (by way of friction) in chronic tumors, chronic affections of the joints, &c., where the object is to excite the action of the lymphatic vessels. It is stated to cause salivation more readily than the common mercurial ointment, owing to the camphor and ammonia.

Emplas'trum Hydrar'gyri.—Plas'ter of Mer'cury.

In the London Pharmacopœia, this is ordered to be prepared by adding eight grains of sulphur to a fluidrachm of heated olive oil, stirring until they unite. Then rub the mercury with the oil until the globules are no longer visible, and add a pound of melted lead plaster. In this process the sulphur of the sulphurated oil forms with the mercury a sulphuret, while the remainder of the metal is mechanically divided. Each drachm of the plaster contains fifteen grains of mercury.

It is supposed to stimulate the lymphatic vessels of the parts to which it is applied, and is used as a discutient in glandular enlargements and other swellings, whether venereal or otherwise, and also to the region of the liver in hepatic complaints. Dr. Wilson Philip (*op. cit.*) has seen it induce salivation.

Emplastrum Ammoniaci cum Hydrargyro (Ph. Lond.)—This is prepared in a similar manner to the last preparation, except that the gum-resin ammoniacum is substituted for the lead plaster. The preparation of the Dublin Pharmacopœia consists of ammoniacum, lb. j.; purified mercury, ℥iij.; common turpentine, ʒij. M. It is a more powerful compound than the last, and is employed in the same cases, especially in venereal buboes.

Hydrar'gyri Ox'ydum.—Ox'ide of Mer'cury.

History.—The mode of preparing this compound was taught by oscat in 1797. This oxide is sometimes termed the *protoxide, sub-ide, ash, grey,* or *black oxide* (*hydrargyri oxydum cinereum, hydrargyri idum nigrum*).

Preparation.—In the London Pharmacopœia it is prepared by ling one ounce of calomel to a gallon of lime water: then frequently ke them, set by, and when the oxide has subsided, pour off the super-ant liquor, and wash the precipitate with distilled water: afterwards it (wrapped in bibulous paper) in the air.

In this process double decomposition takes place: chloride of calcium ormed in solution, while oxide of mercury precipitates.

REAGENTS.		RESULTS.
Chlore. Mercy. = 238	1 eq. Chlorine .. 36	1 eq. Chloride Calcium .. 56
	1 eq. Mercury .. 202	
Lime .... = 28	1 eq. Calcium .. 20	
	1 eq. Oxygen .. 8	1 eq. Oxide of Mercury .. 210

In the Edinburgh Pharmacopœia one-fourth more lime-water is em-yed, and the mixture boiled for a quarter of an hour. In the Dublin armacopœia, one part of calomel and four of water of caustic potash employed. In this case chloride of potassium is formed in solution.

Properties.—Pure oxide of mercury is black, or nearly so. The pre-it preparation, however, is frequently greyish, owing to the presence some undecomposed calomel. It is readily decomposed by light pecially by the solar rays), becomes olive coloured, and is resolved into tallic mercury and the binoxide. It is odourless, tasteless, insoluble in ter and the alkalies, but soluble in nitric acid and acetic acid. By the ion of hydrochloric acid it forms water and calomel. When heated it irst decomposed, and then completely dissipated.

Characteristics.—Heated in a glass tube it evolves oxygen, while tallic globules are sublimed. Dissolved in nitric acid it forms a proto-rcurial salt, known by the before-mentioned characters for these sub-nces.

Composition.—The composition of this oxide is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Sefström.
Mercury	1	202	96·19	96·2
Oxygen	1	8	3·81	3·8
Oxide of Mercury	1	210	100·00	100·0

Purity.—Digested, for a short time, in dilute hydrochloric acid, the ution, when filtered, should form no precipitate with either potash or late of ammonia. If any binoxide had been dissolved, the potash uld throw it down as a reddish or yellowish hydrate. If any carbonate lime had been precipitated, the oxalate would recognise it.

Physiological Effects.—Pure oxide of mercury is one of the least tating of the mercurial preparations, and, therefore, when swallowed, s not produce much disorder of the alimentary canal. In small doses acts as an alterative and purgative. When taken in repeated doses, constitutional effects are similar to those of other mercurials.

Uses.—Mr. Abernethy employed it as a fumigating agent. The fol-ing are his directions for using it:—Place the patient in a vapour bath, in a complete suit of under garments, with a cloth around his chin. Two drachms of the oxide are then to be put on a heated iron within the machine in which the patient is sitting. After continuing in the bath for about fifteen or twenty minutes, the body is found to be covered with a whitish powder. The patient should be placed in bed, and lie in the same clothes till morning, and then go into a tepid bath. By this mode of proceeding, Mr. Abernethy says, he has known salivation induced in forty-eight hours.

Oxide of mercury is rarely employed as an internal remedy; indeed, its varying composition is a strong objection to its use. As an external application it has been used in the form of *ointment,* and also suspended in a weak solution of chloride of calcium, under the name of *black-wash.*

Administration.—For internal use the dose is from half a grain to two or three grains.

Unguentum Hydrargyri Oxydi (oxide of mercury, 1 part; lard, 3 parts: mix them thoroughly, Ph. Edinb.)—This is intended to be a substitute (of a fixed strength) for the common mercurial ointment. According to Mr. Donovan, this ointment should be kept at a temperature of 350° F., for the space of two hours, in order that the oxide and the fatty matter may enter into union. It is used as a substitute for mercurial ointment.

Lotio Nigra (*black-wash; aqua mercurialis nigra; aqua phagedenica mitis*).—This is prepared by adding calomel to lime-water. The proportions of the ingredients may be varied, but in general one drachm of calomel is used to a pint of lime-water. Oxide of mercury precipitates, and chloride of calcium remains in solution. As the efficacy of the wash depends on the oxide, the bottle must be well shaken every time of using it. This compound is a favourite application to venereal sores of almost all kinds,—in most being serviceable, in few or none being hurtful.

Hydrar'gyri Binox'ydum.—Binox'ide of Mer'cury.

History.—This is the *peroxide* or *red oxide of mercury* of some writers. Geber (*Sum of Perfection,* book i. part iv. ch. 16) describes the method of making that variety of it which is prepared by calcination, and which was formerly called *red precipitate per se* (*mercurius præcipitatus ruber per se*) or *calcined mercury* (*hydrargyrum calcinatum*). He calls it *coagulated mercury.*

Preparation. (*a.*) *By precipitation.*—In the London Pharmacopœia this compound is directed to be prepared by adding 28 fluidounces of solution of potash to four ounces of bichloride of mercury, dissolved in six pints (120 fluid ounces) of distilled water. The precipitated powder is to be washed with distilled water until the latter comes off tasteless, and is then to be dried.

In this process one equivalent or 274 parts of bichloride of mercury are decomposed by two equivalents or 96 parts of potash, and yield one equivalent or 218 parts of binoxide of mercury, and two equivalents or 152 parts of chloride of potassium.

REAGENTS.				RESULTS.	
1 eq. Bichlde Mercury..	274	2 eq. Chlorine....	72	2 eq. Chloride Potassium ..	152
		1 eq. Mercury..	202		
2 eq. Potash	96	2 eq. Potassium..	80		
		2 eq. Oxygen	16	1 eq. Binoxide of Mercury ..	218

.) *By calcination.*—In the Dublin Pharmacopœia, *hydrargyrum oxyrubrum* is directed to be prepared by exposing mercury to a heat of ., in an open glass vessel, with a narrow mouth and broad bottom, it is converted into red scales. The heat vapourizes the mercury, h in this state attracts oxygen from the air, and forms this red or xide. The long neck of the vessel prevents the escape of the vapours ewly-formed oxide.

he process is a very tedious one, occupying several weeks; so that er's remark was correct, that "it is a most difficult and laborious , even with the profoundness of clear-sighted industry." The appa- which Mr. Boyle contrived for the manufacture of it, was long ed "*Boyle's Hell*," from a notion that the mercury was tortured in it.

ROPERTIES.—When prepared by precipitation it is in the form of an ge-red powder; but when made by calcination, occurs in small bril- scales of a ruby red colour. Both varieties agree in the following erties:—They are odourless, have an acrid metallic taste, are inso- in water, but soluble in both nitric and hydrochloric acids. They lecomposed and reduced by heat and solar light: the precipitated ty is more readily acted on by solar light than the variety made by ination.

HARACTERISTICS.—When heated in a glass tube by a spi it lamp, it composed into oxygen and mercury: the first may be recognised by wing match, the second condenses in small globules. It dissolves pletely in hydrochloric acid: the solution contains bichloride of mer-, which may be known by the tests hereafter to be mentioned for this tance (*vide* HYDRARGYRI BICHLORIDUM).

OMPOSITION.—The composition of this substance is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Sefström.	Donovan.
Mercury	1	202	92·66	92·68	92·75
Oxygen	2	16	7·34	7·32	7·25
oxide of Mercury	1	218	100·00	100·00	100·00

inoxide of mercury prepared by precipitation usually contains some r.

JRITY.—Binoxide of mercury should be completely dissipated by , and be insoluble in water. Its solution in nitric acid should be un- ted by nitrate of silver, by which the absence of any chloride is n. If an insufficient quantity of potash be employed in the prepa- n of the precipitated variety, the product is brownish or brick-dust ured, and contains oxichloride of mercury (composed, according to erain, of 1 eq. bichloride of mercury and 3 eqs. of binoxide: ias, *Traité de Chimie*, iii. 615).

HYSIOLOGICAL EFFECTS.—Binoxide of mercury is a powerful irritant, when taken internally, even in small doses, readily excites vomiting purging; large doses would excite gastro-enteritis. Orfila (*Toxicol.*) found that binoxide, obtained by precipitation from four grains of loride, killed a dog in eighteen minutes. The constitutional effects is preparation are the same as those of mercurials generally.

SES.—Binoxide of mercury is rarely employed as a medicine. It been applied as an escharotic, either in the form of powder or oint- t. Internally it was formerly exhibited to excite salivation in venereal diseases, but is objectionable, especially where the bowels are morbidly irritable. It is rarely or never used now.

In pharmacy it is employed in the preparation of bicyanide of mercury (*vide* Hydrargyri Bicyanidum).

Administration.—The dose of it is from a quarter of a grain to a grain, given in the form of pill, in combination with opium.

Lotio Flava: Lotio (seu *aqua*) *phagedænica: yellow wash.*—This compound, which was formerly in frequent use, is prepared by adding bichloride of mercury to lime-water. The proportions vary in different formulæ. The quantity of bichloride should not, I think, exceed two grains to an ounce of lime-water: the usual proportions are thirty grains of bichloride to sixteen ounces of lime-water. The preparation, then consists of the yellow hydrated binoxide of mercury (which precipitates), chloride of calcium, and caustic lime; the two latter being in solution. But if the quantity of bichloride exceed $3\frac{7}{10}$ grains to an ounce of lime-water, the precipitate is brown or brick-dust coloured, and contains oxichloride of mercury, while the clear liquor holds in solution some hydrargyro-chloride of calcium; that is, a saline combination, in which chloride of calcium is the base, and bichloride of mercury the acid (Guibourt, *Journ. Chim. Méd.* iii. 377; also *Pharm. Raisonnée*, i. 563; and Souberain, *Nouv. Traité de Pharm.* ii. 529). Yellow or phagedenic wash is applied, by means of lint, to venereal and scrofulous ulcers. Dr. Hintze (*Brit. and For. Med. Rev.* April 1836) used it with advantage in chronic ulcers which succeed to burns. It should be well shaken, and used in the turbid state.

Hydrar'gyri-Ni'trico-Ox'ydum.—Ni'tric-ox'ide of Mercury.

History.—This preparation was known to Raymond Lully in the latter part of the thirteenth century. It is commonly termed *red precipitated mercury* (*mercurius præcipitatus ruber*), or, for brevity, *red precipitate*. It is the *oxidum hydrargyrum rubrum per acidum nitricum* of the Edinburgh Pharmacopœia.

Preparation. — In the London Pharmacopœia this compound is directed to be prepared by dissolving three pounds of mercury in a mixture of a pound and a half of nitric acid and two pints (℥xl.) of distilled water. The solution is to be evaporated to dryness, and the residue reduced to powder; which is to be put in a shallow vessel, and heated by a slow but gradually increased fire, until red vapours cease to arise.

This compound is best prepared on the large scale, for it cannot be so well procured of the bright orange-red colour and crystalline or scaly appearance usually considered desirable, when only small quantities of materials are employed. Some advise a larger quantity of nitric acid to be employed than is directed in the London Pharmacopœia. The reduction of the nitrate to powder is objectionable, as it diminishes the crystalline appearance of the oxide. Mr. Brande (*Manual of Chemistry*) says, "the nitrate requires to be constantly stirred during the process, which is usually performed in a cast-iron pot." But in general a shallow earthen dish is employed, with a second one inverted over it, and care is taken not to disturb the nitrate during the operation. The heat of the sand-bath is employed. Indeed, some have asserted that the finest duct is obtained when the calcination is performed in the same vessel which the nitrate was formed, and without stirring, as directed in the blin Pharmacopœia (Dr. Barker, *Observ. on the Dubl. Pharm.*)

When quicksilver and the diluted nitric acid are digested together, the tal is oxidized at the expense of part of the acid, while binoxide of ogen escapes, and, combining with oxygen of the air, becomes ous acid. The oxidized metal unites to some undecomposed acid to n a nitrate. If no heat be applied, a nitrate of the protoxide only procured; but when heat is employed, a portion of nitrate of the oxide is also produced. The following diagram will explain the nation of the protonitrate :—

REAGENTS.				RESULTS.
Nitric Acid 54	1 eq. Binox. of Nitrog.	30		1 eq. Binoxide Nitrog. 30
	3 eq. Oxygen	24	3 eq. *Oxide Merc.* 630	
Mercury		606		
Nitric Acid		162		3 eq. Protonitr. Mercy 792

When nitrate of mercury is heated, decomposition takes place: the ic acid is resolved into oxygen and nitrous acid, the first of which nbines with the protoxide of mercury, forming therewith the binoxide, le the nitrous acid escapes.

REAGENTS.				RESULTS.
Protonitrate ercury = 264	Nitric Acid 54	1 eq. Nitrous Acid	46	1 eq. Nitrous Acid...... 46
		1 eq. Oxygen	8	
	1 eq. Protoxide of Mercury....		210	1 eq. Binoxide Mercy. = 218

ome pernitrate of mercury usually remains undecomposed, but the ntity is small. Mr. Brande states that 100 pounds of mercury with lbs. of nitric acid (sp. gr. 1·48) yielded 112 pounds of nitric-oxide of cury. Hence 3 pounds of nitric acid must have remained in comation with the oxide.

ROPERTIES.—It occurs in bright tile-red or scarlet crystalline grains scales. When quite free from nitrate of mercury, it is insoluble in er; but owing to the presence of a small quantity of nitrate, the ic-oxide of mercury of commerce is usually slightly soluble in water. Barker (*op. cit.*) found that 1000 parts of water took up 0·62 of this le. The other properties and characteristics of this compound are same as those of the last-mentioned preparation (*vide* HYDRARGYRI OXYDUM)

URITY.—The presence of some undecomposed nitrate may be recognised heating the suspected nitric-oxide of mercury, when nitrous vapours are ved, and by boiling in water, when a solution is obtained, from which -water and hydrosulphuric acid throw down precipitates. The nitricle of mercury is completely dissipated by heat: hence the presence non-volatile matters (as red-lead) might be readily detected. Heated re the blow-pipe on charcoal, the mercurial oxide is reduced and ipated, but if red-lead be present, globules of metallic lead will be left nd.

HYSIOLOGICAL EFFECTS.—Its local action is that of a powerful irri- (*vide* HYDRARGYRI BINOXYDUM). When the nitric-oxide contains ate of mercury, its topical influence is rendered more energetic. Its stitutional effects are the same as those of other mercurials.

abricius Hildanus, Bartholinus, Langius, and Jacobs (quoted by mer, *Wirkung d. Arzneim.* iii. 69), have reported cases in which the rnal use of this agent gave rise to salivation and other constitutional effects of mercury. In the case mentioned by Jacob, death resulted from the application of it to a wart on the face.

Frederic Hoffmann, Ploucquet, Girtanner (Wibmer, *op. cit.*), and more recently Mr. Brett (*Lond. Med. Gaz.* xiii. 117), have related instances of poisoning by its internal employment.

Uses.—Internally it has been administered in the form of pill in venereal diseases, but the practice is highly objectionable.

As an external agent it is used in the form of powder (obtained by levigation) or ointment; the latter is officinal. As a caustic, it is sprinkled over spongy excrescences, venereal warts, chancres, indolent fungous ulcers, &c. Mixed with eight parts of finely-powdered white sugar, it is blown into the eye with a quill in opacity of the cornea (Mackenzie, *On Diseases of the Eye*, 2d ed. p. 584).

Unguentum Hydrargyri Nitrico-Oxydum, Ph. Lond. and Dub. (Finely-powdered nitric-oxide of mercury, ℥j.; white wax, ℥ij.; lard, ℥vj. Mix. The *unguentum oxidi hydrargyri rubri*, Ph. Ed. consists of nitric oxide of mercury, one part; lard, six parts. Mix.)—This ointment undergoes decomposition by keeping; its colour changing from red to grey, in consequence of the partial deoxidation of the nitric-oxide of mercury. Dr. Duncan (*Edinb. Dispens.*) says the presence of resin quickly causes it to become black. It is a valuable stimulant, and is frequently applied to indolent sores and ulcers, when we require to increase the quantity and improve the quality of the discharge; to inflamed eye-lids (*ophthalmia tarsi*); chronic conjunctivitis, &c.

Hydrar'gyri Chlo'ridum.—Chlo'ride of Mer'cury.

History.—Beguin in 1608, and Oswald Croll in 1609, are the first Europeans who mention this compound. Mr. Hatchett (Brande's *Manual of Pharmacy*, 2d edit. 328) says it had been long known to the natives of Thibet. Its discoverer is unknown. It has had a great variety of names. The term *calomel* (*calomelas*, from καλὸς, *good*, and μέλας, *black*) was first applied to it by Sir Theodore de Mayenne (who died in 1655), in consequence, as some say, of his having had a favourite black servant who prepared it; or according to others, because it was a *good* remedy for the *black* bile. *Drago mitigatus*, *aquila alba*, *manna metallorum*, and *panchymagogum minerale*, are some of the appellations for it. *Mercurius dulcis*, *hydrargyrum muriaticum mite*, *submuriate of mercury*, and *subchloride*, *protochloride*, or *dichloride of mercury*, are some of the more modern synonyms of it.

Natural History.—*Native calomel* or *corneous mercury* occurs in crusts, and also crystallized in four-sided prisms terminated by pyramids. It is found at Deux-Ponts, Carniola, and in Spain.

Preparation. (*a.*) *By sublimation.*—Chloride of mercury is prepared by sublimation from a mixture of sulphate of mercury and chloride of sodium.

In the London Pharmacopœia, two pounds of mercury are directed to be boiled with three pounds of sulphuric acid, to dryness, by which bipersulphate of mercury is obtained. When cold, this is mixed, first with two pounds of mercury, then with a pound and a half of chloride of sodium, and afterwards sublimed. The sublimate is to be washed with boiling distilled water, and dried.

In the first stage of this process one equivalent or 202 parts of mer-ry decompose two equivalents or 80 parts of dry sulphuric acid; and, stracting two equivalents or 16 parts of oxygen, to form one equivalent 218 parts of binoxide of mercury, disengage two equivalents or 64 rts of sulphurous acid. The binoxide combines with two equivalents 80 parts of undecomposed sulphuric acid, forming one equivalent or 8 parts of bipersulphate of mercury.

REAGENTS. RESULTS.

ı. dry Sulphc. Acid = 80 { 2 eq. Sulphur 32, 4 eq. Oxygen 32 } ——— 2 eq. Sulphurous Acid .. 64
{ 2 eq. Oxygen 16 }
ı. Mercury .... 202 } 1 eq. *Binox. Mercury* = 218 ——— 1 eq. Bipersulpc. Merc. = 298
ı. dry Sulphuric Acid ...... 80 ———

If one equivalent or 298 parts of bipersulphate, one equivalent or 202 rts of reguline mercury, and two equivalents or 120 parts of chloride sodium, be intimately mixed and sublimed, reaction takes place, and obtain two equivalents or 476 parts of chloride of mercury, and two uivalents or 144 parts of sulphate of soda.

REAGENTS. RESULTS.

. Chloride Sodm. 120 { 2 eq. Chlorine .... 72 ——— 2 eq. Chloride Merc. = 476
{ 2 eq. Sodium 48
. Mercury 202
. Bipersulphate of Mercury = 298 { 1 eq. Mercury 202
{ 2 eq. Oxygen .... 16 .... 2 eq. *Soda* 64 ———
{ 2 eq. Sulphuric Acid 80 ——— 2 eq. Sulphate Soda = 144

Mr. Phillips (*Translation of Pharmacopœia*, 1836) explains the process newhat differently. He assumes that the trituration of bipersulphate h mercury converts this salt into the protosulphate of mercury, and t this yields chloride of mercury by the action of chloride of sodium. t the mere trituration of bipersulphate of mercury with metallic mer-y cannot be admitted to be sufficient to convert this salt into proto-phate. It is not improbable that bichloride of mercury is first formed the mutual reaction of bipersulphate of mercury and chloride of lium; and that this subsequently combines with mercury, both being the state of vapour, to form calomel. For some bichloride is always nd mixed with the sublimed calomel, and calomel may be readily ained by subliming bichloride and mercury: as in the process of the inburgh Pharmacopœia.

At Apothecaries' Hall, 50 lbs. of mercury are boiled with 70 lbs. of phuric acid to dryness in a cast-iron vessel; 62 lbs. of the dry salt are urated with $40\frac{1}{2}$ lbs. of mercury, until the globules disappear, and 34 of common salt are then added. The mixture is submitted to heat earthen vessels, and from 95 to 100 lbs. of calomel are the result. It vashed in large quantities of distilled water, after having been ground fine and impalpable powder.

The subliming apparatus varies in different manufactories. In some onsists of a large earthen retort, with short but wide neck, opening an earthen elliptical receiver, in the bottom of which is water. retort is placed in sand, contained in an iron pot set in a furnace.

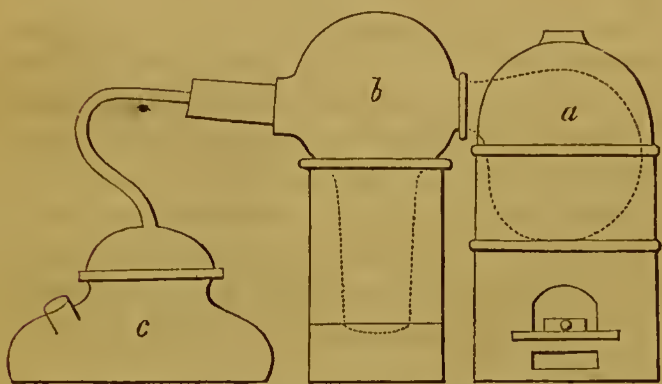
The form in which calomel sublimes," observes Mr. Brande, " de-ds much upon the dimensions and temperature of the subliming ves-. In small vessels it generally condenses in a crystalline cake, the rior surface of which is often covered with beautiful quadrangular matic crystals (Brooke, *Annals of Philosophy*), transparent, and of a texture somewhat elastic or horny: in this state it acquires, by the necessary rubbing into powder, a decidedly yellow or buff colour, more or less deep, according to the degree of trituration which it has undergone. If, on the contrary, the calomel be sublimed into a very capacious and cold receiver, it falls in a most impalpable and perfectly white powder, which only requires one elutriation to fit it for use; it then remains perfectly colourless. By a modification of the process, it may be suffered, as it sublimes, to fall into water, according to Mr. Jewell's patent.

"The above circumstances, too, account for the various appearances under which calomel occasionally presents itself in commerce: it may be added, that the buff aspect of this substance indicates the absence of corrosive sublimate; though it by no means follows as a consequence that when snow-white it contains it. When the surface of massive sublimed calomel is scratched, it always exhibits a buff colour: it also becomes yellow when heated, but loses its tint as it again cools." (*Manual of Chemistry*, 4th ed. p. 788).

Mr. Jewell's process (*Repert. of Arts*, xiii. 79, 2d Series) for preparing calomel consists in keeping the receiving vessel filled with steam, so that the vaporous calomel is condensed in it, and takes the form of a fine powder, which is much finer than can be obtained by levigation and elutriation. This process has been improved by M. O. Henry (fig. 66).

Henry's modification of Jewell's apparatus for preparing calomel by steam (Hydrosublimate of mercury).

FIG. 66.



(*a*) Furnace, containing an earthen retort (having a wide and short neck), in which the ingredients for making calomel are placed.

(*b*) An earthen receiver, having three tubulures: one connecting with the retort; a second dipping into water in an earthen jar, and a third connected to a steam-pipe.

(*c*) Steam-boiler.

(*b.*) *By precipitation.*—In the Dublin Pharmacopœia, a process is given for procuring precipitated calomel. It consists in mixing seven parts of chloride of sodium, dissolved in 400 parts of boiling water, with 17 parts of purified mercury, dissolved in 15 parts of diluted nitric acid. Double decomposition takes place: one equivalent or 60 parts of chloride of sodium decompose one equivalent or 264 parts of protonitrate of mercury, and produce one equivalent or 238 parts of chloride of mercury, and one equivalent or 86 parts of nitrate of soda.

PROPERTIES.—The primary form of the crystals of calomel is the right square prism. The appearance of the crystalline cake of sublimed calomel has been already noticed. As met with in the shops, it is in the form of a fine odourless or tasteless powder, whose sp. gr. is 7·176 (7·2 Brande). When prepared by Jewell's process it is perfectly white, but when obtained in the ordinary way has a light buff or ivory tint. It volatilizes by heat, and, under pressure, fuses. It is insoluble in cold water and alcohol. According to Donovan (*Ann. Phil.* xiv. 323

ıd others (Gmelin, *Handb. d. Chemie*, i. 1299; Geiger's *Handb. d. harm.* by Liebig, i. 561), calomel suffers partial decomposition by long ›iling in water, and a solution is obtained which contains mercury and ılorine (bichloride of mercury ?).

By exposure to light, calomel becomes dark coloured, in consequence, cording to Dumas (*Traité de Chimie*, iii. 605), of the transformation of small portion into mercury and bichloride. Others have ascribed this ıange to the evolution of chlorine and combination of the metal with ygen. Both hypotheses are inconsistent with the statement of Vogel andgrebe, *Ueber das Licht*, 97), that this blackened calomel is insoluble nitric acid. Is it not probable that the change depends on the formaɔn of a subchloride, as Wetzlar has shown to be the case with chloride silver? By digestion in hot and concentrated hydrochloric acid, we ›tain bichloride of mercury and reguline mercury. Boiling sulhpuric id forms bipersulphate and bichloride of mercury, with the evolution of lphurous acid.

CHARACTERISTICS.—Iodide of potassium produces at first a greyish, terwards a greenish-yellow precipitate (iodide of mercury). When ated in nitric acid, calomel is converted into bichloride and bipernitrate mercury; and on the application of the tests already mentioned for ercurial preparations generally, we readily obtain evidence of the prence of mercury. Having thus shown it to be a mercurial compound, e may easily prove it to be calomel by observing that it is insoluble in ater, and that on the addition of lime-water a blackish grey precipitte (protoxide of mercury) is obtained, while the supernatant liquor found, on the addition of the nitrate of silver, to give evidence of the esence of chlorine in solution. Protochloride of tin, added to calomel, ›stracts the chlorine, and becomes bichloride of tin, while globules of etallic mercury are obtained.

COMPOSITION.—The following is the composition of calomel:—

	Eq.	Eq.Wt.	Per Cent.	Turner, Davy, Zaboada.
Mercury	1	202	84·87	85
Chlorine	1	36	15·12	15
Chloride of Mercury	1	238	99·99	100

PURITY.—When pure, calomel is completely vaporized by heat. ater or alcohol which has been digested on it, should occasion no prepitate or change of colour on the addition of lime-water, caustic potash, ımonia, nitrate of silver, or hydrosulphuric acid, by which the absence bichloride of mercury may be inferred. I have met with calomel hich, in consequence of being imperfectly washed, contained bichloride. had been given to several patients before its purity was suspected, and ıd operated on them most violently. When mixed with potash it beme black, like pure calomel: the quantity of bichloride being infficient to produce any perceptible alteration in the colour of the precitate. But water which had been digested on it, gave, with the aboveentioned tests, the characteristic indications of bichloride of mercury.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—Wepfer (*Hist. Cicutæ quat.*), Viborg, Flormann (Wibmer, *Wirk. d. Arzn.*), Gaspard lagendie, *Journ. de Physiol.*), and Annesley (*Diseases of India*), have examined the effects of calomel on dogs, horses, and pigs, but without any remarkable results. Viborg gave half an ounce, with six pounds of water, to a horse: the effects were cough, heaving of the flanks, quick pulse, enfeebled appetite, and in twenty-four hours loose stools. Annesley asserts, from his experiments on dogs, that large doses of calomel diminish the vascularity of the gastro-intestinal membrane.

(*b.*) *On man.*—Calomel may be ranked among the mild preparations of mercury; for although, in its local action, it is somewhat more powerful than the oxide, or than those preparations which contain mercury in a finely divided state (as blue pill), yet it is much milder than any of the other salts of mercury. In *small doses*, as a few grains, it occasionally excites no obvious effects, though more commonly it acts as a purgative; and in very susceptible persons, especially females, it sometimes produces nausea, griping, and great faintness. It appears, from the experience of most practitioners, that adults are more susceptible of the influence of calomel than children. When given to the latter, it frequently produces green stools, (the so-called *calomel stools* of Kraus),—an effect which is more frequently observed in suckling infants, and which is usually supposed to arise from the action of calomel on the liver; though Zeller (quoted by Kraus) thinks it depends on alterations produced in the condition of the blood; and Kraus (*Heilmittellehre*, 161) is disposed to refer it to the operation of calomel on the milk contained in the alimentary canal. (*On the Effects of Calomel in producing Slimy Stools*, consult *Lond. Med. and Surg. Journ.* Apr. 1829, 344). Like other mercurials, it increases the action of the secreting organs, and thus promotes the secretion of bile and of intestinal mucus; and we also presume it has a similar influence over the secretion of the pancreatic fluid. Neumann (Gräfe and Walther's *Journal*, Bd. ii. H. 3. S. 432, quoted by G. A. Richter, *Ausführ. Arzneim.* v. 492) states, that a man took two, then three, and subsequently four grains of calomel, daily, for the space of two months, without inducing salivation; but that three months afterwards he became affected with chronic vomiting, the consequence of a scirrhous pancreas, of which he died in four months. From the manner in which the case is related, it is clear the narrator attributed the disease of the pancreas to the use of mercury; whether justly or not, however, is impossible to determine.

The repeated and continued use of calomel, in small doses, is attended with the constitutional effects of mercurial preparations generally, before described.

In *large doses*, it has been regarded as an irritant poison; and, judging from the fatal effects ascribed to it by several writers, not without reason. Thus Hellweg (Wibmer, *op. cit.* iii. 71) has reported a case in which a few grains of calomel, taken as a laxative, caused death; Vagnitius (Wibmer, *op. cit.*) saw fifteen grains prove fatal; and Ledelius (*ibid.*), half an ounce. Fr. Hoffmann has also related two fatal cases (*ibid.*)

"Whytt, Odier, Quin, Wilmer, Leib, and others," says Gölis (*Treatise on the Hydrocephalus Acutus*, by Dr. Gooch), "gave calomel internally in far larger doses; as two, three, and more grains at a time; and continued its use many days in the same dose, without considering the many evacuations from the alimentary canal, or the violent colic pains; and they affirm that they have never remarked, from the effect of this agent given in these large doses, any bad consequences in the abdomen.

Melancholy experience compels me to contradict them. Many times . saw, under those large and long-continued doses of calomel, the ıydrocephalic symptoms suddenly vanish, and inflammation of the ntestines arise, which terminated in death. Still oftener I observed his unfavourable accident from an incautious use of calomel in croup: iz. where all the frightful symptoms of this tracheal inflammation, vhich threatened suffocation, suddenly vanish, and enteritis develope tself, which passed rapidly into gangrene, and destroyed the patients."

In the *Times* newspaper of the 26th April, 1836, there is the report of . coroner's inquest on the body of a Mrs. Corbyn, who was destroyed by wallowing 20 grains of calomel, she having previously taken a moderate lose without its exciting what she considered a sufficient effect; and in he *India Journal of Medical Science* (*Lond. Med. Gaz.* xviii. 484) is a ase of a lad, aged 14, a native of Nepal, in whom six grains of calomel pparently produced inflammation and ulceration of the mouth, enormous swelling of the face, mercurial fœtor of the breath, mortification, nd death. There was no ptyalism.

In Pierer's *Annalen* for April 1827 (quoted by Wibmer, *op. cit.* 72), s the case of a lady, who by mistake swallowed fourteen drachms of alomel at once. Acute pains in the abdomen came on, accompanied by requent vomiting and purging. These symptoms were allayed by leaginous demulcents; but on the second day salivation and ulceration f the mouth took place. In three weeks, however, she was perfectly ecovered. Other violent effects are noticed by Wibmer, Gmelin, and thers; but the instances adduced are sufficient to show that dangerous and ven fatal effects may result from large doses, and therefore that Teichneyer, Buchner, and others, are justified in ranking it among poisons.

Of late years, however, immense quantities of calomel have been dministered medicinally, without giving rise to any symptoms of irritant oisoning,—nay, apparently with the opposite effect; for we have the oncurrent testimony of many practitioners, that in yellow fever, cholera, nd other dangerous diseases, calomel, in doses of a scruple and upwards, llays vomiting and purging; and on this account has been denominated *sedative.* So that while in small doses (as from two to five grains) alomel is almost universally admitted to be an irritant to the bowels, it asserted that larger ones are actually sedative. These statements ppear to me to be almost inconsistent, and yet they are fair deductions om the experience of numerous intelligent practitioners. We must, erefore, endeavour to accumulate more facts, in order to illustrate the ffects of calomel, and for the present confess we have very imperfect nformation respecting the nature of its action.

In a case published by Mr. Roberts in the *London Medical Gazette* xxii. 611), an ounce of calomel was swallowed by mistake, and retained n the stomach for two hours before the error was discovered. The only ffects were slight nausea and faintness. Subsequently, emetics, limevater, and purgatives, were administered; calomel was vomited up, nd the day but one afterwards the patient was quite well. Neither alivation nor the slightest affection of the gums occurred.

The largest quantity of calomel given as a medicinal agent, at one dose, , I believe, three drachms; "and it was followed," says Dr. Christison *Treatise on Poisons*), from whom I quote the case, which occurred in merica, "by only one copious evacuation, and that not till after the use of an injection." I have now before me reports of eighteen cases of spasmodic cholera, admitted in the year 1832 into the Cholera Hospital at Bethnal Green, in this metropolis, in which enormous quantities of calomel were employed by the house-surgeon, Mr. Charles Bennett (formerly one of my pupils), with very slight physiological effects. When a patient was brought into the hospital, two drachms of calomel were immediately given, and afterwards one drachm every one or two hours, until some effect was produced. In 17 out of 18 cases in which this plan was tried, the vomiting and purging diminished, and the patients recovered. Several of them took from 20 to 30 drachms without the subsequent ptyalism being at all excessive. In one case (a female aged 36 years), 30½ drachms were administered within forty-eight hours, moderate ptyalism took place, and recovery. In the unsuccessful case which I have alluded to, 53 drachms of calomel were administered within forty-two hours, without the least sensible effect.

Dr. Griffin (*Lond. Med. Gaz.* xviii. 880) also tells us, that in several cases of cholera he gave calomel hourly, "in scruple doses, to the amount of two or three drachms or upwards, without eventual salivation; and I recollect," he adds, "one instance in particular, in which I gave two drachms within an hour and a half with perfect success, and without affecting the system."

I do not pretend to reconcile these cases with those recorded by Hellweg, Vagnitius, Ledelius, Hoffman, and Gölis; in fact they appear to me irreconcilable. Dr. Christison, however, suggests that in those cases in which violent effects occurred, the calomel might contain corrosive sublimate.

Mr. Annesley (*Diseases of India*) accounts for the increased quantity of bile found in the stools after the use of calomel, by supposing that the gall-bladder sometimes becomes distended in consequence of the tenacity of the mucous secretion, by which the mouth of the *ductus communis choledochus* is closed; and that calomel acts chemically on the mucus, and detaches it. But the hypothesis is, I think, devoid of foundation.

Uses.—Calomel is very frequently used as an *alterative*, in glandular affections, chronic skin diseases, and disordered conditions of the digestive organs, more particularly in those cases connected with hepatic derangement. For this purpose it is usually taken in combination with other alteratives, as in the well-known Plummer's pill, which I shall presently notice.

It is very frequently employed as a *purgative*, though, on account of the uncertainty of its cathartic effects, it is seldom given alone; generally in combination with other drastic purgatives—such as jalap, scammony, compound extract of colocynth, &c. whose activity it very much promotes. We employ it for this purpose when we are desirous of making a powerful impression on the alimentary canal, and thereby of relieving affections of other organs, on the principle of counter-irritation, before explained. Thus in threatened apoplexy, in mental disorders (Finch, *Lond. Med. Gaz.* iii. 692), in dropsical affections, and in chronic diseases of the skin. In torpid conditions of the bowels, where it is necessary to use powerful cathartics to produce alvine evacuations, as in paralytic affections, it is advantageously combined with other purgatives. Sometimes we use it to promote the biliary secretion—as in jaundice and other affections of the liver, in chronic skin diseases, and in various disordered nditions of the alimentary canal not accompanied by inflammation. oreover, in the various diseases of children requiring the use of purga- es, it is generally considered to be very useful; and its being devoid of ste is of course an advantage.

As a *sedative* it has been administered in yellow fever, spasmodic or alignant cholera, dysentery, and liver affections (vide p. 469). Dr. riffin (*Lond. Med. Gaz.* xxi. 880) asserts that calomel was a most suc- ssful medicine in cholera, controlling or arresting its progress, in 84 ses out of 100, if administered while the pulse was perceptible at the rist; but, on the contrary, detrimental when given in collapse. The actice was tested in 1448 cases. The dose was from one to two ruples every hour or half-hour.

As a *sialogogue*, it may be used in the cases in which I have already entioned (p. 448) that mercurials generally are employed: with the view preventing irritation of the alimentary canal, it is usually given in mbination with opium, unless, indeed, the existence of some affection the nervous system seem to contraindicate the use of narcotics. This mbination is employed in peripneumonia, pleuritis, croup, laryngitis, epatitis, enteritis, and other inflammatory diseases; in fever, syphilis, ronic visceral diseases, &c.

Calomel is frequently combined with other medicines, to increase their fects; as with squills, to produce *diuresis*, in dropsy; or with antimo- als, to promote *diaphoresis*.

As an *anthelmintic* it is in frequent use, and forms one of the active gredients of many of the nostrums sold for worms; though it does not opear to have any specific influence over parasitic animals.

The *local uses* of calomel are numerous. In diseases of the Schneide- an membrane, it is applied as a snuff. It is sometimes blown into the e, to remove spots on the cornea. Dr. Fricke (*Lond. Med. Gaz.* xxii. 97) has used it with great success in chronic cases of rheumatic, tarrhal, and scrofulous ophthalmia; but in two instances bad con- quences resulted from its use. It is sometimes suspended in thick ucilage, and used as a gargle in venereal sore-throat, or injected into e urethra in blenorrhœa. Now and then it is used as a substitute for nnabar in fumigation. As a local application, in the form of ointment, lomel is one of the most useful remedies we possess for the cure of me forms of skin diseases, as will be presently noticed.

Administration.—When used as an *alterative*, it is given in doses of om half a grain to a grain, frequently combined with oxysulphuret of timony (as in *Pil. Hydr. Chlor. Co.*) or antimonial powder, and repeated ery or every other night; a mild saline laxative being given the fol- wing morning; as a *purgative*, from two to five grains, usually in combi- ation with, or followed by, the use of other purgatives, especially jalap, nna, scammony, or colocynth; as a *sialogogue*, in doses of one to three or ur grains, generally combined with opium or Dover's powder, twice or rice a day; and, as a *sedative*, from a scruple to half a drachm, or even ore than this, as already mentioned. Biett (*Lond. Med. Gaz.* viii. 540) s sometimes employed it as an *errhine*, in syphilitic eruptions. It is ixed with some inert powder, and given to the extent of from 8 to 20 ains daily. The use of acids with calomel frequently occasions griping. alomel is most extensively employed in the diseases of children, d may be given to them in as large or larger doses proportionally as to adults. Salivation is a rare occurrence in them: indeed, Mr. Colles (*Pract. Observ.* p. 281) asserts, that mercury *never* produces ptyalism, or swelling or ulceration of the gums, in infants.

Pilulæ Hydrargyri Chloridi Compositæ, Ph. Lond.; *Pilulæ Calomelanos Compositæ*, Ph. Dubl.; *Pilulæ Sub-muriatis Hydrargyri Compositæ*, Ph. Edinb.; *Plummer's Pills*, or *Pilulæ Plummeri* (chloride of mercury; oxysulphuret of antimony, āā ʒij.; guaicum resin, powdered, ℥ss.; treacle, ʒij. M. The Edinburgh College uses mucilage of gum arabic instead of treacle).—These pills are frequently employed as alteratives in chronic skin diseases, in the papular and pustular forms of the venereal disease, in chronic liver affections, and in various disordered conditions of the digestive organs. The dose is from five to ten grains.

Pilulæ Catharticæ Compositæ, Ph. U. S. (Compound extract of colocynth, ℥ss.; extract of jalap, in powder; calomel, āā ʒiij.; gamboge, in powder, ℈ij. M. Divide into 180 pills). This pill is intended to combine smallness of bulk with efficiency and comparative mildness of purgative action, and a peculiar tendency to the biliary organs (*United States Dispensatory*). Each pill contains one grain of calomel. Three pills are a full dose.

Unguentum Hydrargyri Chloridi (calomel, ʒj.: lard, ℥j. M.) This is a most valuable application in porrigo favosa, impetigo, herpes, and the scaly diseases (psoriasis and lepra). Indeed, if I were required to name a local agent pre-eminently useful in skin diseases generally, I should fix on this. It is well deserving a place in the Pharmacopœia.

Hydrar'gyri Bichlo'ridum.—Bichlo'ride of Mer'cury.

History.—We have no account of the discovery of this preparation. Geber (*Inv. of Ver.* viii. 252) described the method of preparing it; but it is supposed to have been known long anterior to him. Like calomel, it has had various synonymes, of which the principal are the following: *chloride*, *hydrochlorate* or *muriate of mercury* (*hydrargyri chloridum*, *hydrochloras* seu *murias*), *corrosive sublimate* (*mercurius sublimatus corrosivus*), *corrosive muriate of mercury* (*hydrargyri murias corrosivus*), and *acidum chloro-hydrargyricum*).

Preparation.—Mercury and sulphuric acid are boiled together, as in the process for making calomel; and the bipersulphate of mercury is sublimed with chloride of sodium, without the addition of metallic mercury. The sublimation is usually effected in an earthen alembic, placed in sand.

The nature of the changes which occur in the manufacture of bipersulphate of mercury have been already explained (p. 465). When this salt is sublimed with chloride of sodium, double decomposition takes place, and we obtain bichloride of mercury and sulphate of soda.

REAGENTS.				RESULTS.
2 eq. Chloride Sodm. 120	2 eq. Chlorine	72		1 eq. Bichlde. Merc. 274
	2 eq. Sodium	48	2eq. *Soda* 64	
1 eq. Bipersulphate Mercury 298	2 eq. Oxygen	16		
	1 eq. Mercury	202		
	2 eq. Sulphurc. Acid	80		2 eq. Sulphate Soda 144

Properties.—As usually met with in commerce, bichloride of mercury is a semi-transparent crystalline mass, in which perfect crystals are rarely found. Occasionally, however, they are obtained either by slow limation, or from a solution of the salt. Their primary form is the it rhombic prism. The sp. gr. of this salt is about 5·2 (5·14 to 5·42, big). The taste is acrid, coppery, and persistent. When heated it s, boils, and volatilizes: the vapour is very acrid. It is soluble in ut three times its weight of boiling, and in about eighteen or twenty es its weight of cold water: the acids (especially hydrochloric) and alkaline chlorides increase its solubility. It is soluble in seven parts old or three and a half parts of boiling alcohol. Ether dissolves it c readily than alcohol, and will even separate it from its watery solu- ; and hence is sometimes employed to remove it from organic tures.

n aqueous solution of bichloride of mercury readily undergoes de- position, especially when exposed to solar light; calomel is precipi- d, and hydrochloric acid set free. This change is facilitated by the ence of organic substances,—as gum, extractive, or oil; whereas it hecked by the presence of alkaline chlorides.

lbumen forms a white precipitate with an aqueous solution of bichlo- of mercury. This precipitate is slightly soluble in water, and con- , according to Lassaigne (*Journ. de Chim. Méd.* iii. 2d series, 161), lbumen, 93·45, and bichloride of mercury, 6·55; so that it is a *argyro-chloride of albumen.* Fibrin forms a similar white compound corrosive sublimate. When albuminous and fibrinous textures immersed in a solution of this salt, combination takes place, tissue contracts, increases in density, becomes whiter, and does not efy. Hence it is employed by the anatomist for hardening and pre- ing certain parts of the body—as the brain.

ichloride of mercury possesses some of the characters of an acid. s it reddens litmus, and unites with the chlor-bases (as chloride of um), which in consequence restore the blue tint of litmus, which had reddened by the mercurial bichloride. The salts which result the combination of the two chlorides are called *hydrargyro- rides.*

HARACTERISTICS.—Bichloride of mercury is known to be a mercurial pound by the following characters:—

Heated in a tube by a spirit lamp, with caustic potash, an alkaline ride is formed, oxygen gas is evolved, and metallic mercury is su- ed and condensed in the form of globules on the sides of the tubes.

Lime-water causes a lemon-yellow precipitate; an additional quan- of the precipitant water produces a brick-dust red precipitate, while a er quantity restores the yellow colour. The yellow-coloured preci- e is the hydrated binoxide; the reddish-coloured precipitate is the hloride.

Caustic ammonia, added to a solution of bichloride, causes hydro- ate of ammonia to be formed in solution, while a white powder *argyri ammonio-chloridum*) is thrown down.

The *alkaline carbonates* throw down a brickdust-coloured precipi- the bicarbonates a white one.

Iodide of potassium occasions a scarlet precipitate of the biniodide ercury; but the precipitate frequently appears at first of a yellow r, though it quickly becomes scarlet. Dumas (*Traité de Chimie,* iii. thinks these yellow and red states of the biniodide depend on some ric phenomena requiring farther examination. If an excess of iodide of potassium be employed, the red precipitate disappears, owing to the formation of a soluble double salt, in which the biniodide of mercury acts the part of an acid, and the iodide of potassium that of a base. This double salt may be called the *hydrargyro-iodide of potassium.* Bichloride of mercury and the biniodide of mercury also form a double salt: hence, if a great excess of the former salt be employed, the red precipitate disappears, owing to the formation of a soluble double salt.

6. *Protochloride of tin* occasions, with bichloride of mercury, a white precipitate of calomel, while perchloride of tin remains in solution. Very shortly this protochloride of mercury is converted into reguline mercury, which falls down in a finely divided state as a greyish powder.

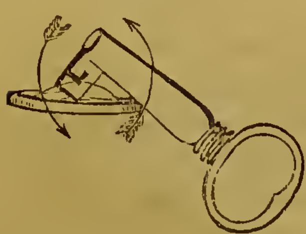
7. *Hydrosulphuric acid* in excess, passed through a solution of bichloride of mercury, occasions a black precipitate of the bisulphuret of mercury: a solution of hydrochloric acid is formed. If the hydrosulphuric acid be not in excess, a white precipitate of the *chloro-sulphuret of mercury* is obtained, and which consists of two atoms bisulphuret of mercury and one of the bichloride.

8. *Ferrocyanide of potassium* causes a white precipitate (ferrocyanide of mercury).

9. *Albumen* is another test for corrosive sublimate, though not one of much value, since it will produce the same white precipitates with many other substances.

10. *Galvanism.*—Drop the suspected solution on a piece of gold, as a sovereign, and apply a key, so that it may touch, simultaneously, the gold and the solution; an electric current is immediately produced, the bichloride is decomposed, the mercury attaches itself to the negative electrode (or pole), namely the gold, while the chlorine unites with the iron of the positive electrode (or pole) to form chloride of iron. The relative position of the gold, the key, and the solution, will be evident from the fig. 67; and the arrows point out the direction of the electric current. The silver stain left on the gold is readily removed by heat. In Dr. Christison's work will be found other methods of applying galvanism; but the one just mentioned is perhaps the most useful, since it can always be readily made use of; whereas a more complicated apparatus is found in the hands of a few persons only. Thus it might be applied at a moment's notice to detect corrosive sublimate in the matters vomited by a patient.

Fig. 67.



The relative delicacy of some of these tests is thus stated by Devergie (*Méd. Lég.* ii. 676):—

		Degree of Dilution.
Ferrocyanide of potassium	stops at . .	1,500
Lime water	,, . .	4,000
Potash or its carbonate	,, . .	7,000
Iodide of potassium	,, . .	8,000
Ammonia	,, . .	36,000
Hydrosulphuric acid, or hydrosulphate of ammonia	,, . .	60,000
Protochloride of tin, or galvanic pile	,, . .	80,000

The preceding tests have not determined the nature of corrosive sublimate, further than that it is a permercurial salt. To prove that it is a chloride, the simplest method of proceeding is to add to the suspected tion, lime-water, or carbonate of soda; then filter, and test the clear id with *nitrate of silver*, which causes a white precipitate if any ride be present (*vide* p. 105). If nitrate of silver be added to a tion of bichloride of mercury, we obtain a white precipitate of chlo- of silver, but mixed with calomel; and it is to avoid the production he latter substance that I prefer the method of testing just men- ed.

OMPOSITION.—The composition of this salt is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Turner.
Mercury	1	202	73·72	73·53
Chlorine	2	72	26·27	26·47
Bichloride of Mercury	1	274	99·99	100·00

URITY.—Pure bichloride should be white, dry, totally vapourized by , and completely soluble in water, alcohol, or ether.

HYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—The effects of solu- s of bichloride of mercury on plants have been examined by Seguin, subsequently by Marcet and Macaire (Decandolle, *Phys. Vég.* 1332), from their experiments it appears, that when growing plants are ersed in a solution of this salt, part of the poison is absorbed, a nge of colour takes place in the leaves and stems, and death is pro- ed; the effect on the irritable stamina of the *Berberis vulgaris*, and he leaves of the *Mimosa pudica*, being the same as that produced by nic (p. 384). Bichloride of mercury is equally poisonous to crypto- ic plants. Hence vegetable tissues soaked in a solution of it are no er adapted for the development of the *Merulius lachrymans*, and of r fungi known under the name of the *dry-rot*. This, in fact, is the ciple adopted by Mr. Kyan (*Lond. Med. Gaz.* xvi. 630) for the pre- ation of timber, and which is now practised by the *Anti Dry-rot pany*.—(*Vide* Dr. Dickson's *Lecture on Dry-rot*, 1837.)

.) *On animals generally.*—The effects of corrosive sublimate on ani- s have been examined by Ettmuller, Wepfer, Sprœgel, Sir Benjamin die (*Phil. Trans.* for 1812), Campbell, Lavort, Smith, Gaspard, Orfila *icol. Gén.*), Schubarth, and Bostock. An abstract of these will be d in the works of Wibmer (*Wirk. d. Arzn. u. Gifte*), and Christison *eat. on Poisons*). Dogs, cats, horses, rabbits, and frogs, are the ani- s on which the experiments have been tried, and on which sublimate been found to exercise a poisonous operation, and the same kind of ct is presumed, from analogy, to be produced on all other animals. results of these experiments have been so briefly yet clearly stated Dr. Christison, that I cannot do better than quote his words:—"Cor- ve sublimate causes, when swallowed, corrosion of the stomach; and hatever way it obtains entrance into the body, irritation of that organ of the rectum, inflammation of the lungs, depressed action, and per- s also inflammation of the heart, oppression of the functions of the n, and inflammation of the salivary glands." I may add, that mer- al fœtor and salivation have been observed in horses, dogs, and its.

.) *On man.*—*α. In small or therapeutic doses*, as from one-eighth to one- th of a grain, it frequently exerts a beneficial effect on diseases (syphi- eruptions, for example), without producing any obvious alteration in actions of the different organs. Occasionally, especially when the stomach and bowels are in an irritable condition, it gives rise to a sensation of warmth in the epigastrium, and causes nausea, griping, and purging. In such cases it is best to diminish the dose, and conjoin opium. By repetition we frequently observe that the pulse becomes somewhat excited and if the skin be kept warm, perspiration is oftentimes brought on; at other times the quantity of urine is increased. Continued use of it causes salivation: but it is said, that corrosive sublimate has less tendency to occasion this effect than other preparations of mercury. Maximilian Locher (Van Swieten's *Commentaries upon Boerhaave's Aphorisms*, xvii. 294), who, from the year 1754 to 1762, cured 4,880 patients affected with the venereal disease, at St. Mark's Hospital, Vienna, by the exhibition of this remedy, says, that no person died, or experienced the least painful or dangerous symptoms, in consequence of its use. He was, however, exceedingly cautious and careful in its employment, and always stopped using it on the first appearance of salivation. Van Swieten says, "I am convinced, from repeated experience, that the menstrual evacuation is not disturbed by the use of this remedy."

β. Chronic poisoning.—In somewhat larger doses, or by the long continued use of the before-mentioned small doses, gastro-enteritis and all the usual constitutional effects of mercury are brought on. Thus heat and griping pain in the alimentary canal (particularly in the stomach and rectum), loss of appetite, nausea, vomiting, purging, and disordered digestion, are the gastro-enteritic symptoms. The pulmonary organs also not unfrequently become affected; the patient complains of dry cough, pain in the chest, disordered respiration, and bloody expectoration. Coupling these symptoms with the specific effects said to be produced on the lungs of animals by the use of corrosive sublimate, we have an important caution not to administer it to patients affected with pulmonary disorders,—a caution, indeed, which Van Swieten gives; "for those," says he, "who have a husky dry breast, are troubled with a cough, whose nervous system is excessively irritable, and are subject to hæmorrhage, bear not this remedy without detriment."

γ. Acute poisoning.—In *very large doses* corrosive sublimate acts as a caustic poison, in virtue of its affinity for albumen, fibrin, and other constituents of the tissues. I shall follow Dr. Christison, and admit two varieties of poisoning by it; in one of which "the sole or leading symptoms are those of violent irritation of the alimentary canal. In another variety the symptoms are at first the same as in the former, but subsequently become conjoined with salivation and inflammation of the mouth, or some of the other disorders incident to mercurial erethysm, as it is called."

First variety: Gastro-enteritis.—In this variety the symptoms are analogous to those of other corrosive poisons: namely, violent burning pain in the mouth, throat, œsophagus, and stomach; difficulty of deglutition; sense of suffocation; nausea; violent vomiting (increased by every thing taken into the stomach) of mucous, bilious, or sanguineous matters. The pain soon extends from the stomach over the whole abdomen, which becomes acutely sensible to the slightest impression; violent purging, often of blood; inexpressible anxiety; flushed countenance; restlessness; pulse quick, small, and contracted; cold sweats; burning thirst; short and laborious respiration; urine frequently suppressed; and, lastly, various indications of a disordered condition of the nervous em, such as a tendency to stupor, or even actual coma; convulsive ements of the muscles of the face and extremities; sometimes inished sensibility of one of the limbs, or of the whole body; or n paraplegia. Occasionally death appears to result from the power- effect produced on the nervous system, or from exhaustion, or from tification of the bowels.

r. Christison points out the following characters as serving to dis- uish poisoning by bichloride of mercury from that by arsenious l:—

The symptoms begin much sooner.
The taste is much more unequivocal and strong.
The acridity and irritation in the gullet is much greater.
The countenance is flushed, and even swollen; whereas, in poisoning by arsenic, usually contracted and ghastly.
Blood is more frequently discharged by vomiting and purging.
Irritation of the urinary passages is more frequent.
Nervous affections are more apt to come on during the first inflammatory stage.
The effects are more curable than those of arsenic.
Deviations in the symptoms are more rare.

econd variety: Gastro-enteritis, accompanied with or followed by curial erethysm.—I here use the term erethysm in the sense in which employed by Dr. Chistison—namely, to indicate all the secondary cts of mercury. In this variety, the symptoms first observed are e mentioned for the last variety, but they are followed, sooner or r, by those of inflammation of the salivary glands, and of the mouth its neighbouring parts; profuse salivation, ulceration of the mouth, t fœtor of breath, and other symptoms of this kind, already de- bed, (p. 444.)

SES.—*Internally,* it has been employed as a sialogogue, alterative, diaphoretic.

he celebrated Baron Van Swieten (*op. cit.*) may be regarded as the cipal introducer of corrosive sublimate into practice as a remedy for *real diseases.* He seems to have been led to its employment from a icion that salivation was not requisite for curing this class of diseases; hence he was desirous of obtaining some mercurial "that could be ted at will, and so tried in a very small dose." Now corrosive sub- tc possessed these properties, and hence he commenced his experi- ts with it, and, meeting with great success, recommended it to rimillian Locher, whose results I have already stated. (For further orical details respecting its use, *vide* Pearson's *Observations on the cts of various Articles of the Mat. Med.* p. 99, et seq.) The nce of evidence is decidedly favourable to the employment of this icine as an internal remedy for venereal diseases. By its partizans it been asserted to be a safe and efficacious mercurial, to remove real symptoms in a very short space of time, and without causing ation, merely by exciting diaphoresis. Its opponents (*vide* Pearson, *it.*) state, on the other hand, that other mercurials are quite as effec- and speedy; that the cure by corrosive sublimate is not permanent; lastly, that its corrosive and irritant properties render its employment ctionable. One of the latest advocates for its use is Dzondi, of Halle *ie zuverläss. Heilart. d. Lusts. in allen ihren Formen,* &c. 1826, in in Richter, *Ausf. Arzn.* v. 596), who states, the best mode of using bichloride of mercury is in the form of pills made with crumb of bread and he gives the following formula for their preparation :—℞ Hydr. Sublim. Corros. gr. xij., solve in Aq. Distill. q. s., adde Micæ Panis Albi, Sacchar. Albi, aa. q. s. ut ft. pilulæ numero CCXL. Of these pills (each of which contains one-twentieth of a grain of corrosive sublimate), four are to be administered daily, and increased until thirty (containing one grain and a half) are taken at a dose. The best time of exhibiting them is after dinner. In irritable subjects and painful affections, a few drops of the tincture of opium may be taken with each dose. During the time the patient is under their influence, he should adopt a sudorific regimen (as is also recommended by Van Swieten), and take decoction of sarsaparilla.

In *acute diseases* few have ventured to employ bichloride of mercury; however, Schwartz gave it in hepatitis after the fever and pain had subsided; Sauter employed it in an epidemic scarlet fever; and Berends administered it in asthenic malignant fevers (Richter, *Ausführ Arzneim.* v. 581). I have already noticed (p. 446) Mr. Lempriere's proposal to use it in fever, as a sialogogue.

In various *chronic diseases* it has been given as an *alterative* and *diaphoretic*, with occasional success. Thus in rheumatism, diseases of the bones, periodical pains, skin diseases, scrofulous affections, disorders of the nervous system, &c. In such it should be associated with diaphoretics (as antimony, sarsaparilla, &c.), warm clothing, &c. Not unfrequently opiates should be combined with it.

As an *external* remedy it has been applied as a *caustic* in substance (either alone or combined with arsenic) to cancerous ulcers, to parts bitten by rabid animals, to chancres, &c.: used in this way, however, it is mostly objectionable. In onychia maligna it is used with great advantage, mixed with an equal weight of sulphate of zinc, and sprinkled thickly upon the surface of the ulcer, which is then to be covered with a pledget of lint saturated with tincture of myrrh (*United States Dispensatory*). A *solution* has been employed for various purposes: thus by Baumé, as already mentioned (p. 448), for pediluvia, to produce salivation; as a lotion in chronic skin disease (as lepra, psoriasis, scabies, rosacea, &c.); as a wash to ulcers, particularly those of a venereal nature; as an injection in discharges from the urinary organs; as a collyrium in chronic diseases of the eye, especially those of a venereal nature; and as a gargle in ulcers of the tonsils. A solution is sometimes used as a preventive for the venereal disease.

Administration.—It may be used internally, in substance or solution. The dose of it in substance is from one-sixteenth to one-eighth of a grain. Some advise it to be given to the extent of one-fourth of a grain; but in this dose it is very apt to gripe and purge. Dzondi's formula, already given, may be employed when we wish to administer it in substance.

In solution it may be exhibited dissolved in water (vide *liquor hydrargyri bichloridi*), alcohol, or ether.

For *external use*, a watery solution may be employed, containing from half a grain to two or three grains, dissolved in one ounce of water.

Liquor Hydrargyri Bichloridi, Ph. L. (Bichloride of mercury; hydrochlorate of ammonia, āā gr. x; distilled water, ℥xx. Dissolve).—Hydrochlorate of ammonia is used to increase the solvent pow the water. Each fluidounce contains half a grain of corrosive sub-iate. The dose of this solution is from half a fluidrachm to two or ee fluidrachms, taken in some bland liquid, as linseed tea.

Antidotes.—Several substances which decompose corrosive subli-te have been employed as antidotes. These are, *albumen*, *gluten of eat* (as contained in wheaten flour), *milk*, *iron filings*, *and meconic d.*

[have already alluded to the decomposition of corrosive sublimate by *umen.* The compound which results from their mutual action appears be inert, or nearly so. In Dr. Christison's *Treatise on Poisons* will be nd several cases noticed, in which albumen has been most effectual: of the most interesting of which is that of Baron Thenard, the cele-ted chemist, who inadvertently swallowed a concentrated solution of rosive sublimate, but by the immediate use of whites of eggs suffered material harm. Peschier states, that one egg is required for every r grains of the poison. *Gluten of wheat* has been recommended by ddei, and may be employed when albumen is not procurable. Wheaten ir (which contains gluten) will probably answer as well as the pure gluten. *lk,* in the absence of albumen or flour, may be used. *Iron filings* are ted to be useful, by reducing the corrosive sublimate to the metallic state. *conic acid* is also said to be an antidote, by forming an insoluble conate of mercury. But a knowledge of the fact is of little practical ue, since the acid is not generally procurable; and tincture of opium, ich contains it, cannot be safely used in sufficient quantity; for Dr. ristison finds that five grains of corrosive sublimate require an infu-n of 33 grains of opium to precipitate the whole of the mercury.

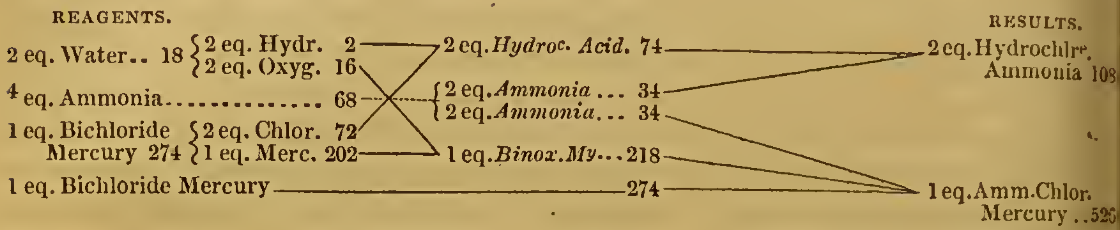
The other parts of the treatment for acute poisoning by corrosive sub-iate are the same as for other irritant poisons, and consist of the usual iphlogistic system—the warm baths, opiates, &c.

ydrar'gyri Ammo'nio-Chlo'ridum.—Ammo'nio-Chlo'ride of Mer'cury.

History.—This compound was discovered by Raymond Lully, in the teenth century. Lemery pointed out two modes of procuring it, and ice it is sometimes termed *Lemery's white precipitate*, to distinguish it n precipitated calomel, also called on the Continent white precipitate. has had various other appellations, as *cosmetic mercury* (*mercurius meticus*), *white precipitated mercury* (*hydrargyrum præcipitatum um*); and, according to the view taken of its composition, it has been led *muriate of ammonia and mercury*,—*ammoniated submuriate of rcury* (*hydrargyri submurias ammoniatum*, Ph. Dub.), *ammoniated rcury*, (Ph. U. S.), *ammonio-chloride of mercury* (*hgdrargyri ammonio-oridum*, Ph. Lond.), *ammoniacal oxychloruret of mercury* (Guibourt).

Preparation.—It is directed, in the London Phamacopœia, to be cured by adding eight fluidounces of solution of ammonia to six ices of chloride of mercury previously dissolved, by the aid of heat, six parts of distilled water, and allowed to cool. The precipitated vder is to be washed until void of taste, and then dried.

The explanation of the changes which occur in this process varies according to the view taken of the constitution of the resulting compound. Sal ammoniac (hydrochlorate of ammonia), but no mercury, is certainly left in solution, so that the precipitate cannot contain so much chlorine as bichloride of mercury. It is probable, therefore, that the mercury from which the chlorine has been removed becomes oxidized by the water, though, according to Dr. Kane (*Trans. Royal Irish Acad.* xvii. 423,) this does not take place. The binoxide of mercury, with some mercurial bichloride, and ammonia, precipitate in combination. The following diagram explains the changes according to this view:—



If we suppose two equivalents or 18 parts of water to be given out by one equivalent or 526 parts of ammonio-chloride of mercury, the residue will have the precise elementary composition assigned by Dr. Kane to white precipitated mercury.

Properties.—It occurs in commerce in masses or in powder. It is white, inodorous, has a taste at first earthy, afterwards metallic. It is decomposed and dissipated by heat, giving out ammonia, nitrogen, calomel, and water. It is insoluble in alcohol. By boiling in water we obtain a solution of hydrochlorate of ammonia, and a yellow powder (white precipitated mercury and binoxide of mercury.—*Kane.*) It is soluble in sulphuric, nitric, or hydrochloric acid.

Characteristics.—When heated with caustic potash, it gives out ammonia, and forms a yellow powder (white precipitated mercury and binoxide of mercury,—*Kane*). The solution contains chloride of potassium, and with nitrate of silver causes a white precipitate (chloride of silver), insoluble in nitric acid, but soluble in ammonia. Protochloride of tin decomposes white precipitated mercury, and separates metallic mercury. To these characters must be added the effect of heat, water, and acids, on it, as above mentioned.

Composition. — The analyses of Mr. Hennell (*Quart. Journ. of Science*, xviii. 297) and Mitscherlich (*Ann. Chim.* xxxv. 428), agree in showing the constituents of white precipitate to be those of binoxide of mercury and hydrochlorate of ammonia, in the following proportions:—

	Eq.	Eq. Wt.	Per Cent.	Hennell.	Mitscherlich.
Binoxide of Mercury	1	218	80·14	80	82·2
Hydrochloric Acid	1	37	13·60	20	10·7
Ammonia	1	17	6·25		7·1
White Precipitate	1	272	99·99	100	100·0

This composition is adopted by Berzelius. But in explaining the theory of the formation of white precipitate, I have assumed, with Mr. Phillips (*Transl. of the Lond. Pharm.*), a somewhat different view of the subject. Two equivalents of white precipitate, according to Mr.

nnell, minus two equivalents of water, are equal to one equivalent of same compound, according to Mr. Phillips.

	Eq.	Eq.Wt.	Per Cent.
Bichloride of Mercury	1	274	52·09
Binoxide of Mercury	1	218	41·44
Ammonia	2	34	6·46
White Precipitate (Phillips)	1	526	99·99

If two more equivalents of water be abstracted, we have the compoon of white precipitate, according to Dr. Kane.

	Eq.	Eq.Wt.	Per Cent.
Bichloride of Mercury	1	274	53·93
~~Binoxide~~ of Mercury	1	234	46·06
White Precipitate (Kane)	1	508	99·99

PURITY.—This compound is largely adulterated with sulphate of ie. I have one sample containing one-third of its weight of this ostance. Carbonate of lime and of lead are sometimes employed to ulterate white precipitate. Pure white precipitate, thrown on a red-hot ovel, is dissipitated without any residuum: whereas the above imrities remain. The carbonates are recognised by the effervescence on addition of hydrochloric acid. Sulphate of lime may be detected by ling the suspected substance in distilled water, and applying the tests sulphates and calcareous salts, as before directed (pp. 265 and 343).

PHYSIOLOGICAL EFFECTS.—Its action on the body is very imperfectly own, no modern experiments having been made with it. It is usually nsidered to be highly poisonous, and somewhat similar in its operation bichloride of mercury. Palmarius and Naboth (Wibmer, *Wirk. d. zn.* iii. 64) have reported fatal cases of its use (*vide* also Gmelin, *App. dicam.* ii. 166).

USES.—It is employed as an external agent only; commonly in the n of an ointment. It is an efficacious application in various skin dises—as porrigo, impetigo, herpes, and even scabies; also in ophlmia tarsi. Among the lower classes it is commonly used to destroy liculi.

UNGUENTUM HYDRARGYRI AMMONIO-CHLORIDI, Ph. Lond., Dubl. l U. S. (ammonio-chloride of mercury, ʒj.; lard, ℥iss. M.)—It is a nulant, alterative, and detergent.

Hydrar'gyri Io'didum.—I'odide of Mercury.

PREPARATION.—This compound, sometimes called *protiodide of mery*, is directed, in the London Pharmacopœia, to be prepared by bbing together an ounce of mercury and ~~ten~~ drachms of iodine, adding dually as much alcohol as may be sufficient, until globules are no ger visible.

In this process the mercury and iodine enter into combination. The ohol facilitates the union by dissolving the iodine.

PROPERTIES.—It is a greenish-yellow powder, whose sp. gr. is 7·75. is insoluble in water, alcohol, or an aqueous solution of chloride of lium; but is soluble in ether, and slightly so in an aqueous solution of ide of potassium. When heated quickly, it fuses and sublimes in red stals, which subsequently become yellow. Solar light decomposes it, and changes its colour. Heated with potash, it yields iodide of potassium and reguline mercury.

Composition.—It consists of

	Eq.	Eq. Wt.	Per Cent.
Mercury	1	202	61·58
Iodine	1	126	38·41
Iodide of Mercury	1	328	99·99

Physiological Effects.—It is a powerfully irritant poison. A scruple killed a rabbit within twenty-four hours, and a drachm destroyed a pointer-dog in five days (Cogswell, *Essay on Iodine and its Compounds*, 160).

In small but repeated doses, it appears to exercise a specific influence over the lymphatic and glandular system. Two grains taken daily caused salivation in two instances (Biett, *Lancette Française*, Juin 1831).

Uses.—It has been used in syphilis and scrofula, especially when they occur in the same individual. Lugol (*Essays on the Effects of Iodine in Scrofulous Disorders*, by Dr. O'Shaughnessy, p. 170) employed an ointment of it in those forms of external scrofulous disease which resemble syphilis. Ricord (*Lancette Franç.* 1834, No. 65) gave it internally with good effect in *syphilis infantum*. Biett (O'Shaughnessy's *Transl. of Lugol's Essays*, p. 201) has successfully employed it in syphilitic ulceration and venereal eruptions.

Administration.—The dose of it for adults is from one grain gradually increased to three or four. Ricord gave from one-sixth to one-half of a grain to children of six months old. Biett employed it internally, and also externally, in the form of ointment, to the extent of twelve or fourteen grains daily, by the way of friction.

Pilulæ Hydrargyri Iodidi, Ph. Lond. (iodide of mercury, ʒj.; confection of dog-rose, ʒiij.; ginger, powdered, ʒj. M.)—Five grains of these pills contain one grain of the iodide. The dose, therefore, will be from five grains to a scruple.

Unguentum Hydrargyri Iodidi, Ph. Lond. (iodide of mercury, ℥j.; white wax, ℥ij.; lard, ℥vj. M.)—This is used as a dressing for scrofulous ulcers, or for syphilitic ulcers in scrofulous subjects. It is also employed in tubercular skin diseases, as lupus, rosacea, and sycosis. (Rayer, *Treat. on Skin Diseases.*)

Hydrar'gyri Binio'didum.—Bini'odide of Mer'cury.

Preparation.—There are two methods of preparing this compound. The process given in the London Pharmacopœia is as follows:—An ounce of mercury and ten drachms of iodine are to be rubbed together, alcohol being gradually added until the globules are no longer visible. The powder is to be dried with a gentle heat, and kept in a well-stopped vessel. The alcohol facilitates the combination of iodine and mercury, as in the process for making the protiodide.

Biniodide of mercury may also be prepared by adding a solution of bichloride of mercury to one of iodide of potassium so long as any precipitate takes place. 274 grains of bichloride will be required to decompose 332 grains of iodide of potassium: these proportions are about 8 of the first to 10 of the second. In this process double decomposition takes place: biniodide of mercury precipitates, while chloride of potassium remains in solution. If excess of iodide of potassium be employed, it tains some biniodide of mercury in solution. It is better, however, to ve a slight excess of iodide of potassium, in order to obtain the mer- rial biniodide free from corrosive sublimate.

PROPERTIES.—It is a scarlet red powder, whose sp. gr. is 6·32. It is soluble in water, but soluble in alcohol, some acids, alkalies, and solu- ns of iodide of potassium, chloride of sodium, and of many of the mer- rial salts. From its solution in boiling rectified spirit it is deposited, cooling, in rhombic prisms. When heated it fuses, forming a ruby- l liquid, sublimes in crystals, which are at first yellow but afterwards come red, and furnish a scarlet-red powder. It combines with other kaline iodides (as iodide of potassium) forming a class of double salts, lled the *hydrargyro-iodides*.

CHARACTERISTICS.—Heated with potash in a tube it yields metallic ercury, which is volatilized: the residue is iodide of potassium, recog- able by the tests before described (p. 280.) From the protiodide of ercury it is distinguished by its colour and its solubility in a solution chloride of sodium. The effects of heat on it, and its solubility in lide of potassium, are other characters which serve to recognise it.

COMPOSITION.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.
Mercury	1	202	44·5
Iodine	2	252	55·5
Biniodide of Mercury	1	454	100·0

PURITY.—The presence of bisulphuret of mercury in it may be recog- ed by fusion with caustic potash in a glass tube, by which a mixture sulphuret and iodide of potassium is obtained: the existence of sul- ur may be proved by the evolution of hydrosulphuric acid on the addi- n of a mineral acid.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—A scruple killed a rabbit twenty-four hours: the stomach was found preternaturally reddened. n grains, dissolved in a solution of iodide of potassium, and given to og, caused vomiting, pain, tenesmus, and depression: in four or five s the animal was well (Cogswell, *Essay on Iodine*, p. 164). Maillet *urn. de Chim. Méd.* iii. 543, 2de. Série) has also made some experi- nts with it.

b.) *On man.*—It is a powerful irritant and caustic. It is nearly as werful as the bichloride of mercury; indeed, Rayer (*Treatise on Skin seases*, by Dr. Willis, p. 79) considers it more active than the latter. plied to ulcers, in the form of ointment, I have known it cause excru- ting pain. Left in contact with the skin for a while, it induces, says yer, a most intense erysipelatous inflammation. When administered ernally, it must be done with great caution. Like other mercurial npounds, its repeated use causes salivation.

USES.—It has been employed in the same cases (*i. e.* syphilis and ofula) as the protiodide of mercury, than which it is much more ener- ic. Breschet (O'Shaughnessy's *Transl. of Lugol's Essays*, p. 204) plied it, in the form of ointment, with great success in a case of obsti- e ulceration (thought to have been carcinomatous) of the angle of the . In the form of a dilute and thin ointment (composed of biniodide mercury, gr. ii.; cerate, ℈ii.; and almond oil, ℈i.) it has been used in acity of the cornea (Graefe and Walther's *Journ. f. Chir.* Bd. 13). In obstinate ophthalmia tarsi, with thickening of the meibomian glands, it has also been successfully employed.

ADMINISTRATION.—It should be given in doses of one-sixteenth of a grain, gradually increased to one-fourth of a grain. It may be exhibited in the form of pills, or dissolved in alcohol or ether.

UNGUENTUM HYDRARGYRI BINIODIDI, Ph. L. (biniodide of mercury, ℥j.; white wax, ℥ij.; lard, ℥vj. M.)

Hydrar'gyri Bisulphure'tum.—Bisul'phuret of Mer'cury.

HISTORY.—It is mentioned in the Old Testament (*Jerem.* xxii. 14). Theophrastus (*De Lapidibus*) says, that *cinnabar* (κιννάβαρι) was accidentally discovered, by Callius, about ninety years before the magistracy of Praxibulus, of Athens—that is, 494 years before Christ. Geiger (*Handb. d. Pharm.*, by Liebig) found it in the colouring matter of the old Egyptian tombs. It was formerly called *minium*. It is commonly termed *red sulphuret of mercury*; and, when in powder, *vermilion.*

NATURAL HISTORY.—The principal repositories of native cinnabar (*cinnabaris nativa*) are Idria, in Carniola, and Almaden, in Spain. It occurs both massive and crystallized; the primary form of its crystals being the acute rhombohedron.

PREPARATION.—Artificial cinnabar (*cinnabaris factitia*) is prepared by mixing two pounds of mercury, with five ounces of melted sulphur, in an iron pot over a fire; and, as soon as the mass begins to swell, it is to be removed from the fire, and covered, to prevent inflammation. When large quantities of sulphur and mercury are heated together, a slight explosion and flame are produced. When cold, it is rubbed to powder and sublimed in earthen pots (*Ann. Chim.* iv.; Aikin's *Dictionary of Chemistry*).

In this process the heat enables the mercury and sulphur to combine, and form the bisulphuret.

PROPERTIES.—Artificial cinnabar has, in the mass, a dark reddish brown crystalline appearance; but, when reduced to a fine powder, is of a beautiful scarlet-red colour, and is then termed *vermilion.* It is tasteless, odourless, insoluble in water or alcohol, and unalterable in the air. It is fusible and volatile. It burns in the air with a blue flame, the sulphur uniting with oxygen to form sulphurous acid, while the mercury is dissipated in a vaporous form.

CHARACTERISTICS.—Heated in a glass tube, with potash, it evolves mercurial vapour, which condenses into liquid globules of this metal. The residue, which is sulphuret of potassium, gives out hydrosulphuric acid on the addition of hydrochloric acid. The colour of cinnabar deepens under the influence of heat.

COMPOSITION.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Guibourt.	Sefström.
Mercury	1	202	86·32	86.21	86·29
Sulphur	2	32	13·67	13·79	13·71
Bisulphuret of Mercury	1	234	99·99	100·00	100·00

PURITY.—Pure cinnabar is totally evaporated by heat, and is insoluble in nitric or hydrochloric acid. If minium or red lead be intermixed, we may recognise it by boiling in acetic acid, by which acetate of lead is

›cured in solution: this forms a black precipitate with hydrosulphuric d,—white with the sulphates,—and yellow with iodide of potassium. algar, or sulphuret of arsenicum, may be detected by boiling the sus-;ted cinnabar in solution of caustic potash, supersaturating with nitric d, and passing a current of hydrosulphuric acid through it, by which yellow precipitate (orpiment or sesquisulphuret of arsenicum) is ob-ned. Earthy impurities are not volatile.

PHYSIOLOGICAL EFFECTS.—According to Orfila (*Archiv. Gén. de Méd.* :. 330), pure cinnabar is inert; for he found no effects were produced dogs, by half an ounce, when either applied to wounds, or taken into stomach. These results being opposite to those obtained by Smith ristison, *Treat. on Poisons*, 3d. ed. 395), it has been presumed that latter must have employed an impure sulphuret.

The vapour obtained by heating cinnabar in the air is poisonous; but s is not in opposition to Orfila's experiments, since this vapour is not ulphuret of mercury, but a mixture of the vapour of mercury (either the metallic or oxidized state) and of sulphurous acid gas. Schenkius *bserv.* L. vii.) has related the case of a young man who died from the of this vapour; and Hill (*Edinb. Med. Essays*, iv.) saw cough, violent ivation, diarrhœa, &c. produced by its inhalation.

USES.—Cinnabar is used merely as a fumigating agent, in venereal erations of the nose and throat. The method of using it is this:—out half a drachm is placed on a heated iron, and the fumes inhaled they arise. In the shops, a copper apparatus, with iron heater, is sold the purpose. In the absence of this, the bisulphuret is to be placed a hot iron shovel, and the vapour inhaled by the patient through a nel. The irritating nature of the sulphurous vapour usually excites ighing, and is injurious in persons disposed to phthisis. Hence the ide of mercury is to be preferred for fumigating.

ADMINISTRATION.—When employed internally, cinnabar has been en in doses of from ten grains to half a drachm. For the purpose of nigation, half a drachm may be employed.

ydrar'gyri Bisulphure'tum cum Sul'phure.—Bisul'phuret of Mer'cury with Sul'phur.

HISTORY.—It is stated that the Chinese used this remedy long before vas known to Europeans. Harris, in 1689, first taught the method of paring it by trituration. Its most common name is *Æthiops mineralis*; it is also called *black sulphuret of mercury* (*hydrargyri sulphuretum rum*, Ph. Dub., Ed. and U. S.) or *sulphuret of mercury with sulphur drargyri sulphuretum cum sulphure*, Ph. Lond.)

PREPARATION.—Equal weights of mercury and sulphur are rubbed ether until globules are no longer visible. In this process part of the phur enters into chemical combination with the mercury, to form the ulphuret, which is mechanically mixed with the remaining sulphur.

PROPERTIES.—It is a heavy, black, tasteless, odourless powder, insolu-in water. When heated it fuses, and is completely dissipated.

CHARACTERISTICS.—By boiling in caustic potash liquor we obtain a ution of sulphuret of potassium (*vide* p. 288). The residue is black, possesses all the chemical characteristics of cinnabar (*vide* p. 484); h as being insoluble in nitric acid, volatile, &c.

Composition.—If this compound be, as Mr. Brande (*Man. of Pharm.* 3d ed. 329) supposes, a mixture of bisulphuret of mercury and sulphur, the proportions must be—

Bisulphuret of Mercury	58
Sulphur	42
Hydrargyri Sulphuretum cum Sulphure, Ph. Lond.	100

Purity.—Free mercury may be detected by its communicating a white stain to gold. Charcoal may be detected by its not volatilizing by heat. Animal charcoal, by this character, as well as by the presence of phosphate of lime in the residue (*vide* p. 359). Sesquisulphuret of antimony may be recognised by boiling in hydrochloric acid, and applying the before-mentioned (p. 400) tests for sesquichloride of antimony.

Physiological Effects.—According to the experiments of Orfila, this preparation, like the last, possesses little or no activity. The late Dr. Duncan (*Edinb. Dispensatory*) also tells us, that he has given it in doses of several drachms, for a considerable length of time, with scarcely any effect. It is commonly regarded as alterative.

Uses.—It has been used in glandular diseases, especially of children; and also in cutaneous diseases.

Administration.—The dose for adults is from 5 to 30 grains.

Hydrar'gyri Bicyan'idum.—Bicy'anide of Mer'cury.

History.—This salt was discovered by Scheele. Its real nature was first pointed out by Gay-Lussac in 1815. It has been known by various appellations, as *Prussian mercury* (*hydrargyrum borussicum*), *prussiate*, *hydrocyanate*, *cyanuret*, or *cyanodide of mercury* (*hydrargyri prussias*, *hydrocyanas*, *cyanuretum*, seu *cyanodidum*).

Preparation.—Two methods have been adopted for the preparation of it.

(*a.*) *Proust's process.*—In the Pharmacopœia, eight ounces of ferrosesquicyanide of iron, or Prussian blue (ferri percyanidum, Ph. L.) are directed to be boiled with ten ounces of binoxide of mercury and four pints of water. The mixture is to be strained and evaporated, so that it may crystallize. The undissolved residuum is to be washed with boiling distilled water, filtered, and evaporated, so as to yield crystals.

REAGENTS.			RESULTS.
2 eq. Ferrosesqui-cyan. Iron 430	3 eq. Protocyan. Iron . 162	*3 eq. Cyan.* 78	$4\frac{1}{2}$ Bicyan. Merc. 1143
		3 eq. Iron . 84	
	4 eq. Sesquicy. Iron .. 268	*6 eq. Cyan.* 156	
		4 eq. Iron . 112	
$4\frac{1}{2}$ eq. Binoxide of Mercury	 981	*$4\frac{1}{2}$ eq. Mer.* 909	
		3 eq. Oxyg. 24	3 eq. Oxide Iron . 108 } *Residue.*
		6 eq. Oxyg. 48	4 eq. Sesquioxide of Iron .. 160 } *Residue.*

The awkwardness of the use of half an equivalent may be easily obviated by doubling all the above numbers; but several reasons have induced me to retain it in the above diagram.

(*b.*) *Winckler's process.*—Bicyanide of mercury may be obtained more economically, and purer, by adding as much finely-pulverized binoxide of mercury to hydrocyanic acid (obtained by distilling ferrocyanide of potassium with diluted sulphuric acid, *vide* p. 236) as will saturate it, er, and crystallize. In this process double decomposition takes place, resulting products being water and bicyanide of mercury.

REAGENTS.				RESULTS.	
. Hydrocyanic Acid	54	2 eq. Hydrogen .	2	2 eq. Water................	18
		2 eq. Cyanogen..	52		
. Binoxide Mercury	218	2 eq. Oxygen....	16		
		1 eq. Mercury ..	202	1 eq. Bicyanide of Mercury..	254

PROPERTIES.—The primary form of the crystals of this salt is the right ıare prism. The crystals are heavy, white, colourless, transparent or ·que, inodorous, and have a strong metallic taste. They are soluble water, both hot and cold, and very little, if at all so, in alcohol.

CHARACTERISTICS.—Perfectly dry bicyanide of mercury when heated ·lds metallic mercury and cyanogen gas. The latter is known by the ·let or bluish red colour of its flame. Heated with hydrochloric acid evolves hydrocyanic acid. It is not decomposed by nitric acid or the ·alies. Its solution throws down a black precipitate with hydrosul- uric acid, and pearly crystalline plates (*hydrargyro-iodo-cyanide of 'assium*) with a concentrated solution of iodide of potassium (*vide* 239).

COMPOSITION.—Its composition is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Gay-Lussac.
Mercury	1	202	79·52	79·91
Cyanogen	2	52	20·47	20·09
Bicyanide of mercury	1	254	99·99	100·00

PURITY.—When prepared from ferrosesquicyanide of iron (Prussian ıe) the crystals are usually yellowish, from the presence of some oxide iron.

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—It acts on plants like hloride of mercury (Gœppert, in Decand. *Phys. Vég.* 1334).

(*b.*) *On animals.*—Coulon (*Traité sur l'Acide Prussique*, quoted by ıbmer, *Wirk d. Arzneim.* iii. 30) found that it acted on dogs, cats, ırrows, frogs, snails, &c. like hydrocyanic acid. After death, inflam- tion of the stomach was observed. Ollivier d'Angers (*Journ. de Chim. d.* i. 269) tried its effects on dogs. Seven grains, dissolved in water, led a small dog in ten minutes, under attempts to vomit, general con- sions, and exhaustion, manifested alternately; respiration and circu- ion at first accelerated, afterwards diminished. Similar effects were oduced by applying the salt to the cellular tissue, or injecting it into veins. Tiedemann and Gmelin (*Versuche ü. d. Wege auf welch. bst. aus d. Magen u. Darmk. ins Blut gelang.*) detected mercury in the od of the splenic vein of a horse to whom the bicyanide had been ninistered.

(*c.*) *On man.*—Taken in *small doses*, it very readily excites nausea and niting. Parent (*Journ. de Chim. Méd.* viii. 473) says it does not pro- ce the epigastric pain which the bichloride of mercury readily occasions. ntinued use causes salivation. In one case, one-eighth of a grain ice a day caused ptyalism in three days (Neumann, in Dierbach's *ueste. Entd. in d. Mat. Med.* ii. 483, 1828). Mendaga (*Decades Medico- rurgicas y Farmaceuticas*, vi. 319, in Richter's *Ausführ Arzneim.* v. 7) says it acts directly on the skin and bones, and hence it sometimes y speedily allays the pain of and disperses nodes.

In large doses, especially in very susceptible persons, it affects the nervous system, and causes fainting, anxiety, and cramps. Twenty-three and a half grains in one instance (*Journ. de Chim. Méd.* i. 210) caused death in nine days. The most remarkable symptoms were, obstinate vomiting; mercurial ulceration of the mouth and abundant ptyalism; contractions of the heart, which at first were very strong, but became successively slower and more feeble; the abdomen was yielding, and not tender, notwithstanding the constant tenesmus; suppression of urine; semi-erection of the penis, and ecchymosis of this organ, as well as of the scrotum; and, ultimately, convulsive movements.

Uses. (*a.*) *Medicinal.*—It has been employed as an *antivenereal* medicine, and was first used as such by Brera (Richter, *op. cit.*) Parent (*Journ. de Chim. Méd.* viii. 473) administered it as a substitute for the bichloride of mercury, over which it has several advantages. Thus, being more soluble, it ought to be more readily absorbed; it does not give rise to epigastric pain; and, lastly, it is not so readily decomposed; for alkalies, several salts, and many solutions of organic matters, which decompose corrosive sublimate, have no effect on it. It may be applied in the form of aqueous solution or ointment to venereal sores.

It has been employed in induration of the liver, in some chronic skin diseases, in obstinate headache, and in other maladies, as an antiphlogistic.

(*b.*) *Pharmaceutical.*—Its principal use in this country is as a source of hydrocyanic acid (*vide* p. 237) and of cyanogen gas.

Administration.—Internally it may be employed in doses of one-sixteenth of a grain gradually increased to one-half of a grain. It may be administered in the form of pills (made with crumb of bread) or alcoholic solution. It will be frequently advisable to conjoin opium, to prevent nausea or vomiting. When used as a *gargle* or *wash*, we may employ ten grains to a pint of water. An *ointment* may be prepared of ten or twelve grains to an ounce of lard.

Antidote.—I am unacquainted with any antidote for it. Albumen does not decompose it. Perhaps ammonia might be found serviceable, to diminish the effect on the nervous system. Opium relieves the vomiting. Our principal object must be to remove the poison from the stomach, which is to be effected by the stomach-pump, emetics, tickling the throat, &c.

Unguen'tum Hydrar'gyri Nitra'tis.—Oint'ment of Ni'trate of Mer'cury.

History.—This ointment is sometimes termed *citrine ointment* (*unguentum citrinum*). Another name for it is *mercurial balsam.*

Preparation.—It is prepared by dissolving mercury in nitric acid and adding the solution to some kind of fatty matter. The relative quantities of acid and metal employed, as well as the nature of the fatty matter used, are various in different formulæ. The following are the proportions directed to be employed in the British and United States Pharmacopœias.

	London	*Dublin*	*Edinburgh*	*United States.*
Mercury	℥j.	℥j.	1 part	℥j.
Nitric Acid	fʒxj.	ʒxiss.	[nitrous acid] 2 parts	fʒxi.
Lard	℥vj.	℥iv.	3 parts	℥iij.
Olive oil	f℥iv.	Oj.	9 parts	Neat's-foot oil f℥ix.

The London Pharmacopœia directs the solution to be mixed while t with the lard and oil melted together. The Edinburgh and United ites Pharmacopœias order the solution to be added to the mixture of d and oil when it begins to stiffen.

The *theory* of the process is as follows:—By the mutual action of rcury and strong nitric acid, a nitrate of the binoxide, as well as of protoxide of mercury, is formed, while binoxide of nitrogen is nerated. Part of the latter escapes, and, combining with atmospheric ygen, forms nitrous acid; the remainder reacts on the free nitric acid, d forms with it hyponitrous or nitrous acid. The liquor then is a xture of *nitric acid* in excess, probably of *nitrous acid*, of the *nitrate* d *hyponitrite of the binoxide of mercury*, and *nitrate of the protoxide mercury*.

When this solution is added to the fatty matter (lard and olive oil), the rous acid, or the hyponitrous acid which it contains, converts the olive into a more consistent and less fusible fatty body, which Boudet *ourn. de Chim. Méd.* viii. 641) calls *elaïdine*, (from *ἐλαῒς, ελαΐδος, an ve tree.*) The stearine and elain of the lard also acquire greater con- tency in consequence of undergoing an analogous change. There is also yellow colouring matter produced, and which may be separated by cohol. By the saponification of a portion of the elaïdine a small antity of mercurial soap (elaïdate of mercury) is produced The ponitrous acid of the hyponitrite is capable of producing the same ect as the free acid.

Boudet is of opinion that these changes are effected by the *physical* luence of the nitrous acid, for he asserts that the decomposition of the id is not essential to the formation of the elaïdine. In this I suspect is in error.

By keeping, this ointment is apt to become hard, pulverizable, and ereby unfit for use. This depends principally on the change which the ve oil suffers. Hence in the United States Pharmacopœia neatsfoot has been substituted for olive oil. The editors of the *United States spensatory* observe, that they had in their "possession, upwards of four onths, a pot of ointment made according to the process of the Pharma- pœia, and though it had, at the end of this time, partially assumed a ecnish colour, it preserved a uniform, soft, unctuous, consistence."

The fatty bodies exercise a deoxidizing influence on the acids (free or mbined) of the solution, and which is supposed to be independent of e formation of elaïdine; and, in consequence of this, nitrogen or noxide of nitrogen is evolved. They also deoxidize the oxides of mer- ry, reducing the binoxide to the state of protoxide, and, in time, nverting the protoxide into metallic mercury; which, being in a finely- vided state, gives to the mass a greyish colour. This latter change is oved by two facts—first, the change of colour which the ointment dergoes; and secondly, by digesting old citrine ointment in ether, the tty matters are dissolved, leaving behind metallic mercury.

It is to prevent this change that Guibourt (*Pharm. Raisonnée*, ii. 146) and Dr. Duncan (*Edinb. Dispensat.*) direct more nitric acid to be used than is contained in the official formulæ.

Properties.—When fresh prepared this ointment has a fine golden yellow colour, a butyraceous consistence, and a remarkable nitrous odour. It is very apt to become grey when mixed with other ointments, in consequence of their deoxidizing powers. It should be spread with wooden or ivory spatulas.

Composition.—When fresh prepared this compound contains the following substances:—

Elaïdine.
Yellow matter soluble in alcohol.
Elaïdate of mercury (mercurial soap.)
Nitrate of mercury.

Elaïdine is a white saponifiable fat, fusible at 97° F. very soluble in ether, but requiring 200 times its weight of boiling alcohol to dissolve it. When mixed with potash or soda it is converted into glycerin and elaïdic acid.

Physiological Effects.—It is an irritant and slight caustic. When it has undergone decomposition by keeping, it irritates ulcers exceedingly, and even excites slight erysipelatous inflammation.

Uses.—We employ it as a stimulant and alterative in *chronic diseases of the skin*, more particularly those affecting the hairy scalp, as the different forms of porrigo, in which it is exceedingly efficacious. It is also used as a *dressing to ulcers*—to stimulate and cleanse them—as in foul syphilitic sores and phagedænic ulcers. Lastly, it is employed in *ophthalmic diseases*—more particularly ophthalmia tarsi, or psorophthalmia, in which it is applied (mixed with its own weight of almond oil) by means of a camel's-hair pencil to the lids, frequently with such advantage that some have regarded it a specific in this complaint.

Hydrar'gyri Ace'tas.—Ac'etate of Mer'cury.

History.—This compound was known to Lefebure in the 17th century.

Preparation.—In the Dublin Pharmacopœia the directions for procuring it are the following:—Add eleven parts of diluted nitric acid to nine parts of mercury, and when the effervescence has ceased let the mixture be digested that the metal may be dissolved. Add this to a boiling solution of nine parts of acetate of potash in a hundred of distilled water acidulated with vinegar; filter through a double hair-cloth, and let it cool, that crystals may form. Wash them with cold distilled water, and dry on paper with a gentle heat. In the Edinburgh Pharmacopœia a larger quantity of nitric acid is used and the vinegar omitted, as well as the directions for filtering through linen.

By the mutual action of diluted nitric acid and mercury we obtain a protonitrate of mercury (*vide* p. 463.) When this is mixed with acetate of potash double decomposition takes place: nitrate of potash and protoacetate of mercury being formed. To prevent precipitation of the yellow subnitrate of mercury, excess of acid (acetic, Ph. Dub., nitric, Ph. Ed.) should be employed: and by filtering, while hot, any which may be formed would be separated before the acetate has deposited.

Properties.—This salt occurs in white, micaceous, flexible scales, which are inodorous, but have an acrid taste. It blackens by light. When heated it is resolved into carbonic acid, acetic acid, and mercury.

is very slightly soluble only in water, requiring 300 times its weight of s liquid to dissolve it, according to Dumas. It is insoluble in cold ohol: boiling alcohol abstracts part of its acid.

Characteristics.—Its appearance, its slight solubility in water, and action of heat on it. Heated with sulphuric acid the vapour of acetic d is evolved. The fixed alkalies precipitate the black oxide of mer-y. Chloride of sodium forms calomel with it.

Composition.—It has the following composition:—

	Eq.	Eq. Wt.	Per Cent.	Dumas.
Protoxide of Mercury	1	210	80·46	80·66
Acetic Acid	1	51	19·54	19·34
Acetate of Mercury	1	261	100·00	100·00

Physiological Effects.—It is one of the mild mercurial preparations. om the reports of Guarin, Colombier, and Vogler (Wibmer, *Wirk. d. zneim.* iii. 67) it appears to have acted in some cases with great lence, and to have occasioned violent vomiting, purging, abdominal in, bloody evacuations, &c. These effects probably arose from the esence of some acetate of the binoxide of mercury.

Uses.—It was introduced into practice in consequence of being pposed to be the active ingredient of Keyser's antivenereal pills. But biquet has subsequently ascertained that Keyser employed the acetate the binoxide (Dumas, *Traité de Chimie*, v. 178). It is occasionally ed in syphilitic affections.

Administration.—The dose of it is from one to five grains. A ution composed of one grain of the acetate dissolved in an ounce of ter, may be used as a *wash*. An *ointment* is prepared by dissolving o or three scruples in an ounce of olive oil.

Hydrar'gyri Subsul'phas Fla'vus.—Yel'low Subsul'phate of Mer'cury.

History.—This compound was known to Croll in the sixteenth ntury. It has been termed *Turpeth* (or *Turbith*) *mineral* (*Turpethum nerale*), from its resemblance in colour to the root of the *Ipomœa rpethum.*

Preparation.—It is prepared by adding one part of persulphate of rcury (the mode of preparing which has been described at p. 464) to enty parts of warm or boiling water. A supersulphate of mercury is med in solution, and a subsulphate precipitates.

Properties.—It is a heavy, lemon-yellow, inodorous powder, having acrid taste. It requires 2000 parts of water at 60°, or 600 parts at 2°, to dissolve it.

Characteristics.—When heated in a tube, sulphurous acid is olved, and globules of mercury sublimed. Boiled with caustic potash soda, the red binoxide precipitates, and a solution of sulphate of tash is obtained, known to be a sulphate by chloride of barium (*vide* 265).

Composition.—Its composition is as follows:—

	Eq.	Eq. Wt.	Per Cent.	Braamcamp and Siqueira-Oliva.
Binoxide of Mercury	1	218	84·5	84·7
Sulphuric Acid	1	40	15·5	15·
Subsulphate of Mercury	1	258	100·0	99·7

Physiological Effects.—In small quantities it occasions nausea, vomiting, and ptyalism. Taken into the nostrils it excites sneezing, and sometimes salivation. Stenzel (Wibmer, *Wirk. d. Arzneim.* iii. 66) mentions a fatal case from its internal use.

Uses.—It is sometimes used as an emetic in cases of swelled testicle, to promote absorption by its nauseating and emetic action (*Observ. on the Dublin Pharmacopœia*). It was formerly given at the commencement of a mercurial course. As an errhine it has been administered in chronic ophthalmia and affections of the brain, as incipient hydrocephalus. As an alterative it has been given in the scaly diseases (lepra and psoriasis).

Administration.—As an alterative, the dose should not exceed half a grain, or at most a grain. As an emetic it is given to the extent of five grains; in which dose it causes violent vomiting. As an errhine, a grain should be mixed with four or five of some mild powder, as starch or liquorice powder. It is rarely given for any other purposes.

Order 21.—Copper and its Compounds.

Cu'prum.—Cop'per.

History.—Cuprum, or copper, received its name κύπρος, from the island of Cyprus, where it was first discovered, or at least worked to any extent. It seems to have been known in the most remote ages of antiquity, for Moses (*Job*, ch. xxviii.) speaks of brass (an alloy of copper and zinc). The alchymists called it *Venus*.

Natural History.—It is found in both kingdoms of nature.

(*a.*) *In the inorganized kingdom.*—Copper is found in the metallic or reguline state, combined with oxygen, with sulphur, with selenium, with chlorine, or with oxygen, and an oxyacid (carbonic, arsenic, phosphoric, sulphuric, or silicic).

(*b.*) *In the organized kingdom.*—It has been discovered in the ashes of most plants, as of stavesacre, rhatany, flax, nux vomica, hemlock, &c. Sarzeau has detected it in the blood of animals (*Ann. de Chim.* xliv. 334).

Preparation.—The copper of commerce is usually prepared from copper pyrites or grey copper ore (both sulphurets). These are roasted and then smelted, by which *coarse metal* is procured. This is calcined and again smelted, by which we obtain *fine metal*, or, when cast in sand, *blue metal*. By re-roasting and smelting, *coarse copper* is produced. These processes, of roasting and smelting, effect the expulsion of the sulphur and the oxidizement of the iron. The copper thus produced is melted and exposed to the air, to drive off any volatile matters by which *blistered copper* is obtained. It is *refined* or *toughened* by melting it and stirring with a birchpole (J. H. Vivian, *Ann. of Philosophy*, N.S. v. 113).

Properties.—It is a crystallizable, brilliant, red metal, crystallizable in regular octahedra and cubes, having a specific gravity of 8·86 to 8·89; malleable and ductile; it has a nauseous, styptic taste, and a peculiar and disagreeable smell. It fuses at 1996° F. (*Daniel*); at a higher temperature it may be volatilized. Its equivalent is 32. It is combustible. It is readily oxidated. Acid, alkaline, saline, and fatty bodies, when placed in contact with it in the air, promote its union with oxygen; and, by dissolving a portion of the newly-formed oxide, acquire poisonous properties.

Characteristics.—Copper is easily recognized by its colour, by its mmunicating a green tinge to flame, and by dissolving it in nitric acid. ie solution possesses the following properties: it is blue, or greenish ie; potash or soda occasions a blue precipitate of the hydrated ide of copper; a small quantity of ammonia produces a similar bluish iite precipitate, but an excess redissolves it, forming a deep blue uid: ferrocyanide of potassium occasions a reddish brown precipitate the ferrocyanide of copper; the hydrosulphurets throw down the ıck sulphuret; and, lastly, a polished iron plate plunged into the uid, becomes coated with metallic copper.

Physiological Effects.—(*a.*) *Of metallic copper.*—Metallic copper pears to produce no pernicious effects when taken internally, so long it retains its metallic state, as many cases are recorded where coins this metal have been swallowed and retained for a considerable ıe without any ill effects arising; and Drouard (*Exper. et Observ. sur* *mpoisonnem. par l'Oxide de Cuivre*, Paris, 1802) gave as much as an nce of finely powdered copper to dogs of different ages and sizes, but ne of them experienced any inconvenience.

Notwithstanding these facts, however, various effects have been attri- ted to it. Thus, Cothenius (Voigtel, *Arzneimittellehre*) says, copper ngs operate by stool, urine, and saliva; and the late Professor Barton hapman's *Elem. of Therap.* ii. 457) was accustomed to relate an stance of a child, who, having swallowed a cent, continued for some ıe to discharge several pints of saliva. Lastly, Portal (Orfila, *Toxicol.* *n.*) mentions a case in which copper filings, incorporated with crumb bread, acted powerfully on the system. I have no doubt but that the ects here mentioned arose from the oxidation of the metal by the acids the alimentary canal.

(*b.*) *Of the Cupreous Compounds.*—If the cupreous preparations be ed in *very small* doses, they sometimes give relief in certain diseases incipally of the nervous system), without obviously disordering the ıctions; in other words, in these instances the only apparent effect is modification observed in the morbid condition. These are the cases which these preparations have been termed *tonic*, *antispasmodic*, or *erative*, according to the nature of the disease; thus, in ague they ve been termed tonic, in epilepsy antispasmodic, in dropsy alterative. ıe beneficial operation is presumed to be owing to some influence erted by the remedy over the nervous system. The effects produced the long-continued use of small doses of the preparations of copper ve not been satisfactorily determined; they are said to be various ections of the nervous system (such as cramps or paralysis), alteration the colour of the skin, chronic inflammation of the respiratory and gestive apparatus, slow fever, and wasting of the body. These mptoms constitute what has been termed *slow*, or *chronic poisoning by* *pper*. The smelters and workers in copper do not suffer from the pour or emanation of this metal, as the workmen employed in the eparation of mercury, of arsenic, or of lead do, from the vapours of ese metals; this, indeed, might be expected, when we consider how ıch more volatile the latter and their preparations are, than copper and compounds. In *larger*, or full medicinal doses, these remedies act *emetics*, exciting speedy vomiting, with less nausea than tartar emetic oduces. In *still larger* quantities these bodies act as poisons, giving rise to gastro-intestinal inflammation, and disordering the functions of the nervous system (especially the cerebro-spinal portion), constituting *acute poisoning by copper.* The usual symptoms are, a coppery taste, eructations, violent vomiting and purging, griping pains, cramps in the legs and thighs, headache, giddiness, convulsions, and insensibility: jaundice is occasionally observed. In some cases the cerebro-spinal symptoms precede those which indicate inflammation of the alimentary canal. In experiments made on animals, it has been observed that death was sometimes produced without any marks of local irritation; the symptoms being those indicative of a disordered condition of the nervous system. By some toxicologists these preparations are ranked among the *irritant* poisons, though Buchner (*Toxicologie*), judging from Reiter's experiments, terms them *astringent.*

Drouard, and others, were of opinion that the preparations of copper do not become absorbed, but Lebkuchner (Christison, *Treat. on Poisons,* 3d ed. 433), has detected copper in the blood of the carotid artery of a cat, into whose bronchial tubes he had injected four grains of the ammoniacal sulphate; and Wibmer, (*Wirk. d. Arzn.* ii. 244), has found it in the liver of animals to whom he had given the acetate for several weeks.

Post-mortem appearances.—In animals killed rapidly by these poisons, no morbid appearances are found, in consequence of death being produced by their action on the nervous system; but when the death was slow, marks of gastro-intestinal inflammation, and occasionally indications of inflammation of the brain, have been observed.

Uses. (*a.*) *Of metallic copper.*—Copper filings, in doses of three or four grains, were formerly used in rheumatism, and also as an antidote against the effects of the bite of a mad dog.

(*b.*) *Of the cupreous compounds.*—These preparations are used both as external and as internal remedies; externally as stimulants, astringents, styptics, and caustics; internally, as emetics and tonics, or antispasmodics. The particular cases will be noticed when treating of the individual preparations.

Antidotes.—The chemical antidote for the cupreous preparation is *albumen*; hence, the whites of eggs, and in the absence of these, milk, or even wheaten flour, should be employed. *Iron filings* have been proposed by Navier, by Payen and Chevallier, and subsequently by Dumas and Milne Edwards. The iron decomposes the cupreous salt, and precipitates the copper in the metallic (and, therefore, in an inert) state. The *ferrocyanide of potassium* is also said to be a good antidote: a drachm or two of it may be taken with safety, for it is not so poisonous as was at one time imagined. *Sugar* was proposed by Marcelin Duval as an antidote; its efficacy, though denied by Orfila and Vogel, has been lately reasserted by Postel. The alkaline sulphurets formerly used are worse than useless, since they are active poisons. The inflammatory symptoms are of course to be subdued by the usual means. (For further details on this subject consult Christison's *Treat. on Poisons.*)

Cu'pri Sul'phas.—Sul'phate of Cop'per.

History.—This substance was probably employed by Hippocrates (*De ulceribus*), under the name of χαλκῖτις κυανέη (*chalcitis cærulea*), to promote the healing of ulcers. Pliny (*Hist. Nat.* xxxiv. 32.) also was ubtless acquainted with it, though he seems to have confounded it ith sulphate of iron. His *chalcanthum cyprium* was, perhaps, sulphate copper. This salt has had various synonymes, such as *blue vitriol* *itriolum cæruleum*) *Roman vitriol*, *blue copperas*, *blue stone*, *bisulphate* *copper*.

Natural History.—It occurs in copper mines (as those of Cornwall, c.) and is formed from sulphuret of copper by the joint agency of air d water. The cupreous solutions of copper mines are termed *waters* *cementation*.

Preparation.—It may be prepared by evaporating the water found , or issuing from, copper mines. It is also produced by roasting copper rites, lixiviating the residuum to dissolve the sulphate, and evaporating as to obtain crystals. In this process both the sulphur and the copper the pyrites abstract oxygen from the air, and become, the one sulphuric id, the other oxide of copper: these by their union constitute the lphate of copper.

Properties.—This salt occurs in fine blue crystals, whose primary m is the doubly oblique prism. Its sp. gr. is 2·2. It has a styptic etallic taste, and reacts on litmus as an acid. By exposure to the r it effloresces slightly, and becomes covered with a greenish white wder. When heated it loses its water of crystallization, and becomes white powder (*pulvis sympatheticus*.) By a very intense heat it is composed,—sulphurous acid and oxygen are evolved, and oxide of pper left. It dissolves in about 4 parts of water at 60°, and 2 parts of iling water. It is insoluble in alcohol.

Characteristics.—Its characteristics are those of the sulphates *ide* p. 265), and of the cupreous compounds (*vide* p. 493.)

Composition.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Thomson.	Berzelius.
Oxide of Copper	1	40	32	32	32·13
Sulphuric Acid	1	40	32	32	31·57
Water	5	45	36	36	36·30
Crystallized Sulphate of Copper	1	125	100	100	100·00

Impurity.—The commercial sulphate of copper sometimes contains ces of sulphate of iron. It may be detected by excess of ammonia, ich throws down the oxide of iron, but dissolves the oxide of copper.

Physiological Effects. (*a*.) *On vegetables*.—It is poisonous to plants ecandolle, *Phys. Vég.* 1335): hence its use in preventing dry rot *erulius lachrymans*), by soaking timber in it, according to Mr. argary's patent; and in destroying or preventing the smut (*Uredo* *etum*), or bunt (*U. caries*), in corn, by immersing the grain in a weak ution of it: the solution is not made sufficiently strong to injure the seed.

(*b*.) *On animals*.—This salt operates as a poison to animals. Six ins killed a dog in half an hour, without producing any appearance inflammation (Drouard). Applied to a wound it destroyed the animal twenty-two hours, and the body was every where in a healthy state uncan, in Christison *on Poisons*, 432). Orfila (*Tox. Gén.*) also found t it proved fatal in a few hours when applied to wounds. The only nptoms mentioned are dulness, loss of appetite, and sometimes rging. Inflammation of the mucous membrane of the stomach and tum was found after death.

(*c.*) *On man.*—In *very small doses* it has no sensible operation on the body, though it occasionally ameliorates certain diseases, such as epilepsy and ague: in these cases it has been denominated an antispasmodic and tonic. The local action on the alimentary tube is that of an astringent. Dr. Elliotson (*Lond. Med. Gaz.* xii. 557) has known a patient to take it for three years, for a particular kind of diarrhœa, without any constitutional effect. In *larger doses* it is a safe and useful emetic, acting very speedily, and without exciting any great disorder of the general system. In *excessive doses* it becomes a poison, producing inflammation of the alimentary canal, and disordering the functions of the nervous system, as noticed when describing the action of the cupreous preparations generally. In a case mentioned by Dr. Percival (*Trans. Lond. Coll. Phys.* iii. 88) two drachms proved fatal: the patient was violently convulsed. In a more recent case (*Lond. Med. Gaz.* xviii. 624 and 742) there were vomiting and insensibility, but no convulsions or purging: the child died in four hours.

Its topical action is stimulant, astringent, styptic, and caustic. Its causticity depends on its union, either as a neutral or basic salt, with one or more of the constituents of the tissues. Thus it combines with albumen to form a pale bluish green compound, which produces with caustic potash a violet-coloured solution (Dr. C. G. Mitscherlich, *Brit. Ann. of Med.* i. 751 and 817, and ii. 51).

Uses.—Where speedy vomiting without much nausea is required, as in cases of narcotic poisoning, sulphate of copper is a tolerably sure and valuable *emetic*. It has also been used, with success, to provoke vomiting in croup, and thereby to promote the expulsion of the false membrane, (*Brit. and For. Med. Rev.* i. 568.)

As an *astringent* it has been used in chronic diarrhœa and dysentery by Dr. Elliotson (*Lond. Med. Gaz.* viii. 378, and xii. 557; also *Med. Chir. Trans.* xiii. 451), who found it succeed where the ordinary vegetable astringents fail. It should be given in doses of from half a grain to two grains twice or thrice a day, in combination with opium. It is also used as an astringent to check excessive secretion from the bronchial and urino-genital mucous membranes. Dr. Wright (*Lond. Med. Journ.* i. and x.) found it serviceable in dropsy.

As a *tonic* or *antispasmodic* it has been given in intermittent diseases, as the ague; and in some maladies of the nervous system (epilepsy and chorea). In epilepsy it has recently been strongly recommended by Dr. F. Hawkins (*Lond. Med. Gaz.* viii. 183).

As a *topical* agent, it is often employed in substance as an application to ulcers, either for the purpose of repressing excessive soft and spongy granulations, commonly denominated "proud flesh," or of hastening the process of cicatrization; and for either of these purposes it is one of the best agents we can employ. Solutions of it are frequently applied to mucous membranes, to diminish excessive secretion: thus to the conjunctiva, in chronic ophthalmia, and to the mucous lining of the vagina or urethra, in discharges from these parts. In superficial ulcerations of the mucous membranes (especially of the mouth), one or two applications of the sulphate of copper, in substance, are generally sufficient to heal them.

As a *styptic* a solution of this salt is sometimes used to repress hæmorrhages from a number of small vessels. Rademacher applied with good effect brandy impregnated with sulphate of copper in a case of alopecia, baldness, which occurred in a young man ; but it failed in the hands Dr. T. J. Todd (*Cyclop. of Pract. Med.* i. 52.)

ADMINISTRATION.—The dose of it, as an *emetic*, is from three or four ains to fifteen; as an *astringent*, or *tonic*, from a quarter of a grain to e or two grains. Solutions used for external purposes vary consider-ly in their strength in different cases, but usually from one or two ains to eight or twelve, dissolved in an ounce of water.

ANTIDOTES.—*Vide* CUPRUM.

SOLUTIO SULPHATIS CUPRI COMPOSITA, Ph. Ed. (sulphate of pper; alum, āā ℥iij.; water, lb. ij.; sulphuric acid, ℥iss. Boil until e sulphates are dissolved; then filter, and add the acid.)—It is employed a styptic, to arrest hæmorrhage ; and, when diluted, in the purulent hthalmia of children.

Ammo'niæ Cu'pro-Sul'phas.—Cu'pro-Sul'phate of Ammo'nia.

HISTORY.—Boerhaave was acquainted with an ammoniacal solution of pper. In 1757 Weissman gave imperfect directions for its preparation. 1799 Acoluth published a better process. Dr. Cullen introduced this bstance into practice in this country. It is frequently called *ammoni-ed copper* (*cuprum ammoniatum*, Ph. Dubl. and U. S.) or *ammoniuret of pper* (*cupri ammoniaretum*, Ph. Ed.) In the London Pharmacopœia it termed *ammonio-sulphate of copper* (*cupri ammonio-sulphas*).

PREPARATION.—In all the British Pharmacopœias, this compound is ected to be prepared by rubbing an ounce of sulphate of copper with ounce and a half of sesquicarbonate of ammonia until carbonic acid ises to evolve.

The *theory* of the process is imperfectly understood. The proportions ingredients employed are about two equivalents of sulphate and three d one-fifth equivalents of sesquicarbonate. When rubbed together, se salts give out part of their water of crystallization, by which the ss becomes moist; and, at the same time, a portion of carbonic acid the sesquicarbonate escapes, producing the effervescence alluded to ; l the compound becomes of a deep azure-blue colour. This colour is obably owing to cuprate of ammonia ; for oxide of copper with caustic monia forms a similarly-coloured liquid. If this notion be correct, decomposition may be thus explained :—Two equivalents or 118 parts hydrated sesquicarbonate of ammonia react on one equivalent or 125 ts of crystallized sulphate of copper, and produce one equivalent or parts of cuprate of ammonia, one equivalent or 57 parts of sulphate of monia, seven equivalents or 63 parts of water, and three equivalents 66 parts of carbonic acid. The cuprate and sulphate of ammonia h one equivalent of water represent the crystallized cupro-sulphate of monia (*cuprum ammoniacale* of some authors).

REAGENTS.			RESULTS.
Hydratd. Sequi-rb. Ammon. 118	3 eq. Carb. Acid 66		3 eq. Carb. Acid 66
	2 eq. Water.... 18	6 eq. *Water* 54	6 eq. Water.... 54
	1 eq. Ammonia 17	1 eq. *Water* 9	1 eq. Crystd Cupro-Sulph. of Am. 123
	1 eq. Ammonia 17	1 eq. *Sulphate of Ammonia*, 57	
Crystall. Sulph. Copper 125	5 eq. Water.... 45		
	1 eq. Sulph. Acid 40		
	1 eq. Oxde Coppr 40	1 eq. *Cuprate of Ammonia*, 57	

PROPERTIES.—It has a deep azure-blue colour, a styptic metallic taste, l an ammoniacal odour. It reacts on vegetable colours as an alkali :

thus it reddens turmeric, and restores the blue colour of litmus, which has been reddened by an acid. By exposure to the air, ammonia is evolved, and a green powder is left, composed of sulphate of ammonia and carbonate of copper. To prevent this, therefore, it should be preserved in a well-stoppered bottle. It is soluble in water; but unless excess of sesquicarbonate of ammonia be present, the solution, when much diluted, lets fall a subsulphate of copper.

Characteristics.—Dissolved in water it forms a green precipitate (*arsenite of copper*) with a solution of arsenious acid. When heated, all its constituents are dissipated, save the oxide of copper. Boiled with caustic potash a solution of sulphate of potash is obtained, the hydrated oxide of copper is thrown down, and ammonia is disengaged. Sulphuric acid may be recognised in the solution by the barytic salts.

Composition. — The essential part of this compound is the cupro-sulphate of ammonia. This, in the crystalline state, has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Brandes.
Oxide of Copper	1	40	32·52	34·00	33·017
Ammonia	2	34	27·64	26·40	21·410
Sulphuric Acid	1	40	32·52	32·25	31·753
Water	1	9	7·32	7·35	13·358
Cupro-sulphate of Ammonia	1	123	100·00	100·00	99·538

The cupri ammonio-sulphas, Ph. L., usually contains some undecomposed sesquicarbonate (bicarbonate?) of ammonia, and probably some sulphate (subsulphate?) of copper.

Physiological Effects.—Its action is, for the most part, similar to sulphate of copper. Wibmer (*Wirk. d. Arzneim.* ii. 256) examined its effects on horses and dogs. Four grains dissolved in water, and injected into the veins, killed a dog. The respiration and circulation were quickened by it. In some cases vomiting and purging were produced; weakness, tremblings, and paralysis, indicated its action on the nervous system. Its general effects on man are like those of sulphate of copper, but it is thought to be less disposed to occasion nausea and vomiting. An over-dose, however, readily acts as an emetic. Its action is probably somewhat more stimulant to the general system than the sulphate. It is employed in medicine as a tonic and antispasmodic.

Uses.—*Internally* it has been principally employed in chronic spasmodic affections; such as epilepsy, chorea, catalepsy, hysteria, spasmodic asthma, and cramp of the stomach. In epilepsy it has been much esteemed, and was found useful by Dr. Cullen (*Treat. on Mat. Med.*), and other accurate observers; but, like all other remedies for this curious disease, it frequently fails. It has also been used in ague and dropsy. As a *topical* remedy, a solution of it has been employed as an injection in gonorrhœa and leucorrhœa; and as a collyrium to remove opacity of the cornea.

Administration.—It may be administered internally in doses of from half a grain gradually increased to five grains. It is usually exhibited in the form of pill; rarely in that of solution.

Pilulæ Ammoniareti Cupri, Ph. Ed. (ammoniaret of copper, in fine powder, gr. xvj.; crumb of bread, ℈iv.; water of carbonate of ammonia, q. s. Beat into a mass, and divide into thirty-two equal pills).—

ach pill contains half a grain of ammoniaret of copper. The dose is om one to five or six pills.

Liquor Cupri Ammonio-sulphatis, Ph. Lond. *Cupri ammo-ati aqua*, Ph. Dub. (Ammoniated copper, ʒj.; distilled water, ℥xx. issolve and strain. In the Dublin Pharmacopœia one part of the salt used to a hundred parts of distilled water).—It is applied to indolent cers as a stimulant and detergent; and, when diluted, to the eye, to move slight specks of the cornea.

Cu'pri Subace'tas.—Subac'etate of Cop'per.

History.—Hippocrates employed *verdigris*, which he terms χαλκοῦ ἰὸς, *rust of copper*, in diseases of the eyes, and as an astringent in hæmor-oids (Ed. Fæs. 635, 636 & 894). Theophrastus (*De Lapidibus*), Diosco-les (lib. v. cap. xci.), and Pliny (*Hist. Nat.* xxxiv.) describe the method procuring it. The Romans called it *ærugo*. It is frequently termed *acetate of copper;* but this name is objectionable, since verdigris fre-iently occurs as a *subsesquiacetate* mixed with the *trisacetate*. I prefer e less precise, though more accurate term, *subacetate of copper*.

Preparation.—At Montpellier it is thus made:—The refuse of grapes allowed to ferment with sour wine, and is then laid in alternate strata th plates of copper: acetous fermentation takes place, and the metal comes oxidized by the combined influence of the air and acid. In out fifteen days the plates are covered with the acetate of copper; they e then wetted, and exposed for a month to the air: the acetate absorbs e water, and uniting with more oxide of copper, forms a subacetate, iich is scraped off, and packed in leathern sacks for exportation. At renoble verdigris is obtained by sprinkling plates of copper with ready-ide vinegar (Dumas, *Traité de Chim.* v. 169). In this country it is epared by exposing thin plates of copper to the action of acetic acid, its fumes: the method now practised consists in alternating plates of pper with pieces of woollen cloth steeped in acetic acid; they gra-ally become corroded, and superficially covered with verdigris, which from time to time removed, and the operation repeated, as long as the ate lasts (Brande's *Manual of Chemistry*). French verdigris is imported sacks, weighing from 25 to 30 pounds.

Properties.—It occurs in masses or in powder. One variety is of a le bluish green colour; another is blue. Its taste is astringent and etallic; its odour is somewhat similar to, though more disagreeable, an acetic acid. It is insoluble in alcohol. Water resolves it into a uble acetate and an insoluble trisacetate. Hence the *cupri subacetas æparatum* of the Dublin Pharmacopœia, and which is directed to be epared by levigation and elutriation, is in fact the trisacetate, the rdigris having undergone a chemical change by the action of water.

Characteristics.—When digested with strong sulphuric acid, it olves acetic acid, which is readily distinguished by its odour. Heated a glass tube it gives out acetic acid; the residue contains metallic pper. If verdigris be boiled in distilled water a solution is obtained, iich is known to contain copper by its colour, and by the before-men-ned tests for the cupreous compounds (*vide* p. 493).

Composition.—The blue verdigris is a hydrated diacetate of copper.

Verdigris with a greenish tint consists of the subsesquiacetate and the trisacetate (Berzelius, *Traité de Chimie*, iv. 347 & 349). The composition of these salts is as follows:—

	DIACETATE.			SUBSESQUIACETATE.			TRISACETATE.		
	Eq.	Eq.Wt.	Per Cent.	Eq.	Eq.Wt.	Per Cent.	Eq.	Eq.Wt.	Per Cent.
Oxide of copper	2	80	43·24	1½	60	43·48	3	120	63·5
Acetic Acid	1	51	27·57	1	51	36·96	1	51	27·0
Water	6	54	29·19	3	27	19·56	2	18	9·5
	1	185	100·00	1	138	100·00	1	189	100·0

Physiological Effects.—The action of verdigris on the system is very similar to that of the other preparations of copper: thus, taken in small and repeated doses, it acts on the nervous system, and is called tonic and antispasmodic; in larger doses it operates as an emetic; and, in excessive doses, is a powerful poison, producing both gastro-enteritis (indicated by vomiting, purging, and pain), and an affection of the nervous system (marked by insensibility, convulsions, and even tetanus).

Uses.—Verdigris, when taken into the stomach, being variable and dangerous in its operation, is never administered internally. It was formerly employed in obstinate syphilis, when mercurials failed.

The *powder* is sometimes employed as an escharotic. It is sprinkled over foul and indolent ulcers, or, when mixed with savin, is applied to destroy venereal warts. When used for the latter purpose it rarely fails.

Linimentum Æruginis, Ph. Lond. *Oxymel cupri subacetatis*, Ph. Dubl. (verdigris, powdered [prepared subacetate, *Dubl.*], ℥j.; vinegar [distilled, *Dubl.*] f.℥vij.; clarified honey, ℥xiv. Dissolve the verdigris in the vinegar, and strain the solution through linen; afterwards, the honey being added, boil down to a proper consistence).—This was formerly called *Mel Ægyptiacum*, *Unguentum Ægyptiacum*, or *Oxymel Æruginis*. It is stimulant, detergent, and slightly escharotic. It is applied by means of a camel's-hair pencil to venereal ulcers of the throat, as well as to other indolent ulcers. Diluted with water it is employed as a gargle.

Unguentum Cupri Subacetatis, Ph. Dubl.; *unguentum cupri subacetatis*, Ph. Ed. (Prepared subacetate of copper, ℥ss.; olive oil, ℥j.; ointment of white resin, ℔j. M. *Ph. Dubl.*—Resinous ointment, 15 parts; subacetate of copper, in very fine powder, 1 part. M. *Ph. Ed.*)—This is a stimulant and mild escharotic. It is used as an application to foul ulcers, in ophthalmia tarsi, as a cure for the obstinate forms of ring-worm, and as an application to corns.

Andidotes.—*Vide* Cuprum.

Cu'pri Ace'tas.—Ac'etate of Copper.

This salt is commonly, though very improperly, termed *distilled* or *crystallized verdigris*, and is met with in the shops crystallized on sticks. It is usually prepared by dissolving common verdigris in acetic acid, and crystallizing. The crystals are oblique rhombic prisms. They consist of one equivalent of oxide of copper, one equivalent of acetic acid, and one equivalent of water. This salt is completely soluble in water, by which it is distinguished from common verdigris. In most other properties it agrees with the latter. It is included in the list of materia edica of the Dublin Pharmacopœia, but for what reason I cannot divine, nce it is never used in medicine.

Order 22.—Bismuth and its Compounds.

Bismu'thum.—Bis'muth.

History.—This metal is first mentioned by Agricola, in 1529. It has en termed *Marcasita*, *Tectum Argenti*, or, by the Germans, *Wismuth.* The old miners called it Wismuth," says Matthesius, " because it ooms as a beautiful meadow (*Wiesematte*), on which variegated flowers all kinds are glittering," (Schwartze, *Pharm. Tabellen*).

Natural History.—Bismuth occurs only in the mineral kingdom. It found in Cornwall, Saxony, Bohemia, &c. It is met with in the me-llic state nearly pure (*native bismuth*), and in combination with sul-ıur and with oxygen.

Preparation.—It is chiefly obtained from native bismuth by melting e metal out of its gangue.

Properties.—It is a reddish white metal, without taste or smell, com-osed of brilliant broad plates, and readily crystallizable in cubes or gular octahedrons. Its sp. gr. is 9·83 to 9·88. It is moderately hard, ittle, pulverizable, fusible at 476° F. When strongly heated in the air takes fire, and burns with a faint blue flame, emitting a yellow smoke ıe oxide). In close vessels it may be volatilized. Its equivalent is 72.

Characteristics.—It is distinguished by its brittleness, its ready sibility, its solubility in nitric acid, and by the characters of the nitric lution, which throws down a white precipitate on the addition of ıter, and a black one when hydrosulphuric acid or the hydrosulphates e added to it.

Purity.—Any arsenicum, which may be mixed with bismuth, is soluble in nitric acid: it is converted by the acid into an insoluble seniate. Copper may be detected by precipitating the nitric solution th ammonia; the supernatant liquor is blue if copper be present.

Physiological Effects and Uses.—In the metallic state, bismuth is ert. Its only use is in the preparation of the trisnitrate.

Bismu'thi Trisni'tras.—Trisni'trate of Bis'muth.

History.—This compound was first prepared by Lemery. It has had rious appellations, such as *pearl* or *flake white*, *magistery of bismuth* lso a name for submuriate of bismuth), *Spanish white*, *subnitrate* or *'arto-nitrate of bismuth.*

Preparation.—In the London Pharmacopœia it is directed to be epared by dissolving one ounce of bismuth in a fluid ounce and a half nitric acid, to which six drachms of water have been added. After e solution has been filtered, about three pints of distilled water e to be added: the subnitrate precipitates, and is to be collected, ıshed, and dried.

In the Dublin Pharmacopœia, seven parts of bismuth are dissolved in enty parts of diluted nitric acid, and the solution added to a hundred rts of water.

In the first part of this process we obtain a nitrate of bismuth by the re-action of three equivalents or 216 parts of bismuth, on four equivalents or 216 parts of nitric acid. One equivalent or 30 parts of binoxide of nitrogen are evolved, and three equivalents or 402 parts of nitrate of bismuth formed.

REAGENTS.			RESULTS.
1 eq. Nitric Acid 54	1 eq. Binox. Nitrog. 30		1 eq. Binox. Nitrog. 30
	3 eq. Oxygen 24	3 eq. *Ox. Bism^h*. 240	
3 eq. Bismuth	216		
3 eq. Nitric Acid	162		3 eq. Nitrate Bism. 402

When nitrate of bismuth is mixed with water, two bismuthic salts are produced; a soluble supersalt (*ternitrate*), and an insoluble subsalt (*trisnitrate*).

REAGENTS.		RESULTS.
1 eq. Nitrate Bismuth = 134		1 eq. Ternitrate Bismuth = 242
3 eq. Nitrate Bismuth = 402	2 eq. Nitric Acid 108	
	1 eq. Nitric Acid 54	1 eq. Trisnitrate Bismuth = 294
	3 eq. Oxide Bismuth = 240	

Properties.—It is a dull white, inodorous, tasteless powder, which consists of very fine silky needles. It is nearly insoluble in water, but is readily dissolved by nitric acid. By exposure to light it becomes greyish.

Characteristics. — Hydrosulphuric acid, or the hydrosulphates, blacken it, by forming the sulphuret of bismuth. It dissolves in nitric acid without effervescence. Heated on charcoal by the blowpipe flame it gives out nitrous acid, and yields the yellow oxide of bismuth; and, by a continuance of the heat, the oxide is reduced, globules of metallic bismuth being obtained, which may be readily distinguished from globules of lead by their brittleness; for, when struck sharply by a hammer on an anvil, they fly to pieces: from antimony they are distinguished by their solubility in nitric acid.

Composition.—Its composition, according to Mr. Phillips (*Phil. Mag.* Dec. 1830, p. 409,) is as follows:—

	Eq.	Eq.Wt.	Per Cent.	R. Phillips.
Oxide of Bismuth	3	240	81·64	81·92
Nitric Acid	1	54	18·36	18·28
Trisnitrate of Bismuth ...	1	294	100·00	100·00

Purity.—Its freedom from any carbonate (as of lead) is distinguished by its solution in nitric acid without effervescence. Sulphuric acid added to the solution throws down a white precipitate, if lead be present.

Physiological Effects. (*a.*) *On animals.*—It acts as a local irritant and caustic poison. Moreover it appears to exercise a specific influence over the lungs and nervous system (Orfila, *Toxicol. Gén.*)

(*b.*) *On man.*—In *small doses* it acts locally as an astringent, diminishing secretion. On account of the frequent relief given by it in painful affections of the stomach, it is supposed to act on the nerves of this viscus as a sedative. It has also been denominated tonic and antispasmodic. Vogt (*Pharmakodynamik*, i. 288, 2^te Aufl.) says, that when used as a cosmetic, it has produced a spasmodic trembling of the muscles of the face, ending in paralysis.

Large medicinal doses disorder the digestive organs, occasioning pain, vomiting, purging, &c.; and sometimes affecting the nervous system, and producing giddiness, insensibility, cramps of the extremities, &c.

The following is the only reported case of poisoning with it. A man took two drachms by mistake, and died therefrom on the ninth day. In ldition to the usual symptoms of gastro-enteritis, there was a dis-dered condition of the nervous system, indicated by cramps of the inds and feet, disordered vision, and delirium. It is deserving also of mark, that there were difficulty of breathing, and salivation. Post-ortem examination showed inflammation throughout the alimentary inal; the spinal vessels were gorged with blood, particularly towards e cauda equina; there was fluid in the cerebral ventricles; and the ner surface of both ventricles of the heart was very red (Christison's *reatise on Poisons*).

We have not at present sufficient evidence before us to determine hether this medicine affects the general system by absorption or through ie intervention of the nervous system: its insolubility has led to the onclusion that it does not become absorbed.

Use.—It has been principally employed in those chronic affections of ie stomach which are unaccompanied with any organic disease, but hich apparently depend on some disordered condition of the nerves of iis viscus; and hence the efficacy of the remedy is referred to its sup-osed action on these parts. It has been particularly used and recom-iended to relieve gastrodynia and cramp of the stomach, to allay sick-ess and vomiting, and as a remedy for the waterbrash. It has also been dministered in intermittent fever, in spasmodic asthma, &c. Hahnemann as recommended a portion to be introduced into a hollow tooth, to allay ooth-ache. I have used it, with advantage, in the form of ointment, pplied to the septum nasi, in ulceration of this part, and as a local emedy in chronic skin diseases.

Administration.—The usual dose of this remedy is from five grains o a scruple, exhibited in the form of a pill. The ointment which I have ist referred to was composed of one drachm of the subnitrate, and half n ounce of spermaceti ointment.

Antidotes.—No chemical antidote is known. Emollient drinks should e administered, and the poison evacuated from the stomach as speedily s possible. The antiphlogistic plan is to be adopted, to obviate inflam-iation.

Order 23.—Tin.

Stan'num—Tin.

History.—Tin has been known from the most remote periods of ntiquity. It is mentioned by Moses (*Numbers*, xxxi. 22) and by Homer *Iliad*, xi. 25). The alchymists called it *Jove*, or *Jupiter*.

Natural History.—It is peculiar to the mineral kingdom. It occurs i two states; as an oxide (the *tin stone* and *wood tin* of mineralogists), nd as a sulphuret (*tin pyrites*). It is found in both states in Cornwall, hich has long been celebrated for its tin works. The Phœnicians, who ere perhaps the first people who carried on commerce by sea, traded ith England and Spain for tin at least 1000 years before Christ.

Preparation.—In Cornwall, *stream tin* (a variety of *tin stone*) is melted with charcoal. The metal thus procured is subsequently made iot, and then let fall from a height, by which it splits into a number of rregular prisms, somewhat like a basalt pillar. This is called *grain tin*. *Mine tin* (another variety of *tin stone*) is ground, washed, roasted, and afterwards smelted with Welsh culm and limestone, by which *block tin* is procured; the finest kind of which is called *refined tin* (Mr. John Taylor, *Ann. Phil.* iii. 449).

Besides the two varieties of tin just described, other kinds are met with in commerce. *Malacca tin* occurs in quadrangular pyramids, with flattened bases. *Banca tin* is met with in wedge-shaped pieces.

Properties.—In its massive form it is a yellowish-white metal, having a peculiar odour when rubbed or handled. Its sp. gr. is 7·29. It melts at 442° F. and at a white heat is volatilized. It is malleable, and forms *sheet tin* and *tin foil* (*stannum foliatum*), but is sparingly ductile. Its equivalent is 58.

Tin may be reduced to powder, by pouring melted tin into an iron mortar, and rubbing until it is cold; or by shaking melted tin in a wooden box, the inside of which has been rubbed with chalk. In this state it constitutes *powdered* or *granulated tin* (*pulvis stanni*, Ph. Dub., Ed. and U. S.) This as well as *tin filings* (*stanni limatura*, Ph. Ed. seu *rasura stanni*) have been used in medicine.

Characteristics.—Boiled in strong hydrochloric acid, we obtain a solution of protochloride of tin, which possesses the following characters:—Potash causes a white precipitate, soluble in excess of the precipitant; hydrosulphuric acid, a brown; and chloride of gold, a purple precipitate (the *purple powder of Cassius*). If protochloride of tin be heated with nitric acid, we obtain a perchloride which causes a yellowish precipitate with hydrosulphuric acid.

Physiological Effects.—In the mass, tin has no operation on the body, except that arising from its form and weight. Powdered tin is not known to produce any disorder in the functions of the body. It appears, however, that acid, fatty, saline, and even albuminous substances, may occasion colic and vomiting by having remained for some time in tin vessels. Oxide of tin is poisonous, according to Orfila (*Toxicol. Gén.*); but Schubarth (quoted by Dr. Christison, *Treat. on Poisons*) found it inactive.

Uses.—Powdered tin has been employed with great success by various eminent practitioners, as a vermifuge, particularly in tape-worm. Dr. Alston (*Med. Essays*, v. 89, 92; also *Lect. on Mat. Med.* i. 150) explains its operation on mechanical principles: he supposes that the powder of tin gets betwixt the worms and the inner coat of the alimentary canal, and causes them to quit their hold, so that purgatives easily carry them away with the fæces. It has, however, been asserted that water in which tin has been boiled is anthelmintic, at least so says Pitcairn and Pietsch (quoted by Richter, *Ausf. Arzneim.* iv. 553); wine which has been digested in a tin vessel is also said to be noxious to worms. If these statements be true, the before-mentioned mechanical explanation is inadmissible. Some have, therefore, supposed that the efficacy must depend on the tin becoming oxidized in the alimentary canal; others have fancied that arsenic, which is frequently found in tin, is the active agent; while, lastly, some have imagined that the metal, by its action on the fluids of the canal, generated hydrogen, or hydrosulphuric acid, which destroyed these parasites.

Dr. D. Monro (*Treat. on Med. and Pharm. Chem.* i. 289), Fothergill, and Richter, have used powdered tin in epilepsy produced by worms, and, as it is stated, with advantage.

Administration.—The usual mode of exhibiting it is mixed with ·eacle: the dose usually stated in pharmaeological works is one or two aehms, but Alston gave much larger quantities; his mode of employing as a vermifuge was the following:—The patient was well purged with nna, and on the following morning *one ounce* of tin powder was given four ounces of treacle; on each of the two following days half this antity was taken, and then the patient again purged. However, tin wder is certainly much inferior to oil of turpentine as a remedy for pe-worm.

Order 24.—Lead and its Compounds.

Plum'bum.—Lead.

History.—This metal was known in the most remote ages of antiquity. is mentioned by Moses (*Job*, xix. 23, 24.) The Greeks called it λιβδος; the alchymists, *Saturn*.

Natural History.—It is found in the metallic state (*native lead*), mbined with sulphur (*galena*), with selenium, with chlorine (*horn ad*), with oxygen (*native minium*), and with oxygen and an acid, forming oxy-salt (*carbonate, phosphate, sulphate, tungstate, molybdate, chromate, seniate*, and *aluminate*.)

Preparation.—It is usually extracted from galena, which is roasted reverberatory furnaces, by which it is converted into a mixture of lphate and oxide of lead, and afterwards smelted with coal and lime, e first to abstract oxygen, the second to remove the sulphur.

Properties.—It has a bluish-gray colour and considerable brilliancy. may be crystallized by cooling in four-sided pyramids. It is malleable, t not ductile. Its sp. gr. 11·35. It has a peculiar odour when ndled. It fuses at 612° F. and at a red heat boils and evaporates. s equivalent is 104. By exposure to the air it attracts, first oxygen, d then carbonic acid, so as to form carbonate of lead.

Pure distilled water has no action on lead, if the gases (as air and rbonic acid) be excluded; but if these be admitted, a thin crust of rbonate is soon formed. It is remarkable that the presence of most utral salts—sulphate of soda and chloride of sodium, for example— pairs the corrosive action of air and water. Hence, therefore, we can sily comprehend the reason why leaden cisterns and pipes do not more quently give a metallic impregnation to water; and why rain-water is ore apt than spring-water to become impregnated with lead. The ter, however, by long keeping in leaden vessels, may also become ntaminated with lead.

Characteristics.—If lead be dissolved in nitric acid, we may easily cognise its presence in the solution by the following tests:—Alkalies, eir carbonates, sulphuric acid and the sulphates, and ferrocyanide of tassium, produce white precipitates; chromate of potash and iodide of tassium occasion yellow precipitates; hydrosulphuric acid and the drosulphates form black precipitates of the sulphuret of lead; lastly, piece of zinc throws down metallic lead in an arborescent form.

The delicacy of these tests is, according to Devergie (*Méd. Lég.* ii. 779), follows:—

		Degree of Dilution.
Sulphate of Soda	stops at	5,000
Iodide of Potassium		10,000
Ferrocyanide of Potassium		18,000
Potash		20,000
Carbonate of Soda or of Potash		60,000
Chromate of Potash		100,000
Hydrosulphuric Acid		500,000

PHYSIOLOGICAL EFFECTS.—1. *Metallic lead.*—I believe that so long as lead retains its metallic form it is inert. In a French journal (*Journ. de Méd. de Leroux*, xxiii. 318) we are told that three ounces and six drachms of this metal have been given to a dog without any obvious effects. As, however, it is a metal which is readily oxidated, it occasionally proves active when swallowed, in consequence of its being acted on and oxidized by the contents of the alimentary canal. An instance of this kind is mentioned by Paulini (*Miscell. Nat. Cur. Dec.* ii. Ann. vi. App. p. 7. quoted by Voigtel, *Arzneimitellehre*), in which colic was produced by swallowing a leaden bullet. Proust (*Ann. de Chim.* lvii. 84) says, that the alloy of lead and tin may be swallowed with impunity, in consequence of its being much less easily oxidated than the pure metal.

2. *Of the preparations of lead.* (*a.*) *On vegetables.*—Marcet found the solution of acetate of lead injurious to plants; but Wiegmann declares it to be inert, and ascribes its inertness to the formation of an insoluble salt (carbonate) of lead by the carbonic acid of the roots of plants.

(*b.*) *On animals.*—The preparations of lead are, for the most part, energetic poisons. The *sulphuret*, however, appears to be inactive, or nearly so; for Orfila (*Toxicol. Gén.*) gave an ounce of it to dogs without observing any ill effects; four ounces have even been given to horses without any unpleasant results. The *sulphate*, also, according to Orfila, is inactive. Our knowledge of the effects of the salts of lead on animals is derived from experiments made with the acetates, nitrate, and carbonate. The first two act as corrosives: all affect the nervous system, manifested by convulsions, palsy, and colica pictonum. (Christison, *Treat. on Poisons*, 506 et seq. 3d ed.)

(*c.*) *On man.*—Mr. Braid (Christison, *op. cit.* 518) states that workmen who dig and pulverize the ore (sulphuret of lead), at the lead-mills in Lancashire, never have the lead colic until they work at the smelting furnaces.

Most, if not all, the other preparations are more or less active; the effects and symptoms, however, vary with the dose.

In *small doses* these preparations act on the alimentary canal as astringents; checking secretion and causing constipation. These may be regarded as the local effects. When absorbed, the constitutional effects of lead are observed: the arteries become reduced in size and activity, for the pulse becomes slower and smaller; the temperature of the body is diminished; and sanguineous discharges, whether natural or artificial, are frequently checked, or even completely stopped. This constringing and sedative effect seems extended to the secreting and exhaling vessels; the discharges from the mucous membranes, the exhalation from the skin, and the urine, being diminished in quantity. Thus we observe dryness of the mouth and throat, thirst, greater solidity of the alvine evacuations, diminution of the bronchial secretion, and of utaneous exhalation. From all these circumstances it would appear hat these preparations give rise to a contracted state of the coats of he blood-vessels (at least of the arteries.) It is not at all improbable hat the coats of the absorbents are similarly affected, as has been asserted. f this be the case, some obstruction would probably be offered to the assage of lymph ; the functions of absorption would be carried on with ess energy, and the lymphatic glands would perhaps become in conse-uence affected: the wasting of the body produced by lead in these small oses has been denominated *tabes saturnina*, or *tabes sicca.*

The long-continued use of the preparations of lead rarely fails to give vidence of its effect on the muscular and nervous systems, and which s manifested by a curious train of symptoms, commencing with colic, and erminating in palsy or apoplexy. *Lead* or *painter's colic* (*colica pictonum*) s variable in its mode of attack ; at one time commencing suddenly, and vithout any very marked premonitory symptoms, at another being pre-eded by dyspeptic symptoms—such as diminished appetite, with a ainful and constipated state of the bowels, the fæces being very hard. During an attack, there is usually obstinate constipation, with acute pain, nuch increased at intervals ; but sometimes a relaxed condition of the owels has been met with. Merat (*Traité de la Colique Métallique*) efers the continued pain to the small intestines, while the more violent nd intermitting kind resides principally in the transverse portion of the olon. Pressure rarely increases, and very commonly relieves, the pain. Cases, however, do occur (and I have seen several) in which there is great enderness of the bowels. The abdomen is strongly retracted, sinks in bout the navel, and feels very hard. To these symptoms may be added omiting, cramps of the lower extremities, hard and generally slow pulse, hough sometimes it has been found frequent.

De Haen and Merat, on examining the bodies of patients who have ied affected with lead colic, found a contracted condition of the colon, nd this was considered by the last-mentioned writer to indicate the seat f the disease. But Sir G. Baker, Andral (*Path. Anat.* by Townsend nd West, ii. 140), Louis, and Copland (*Dict. Pract. Med.* i. 366), have ot, in some cases, found any alteration. Moreover, it would appear robable from Dr. Abercrombie's observations on ileus (*On Diseases of he Abdom. Viscera*) that the empty and collapsed portion of the intestine vas not the seat of the colic, but another part found in a state of distension,— or the collapsed or contracted state is the natural condition of healthy ntestine when empty ; while the distended portion is, in ordinary cases f ileus, the primary seat of the disease, the distension arising from a aralytic condition of the muscular fibres, whereby it is unable to contract nd propel its contents onward. Now this view of the case is the more robable, since the action of lead on the muscular fibres of the intestine s regarded as of the same kind as that on the fibres of the voluntary nuscles. Some have found intus-susception, others have noticed marks f inflammation.

Another effect of poisoning by lead is an affection of the cerebro-spinal ystem, generally manifested by *paralysis*, but occasionally by giddiness, onvulsions, and coma, and now and then by apoplexy. The palsy may ccur without colic, or it may come on while the patient is suffering with t, but in general it succeeds colic. It may happen in both upper and ower extremities, though more frequently in the former ; and it affects the extensor more than the flexor muscles, so that the hands are generally bent on the arms, which hang dangling by the side. Frequently pain is experienced in the paralyzed part, and sometimes in the region of the spine also. On examining the bodies of persons who have died with this disease, no lesion has hitherto been discovered in the spinal marrow. The muscles of the affected limb are observed to be wasted and very pale, and have somtimes the appearance of a white fibrous tissue.

In *very large doses*, some of the plumbeous preparations (the acetate, for example) act as irritant and caustic poisons; giving rise to the usual symptoms indicative of gastro-enteritis. However, none of them equal, in the intensity of their local action, the mercurial or even the cupreous compounds.

Modus Operandi.—Tiedemann and Gmelin (*Vers. über d. Wege, wie Subst. aus d. Mag.'ins Blut. gelang.*) found lead in the blood of the splenic, mesenteric, and hepatic veins of dogs killed by the acetate; they also found it in the contents of the stomach and intestines, but neither in the chyle nor the urine. Wibmer (Christison's *Treatise on Poisons*, 3d edit. p. 509) detected it in the liver, muscles, and spinal cord.

The local or corrosive action of the soluble salts of lead depends on the affinity of these bodies for the organic constituents of the tissues (*vide* Plumbi Acetas).

The nervous system is specifically affected by lead. The paralysis of the voluntary muscles, the pain in the course of the spine, the occasional giddiness, coma, or apoplexy, seem to establish this. The colic as well as the astringent influence of lead over the coats of vessels are probably secondary effects of the action of lead over the nervous system.

The constitutional effects of lead may be produced in various ways: as, when taken with articles of food and drink into the stomach; when inhaled in the form of dust or vapour with the air; when applied to mucous membranes, ulcers, &c. Hence the persons most liable to these effects are those whose occupations bring them in contact with this metal; for example, painters, plumbers, roasters and smelters of lead, the manufacturers of the plumbeous preparations, glass-blowers, potters, lapidaries, &c.

Dr. Anthony Todd Thomson (*Lond. Med. Gaz.* v. 538, and x. 689) is of opinion, that carbonate of lead is the only preparation of this metal that can produce colic: and though he has, I think clearly, shewn that lead colic more frequently arises from the carbonate than from any other salt of lead, he has, in my opinion, failed in proving that no other preparation of lead *can* produce it. Indeed, if his opinion were true, it would constitute an exception to the general effects of the metallic preparations; for we do not find that the specific effects of arsenic, or of mercury, or of copper, or of antimony, are produced by one preparation only; so that, *à priori*, analogy is against the opinion. Furthermore, it is well known that the vapour of the oxide of lead taken into the lungs may produce colic, and that the ingestion of the acetate, citrate, or tartrate of lead, is capable of exciting the same effect. Now Dr. Thomson explains these facts by assuming that the oxide of lead unites with carbonic acid in the lungs, and is thus converted into carbonate: and that the acetate, citrate, and tartrate, are decomposed in the alimentary canal, and converted into carbonates. But it appears to me to be much more mple and consistent with analogy, to admit that these preparations are f themselves capable of producing colic, than to assume that they ndergo the changes here supposed. Moreover, in some instances in hich colic was produced, it is unlikely that these changes could have ccurred, owing to the excess of acid taken with the salt of lead.

USES.—The uses of the preparations of lead may be in part inferred om the foregoing account of their effects. These agents are employed hen we wish to constringe the capillary vessels and to diminish their ital activity. Thus we administer them internally to check excessive cretion and exhalation, as in catarrhal affections of the mucous memranes of a chronic nature; in profuse secretion of pus; in sanguineous xhalations from the mucous membranes; and in colliquative sweating. hey have also been applied, in some instances with success, in certain hronic affections of the nervous system, as epilepsy; but the practice is ltogether empirical, as we have no rational principles to guide us in sing them. As topical remedies, we employ the preparations of lead to iminish vascular excitement, to allay preternatural heat, and to check xcessive secretion. Thus we apply them to inflamed parts to promote esolution, and to ulcers and other secreting surfaces as astringents or esiccants. During the internal employment of lead, attention must be aid to the condition of the stomach and bowels, as we find the traces of heir injurious effects in these organs. Constipation is a very frequent esult of their medicinal employment. Loss of appetite, indigestion, and riping pains, are also often noticed. The tendency to colic is dimiished, according to Dr. A. T. Thomson, by conjoining acetic acid.

ANTIDOTES.—Poisoning by lead usually puts on one of three forms—*rritant poisoning*, *lead colic*, and *paralysis*.

1. *Irritant poisoning.*—Administer diluents holding in solution some ulphate (as sulphate of soda, of magnesia, or of potash or alum), so that sulphate of lead may be formed. If vomiting have not already come n, tickle the throat, and administer emetics of the sulphate of zinc or of opper, or the stomach-pump may be employed.

2. *Lead colic.*—Here the best remedy is alum (*vide* pp. 372, 373). But in this country lead colic is frequently treated by the combined use f purgatives and anodynes, the purgatives being either castor oil or salts nd senna, the anodyne being opium. When the vomiting is very roublesome, and liquid medicines do not remain on the stomach, we may ive the compound extract of colocynth, with opium, in the form of pill. n several cases in which the pulse was full and strong, the face flushed, nd the tongue furred and dry, I have used blood-letting with evident dvantage. The sulphates have been recommended, as also mercury.

3. *Lead paralysis.*—Nux vomica, and its active principles—strychnia nd brucia, are perhaps of all internal remedies most deserving of trial, ecause of their specific effect on the spinal marrow; and the chance of heir success is, of course, much increased by the circumstance of there eing no discoverable lesion of this portion of the nervous system. Mercury has been recommended by Dr. Clutterbuck. Various local neasures have been tried, but without much benefit; for example, lectricity and irritants (such as ammonia and cantharides).

Plum'bi Ox'ydum.—Ox'ide of Lead.

History.—The ancients were acquainted with oxide (or *protoxide*) of lead. Hippocrates (*De Morb. Mul.* ii.) employed the semi-vitrified oxide (*litharge*, λιθάργυρον). Dioscorides (lib. v. cap. cii.) and Pliny (*Hist. Nat.* xxxiv. 53) both mention litharge: the latter calls it *molybdæna.*

Preparation.—Litharge is usually obtained as a secondary product in the cupellation of argentiferous lead. The alloy is melted on a porous vessel, called a *test* or *cupel*, and exposed to the blast of a bellows, by which the lead is oxidized, half vitrified, and driven off into hard masses of a scaly texture, and is called, in that state, *litharge* or *silver stone* (Watson's *Chem. Essays*, iii. 325, 6th ed.)

The compound called in the London Pharmacopœia *hydrated oxide of lead* (*plumbi oxydum hydratum*) is prepared by mixing six pints (or as much as may be sufficient) of solution of potash with six pints of solution of diacetate of lead and three gallons of distilled water. The precipitate is to be washed until nothing alkaline remains. In this process the potash combines with acetic acid, and forms acetate of potash, which remains in solution; while a white compound, called by Mr. Phillips hydrated oxide of lead, is precipitated. But it is stated, that "oxide of lead does not form a hydrate with water, the white powder which caustic alkalies throw down in solution of lead being a basic (sub) salt" (Geiger's *Handb. d. Pharm.* von J. Liebig).

Properties.—Oxide of lead presents itself in several forms. One of these is yellow, and is termed *Massicot* (*cerussa citrina*). When semi-vitrified (*plumbi oxydum semivitreum*), it is called *litharge* (*lithargyrum*), which occurs in the form of small yellow or reddish scales or flakes, and, according to its colour, is called *gold* or *silver litharge* (*lithargyrum aureum* [*chrysitis*] seu *argenteum* [*argyritis*]). The *plumbi oxydum hydratum*, Ph. Lond., is a perfectly white powder.

Oxide of lead is fusible, and at a very high temperature volatile. When heated in contact with charcoal or carbonaceous bodies, it is readily reduced to the metallic state. It is insoluble in water.

Characteristics.—Heated on charcoal by the blowpipe, it is readily reduced to the metallic state. It is blackened by hydrosulphuric acid, and completely dissolves in nitric acid. The characteristics of this solution have been already described (*vide* p. 505). The varieties of the oxide are distinguished by their physical peculiarities.

Composition.—Oxide of lead is thus composed:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Berthier.
Lead	1	104	92·85	92·85	93·3
Oxygen	1	8	7·14	7·15	6·7
Oxide of Lead	1	112	99·99	100·00	100·0

Physiological Effects.—Inhaled in the form of vapour, or fine dust, it produces the before-mentioned constitutional effects of lead (*vide* p. 506).

The effects of this substance, when swallowed, are but little known. It possesses very slightly irritant properties. "The experimentalists of ons found litharge to be irritant in large doses of half an ounce," ıristison, *op. cit.* p. 509).

From its external use ill consequences have sometimes resulted.

USES.—The oxides of lead are never employed internally. Litharge sometimes sprinkled over ulcers, as an astringent and desiccating ›stance.

In pharmacy, litharge is used in the preparation of EMPLASTRUM ·MBI, CERATUM SAPONIS, ACETAS PLUMBI, and LIQUOR PLUMBI ·CETATIS.

The *plumbi oxydum hydratum*, Ph. Lond., is directed to be used in ·paring QUINÆ SULPHAS. But the Pharmacopœial process for making ː latter substance has not been found by manufacturers to answer, d, therefore, the hydrated oxide of lead is, in fact, not employed in armacy.

HAIR DYE.—Various powders, pastes, and liquids, have been pre- ·red for dyeing the hair brown or black (*Journ. de Chém. Méd.* ii. 250, ᶜ Ser.) In general a mixture, or rather compound, of litharge and ıe is employed. The preparation sold as *Orfila's hair dye* is of this ıd. The proportions are one part of each, or three parts of litharge d two of lime. Sometimes carbonate of lead is partially or wholly ›stituted for litharge. The mixture is made into a paste with hot ·ter or milk, and applied to the hair for four or five hours, the ·rt being enveloped in oil-skin or a cabbage leaf. The water causes ː oxide of lead to combine with the lime, and thereby form a saline ·mpound, called *plumbite of lime*. The lime is useful by removing the ·ty matter of the hair, while the oxide of lead forms, with the sulphur ·ntained in the oil of the hair, a black sulphuret of lead. Dyed hair is ·y and crisp. The mode of detecting stained hair has been described the late Dr. Cummin (*Lond. Med. Gaz.* xix. 215), and by Devergie *Iéd. Lég.* ii. 931).

Plum'bi Chlo'ridum.—Chlo'ride of Lead.

NATURAL HISTORY.—Chloride of lead occurs in the mineral kingdom.

PREPARATION.—In the London Pharmacopœia this compound is di- ·ted to be prepared as follows :—Dissolve 19 ounces of acetate of lead three pints of boiling distilled water, and 6 ounces of chloride of ·dium in one pint of boiling distilled water: mix. Wash the precipi- ·e when cold with distilled water, and dry it.

In this process one equivalent or 163 parts of dry acetate of lead are composed by one equivalent or 60 parts of chloride of sodium; by ıich one equivalent or 140 parts of chloride of lead are precipitated, d one equivalent or 83 parts of acetate of soda remain in solution.

REAGENTS.				RESULTS.
·. Acetate of ·ead.... 163	1 eq. Acetic Acid............... 51			1 eq. Acetate Soda 83
	1 eq. Ox. Lead 112	1 eq. Oxyg. 8	1 eq. *Soda* 32	
		1 eq. Lead 104		
·.Chloride of ·odium.. 60	1 eq. Sodium 24			
	1 eq. Chlorine 36			1 eq. Chlorde Lead 140

ydrochloric acid occasions the precipitation of more chloride of lead ·er the action of the chloride of sodium is over; so that there must be ·me compound of lead in solution (Phillips, *Transl. of Pharm.* 3rd ed.)

Properties.—It is a white crystalline powder (*magisterium saturni Crollii*), soluble in thirty parts of cold or twenty-two parts of boiling water. When heated it fuses; and by cooling forms a semitransparent horny-like mass, called *horn lead* (*plumbum corneum*).

Characteristics.—Its aqueous solution causes a white precipitate with nitrate of silver, soluble in ammonia but insoluble in nitric acid: hence it is shown to be a chloride. The solution is known to contain lead by the before-mentioned tests for this metal (*vide* p. 505).

Composition.—The following is its composition:—

	Eq.	Eq.Wt.	Per Cent.	J. Davy.
Lead	1	104	74·3	74·22
Chlorine	1	36	25·7	25·78
Chloride of Lead	1	140	100·0	100·00

Use.—It is employed in the preparation of hydrochlorate of morphia.

Plum'bi Io'didum.—I'odide of Lead.

History.—This compound was introduced into medicine by Cottereau and Verdé-Delisle.

Preparation.—It is prepared by adding a solution of iodide of potassium to a solution of acetate of lead. The reacting proportions are 166 parts of iodide and 190 of crystallized acetate. In the London Pharmacopœia, the proportions directed to be employed are seven ounces of iodide of potassium and nine ounces of acetate of lead: the quantity of iodide of potassium is, therefore, larger than theory would dictate, supposing the acetate to be neutral. This excess is disadvantageous, since it retains a portion of the iodide of lead in solution. To prevent the formation of an oxyiodide of lead, a little acetic acid should be added to the acetate of lead, before adding the iodide of potassium. The precipitate should be washed and dried.

By the mutual reaction of one equivalent or 163 parts of dry acetate of lead, and one equivalent or 166 parts of iodide of potassium, we obtain one equivalent or 230 parts of iodide of lead, and one equivalent or 99 parts of dry acetate of potash.

REAGENTS.					RESULTS.
1 eq. Acetate Lead, 163	1 eq. Acetic Acid		51		1 eq. Acet. Potash, 99
	1 eq. Ox. Lead 112	1 eq. Oxyg.	8	1 eq. *Potash*, 48	
		1 eq. Lead	104		
1 eq. Iodide Potassm. 166	1 eq. Potassium		40		
	1 eq. Iodine		126		1 eq. Iodide Lead, 230

Properties.—It is a fine yellow powder, very sparingly soluble in cold water, but readily soluble in boiling water; from which it for the most part separates, as the solution cools, in the form of golden yellow, brilliant, small scales. It is fusible. It combines with the alkaline iodides, forming a class of double salts, called the *plumbo-iodides* (*iodo-plumbates*, Thomson). Caustic potash dissolves it, and forms a plumbo-iodide of potassium and plumbate of potash (Dumas, *Traité de Chim.* iii. 379). It is soluble in acetic acid and in alcohol.

Characteristics.—When heated, it first forms a yellow vapour (iodide of lead), and afterwards a violet vapour (iodine), leaving a residue (lead), which, when dissolved in nitric acid, gives all the characters of a ution of lead (*vide* p. 505). Boiled with carbonate of potash, it forms rbonate of lead and iodide of potassium.

COMPOSITION.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Henry.
Lead	1	104	45·21	45·1
Iodine	1	126	54·78	54·9
Iodide of Lead	1	230	99·99	100·0

PURITY.—It should be completely soluble in boiling water.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—Twenty-four grains of lide of lead were given to a cat at two doses, with an interval of four urs: the animal suffered violent colic, and died in three days; but no ns of irritation were observed after death (Paton, *Journ. de Chim.* iii. , 2nde Ser.) Iodide of lead was given in doses of from gr. v. to ʒss. a bull-dog: no effect was observed until the fifteenth day, when the imal refused food, and kept in the recumbent posture. He died on the hteenth day, having swallowed altogether ten drachms and fifty grains iodide. During the whole period, he had only three or four intestinal icuations (Cogswell, *Essay on Iodine*, 143).

(*b.*) *On man.*—Its effects on man have been imperfectly determined. does not appear to act as an irritant when applied to the skin or erated surfaces. Under the continued external and internal use of it, argements of the lymphatic glands have disappeared, from which we er a specific influence over the glandular and lymphatic system. In ne cases it appeared to occasion irritation of the stomach. I have n constipation induced by it.

USES.—It has been principally employed to reduce the volume of lolent tumors, especially enlargements of the cervical, axillary, and senteric glands. In these cases it should be simultaneously adminis- ed internally and externally. I have used it in two cases of enlarged vical glands, but without benefit. Velpeau (Lugol's *Essays*, by Dr. Shaughnessy, p. 206) and others, however, have been more successful.

ADMINISTRATION.—The dose is half a grain gradually increased. Dr. Shaughnessy (Lugol's *Essays*, p. 207) says, ten-grain doses are easily ne, without the slightest annoyance.

UNGUENTUM PLUMBI IODIDI, Ph. Lond. (iodide of lead, ℥j.; lard, ij. M.)—This is applied, by way of friction, to scrofulous and other olent swellings.

Plum'bi Car'bonas.—Car'bonate of Lead.

HISTORY.—This substance was employed by Hippocrates (*De Morbis*, ii.), under the name of ψιμμίθιον. Theophrastus (*De Lapidibus*) de- ibed the method of making it. Dioscorides (lib. v. cap. ciii.) and ny (*Hist. Nat.* lib. xxxiv.) also mention it.

t has been known by several names, as *psimmythium*, *ceruse* (*cerussa*), *gistery of lead* (*magisterium plumbi*), *white lead*, and *subcarbonate of l.*

NATURAL HISTORY.—This salt is found native, crystallized, or mas- , in Scotland, England, &c. It is called *white-lead ore.*

PREPARATION.—The old method of obtaining it is by exposing coils of l-plate, placed perpendicularly in earthen pots, to the vapour of acetic acid. The pots, in the bottom of which is contained the acid, are buried in stable litter or tanners' bark. The plates become corroded and covered with carbonate of lead. In this process, the lead, when in contact with acetic vapour, rapidly abstracts oxygen from the air, and the oxide which is formed, combining with some acetic acid, forms a sub-acetate, which is decomposed by the carbonic acid of the air, forming carbonate and the neutral acetate of lead. The latter is reconverted into a subsalt, and is then decomposed by carbonic acid. At the end of the process, a small quantity of acetate of lead remains mixed with the carbonate, and is removed by washing.

Pure carbonate of lead may be procured by adding a solution of an alkaline carbonate to a solution of acetate of lead.

Carbonate of lead may be also procured by passing carbonic acid (obtained by the combustion of charcoal or coal) through a solution of subacetate or subnitrate of lead.

Properties.—The primary form of the crystals of the native carbonate of lead is a right rhombic prism. Artificial carbonate is a heavy, snow-white, tasteless powder, or in white chalk-like masses. It is insoluble in water, but dissolves in caustic potash. When heated it gives out carbonic acid, and forms the yellow oxide.

Characteristics.—Heated before the blow-pipe, on charcoal, it yields metallic lead. It is blackened by hydrosulphuric acid. It dissolves in nitric acid with effervescence. The solution possesses the general characters of the plumbeous solutions already described (*vide* p. 505).

Composition.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Oxide of Lead	1	112	83·58	83·5
Carbonic Acid	1	22	16·42	16·5
Carbonate of Lead	1	134	100·00	100·0

Purity.—Carbonate of lead of commerce is rarely pure. It is usually adulterated with earthy or metallic sulphates (as of lime, baryta, or lead.) These are detected by their insolubility in diluted nitric acid. Chalk (which is by some used to adulterate it) may be detected as follows:—Dissolve the suspected substance in nitric acid, and precipitate the lead by hydrosulphuric acid. Boil and filter the solution, in which will be contained nitrate of lime (if chalk had been present), recognizable by oxalic acid or oxalate of ammonia (*vide* p. 343.)

Physiological Effects.—Its *local* effects are not very powerful: applied to ulcerated surfaces, it acts as a desiccative and astringent substance: swallowed in large quantities, it does not act as a local irritant, like the acetate. Its *constitutional* effects are similar to those of the other preparations of lead, already described. It appears probable (*vide* p. 508) that carbonate of lead more frequently produces colic than the acetate of lead—a circumstance which Dr. Christison thinks may be owing to the great obstinacy with which its impalpable powder adheres to moist membranous surfaces, and the consequent greater certainty of its ultimate absorption.

Uses.—It is never administered internally.

Externally it is employed as a dusting powder in excoriations of children and lusty persons; but the practice is objectionable, on account of the nger of absorption. In one case, related by Kopp (Richter, *Ausführ. rzneim.* iv. 613) a child was destroyed by it.

Unguentum Plumbi Carbonatis, Ph. Dubl. and Ed. (Carbonate lead, reduced to very fine powder, ℥ij.; ointment of white wax, lbj. M. ne Edinburgh formula is one part of carbonate of lead, and five parts simple ointment.)—This ointment is valuable as a cooling and desiccative plication to excoriated surfaces or burns.

An ointment or plaster of carbonate of lead has been known to give ief in some cases of neuralgia (*Journ. de Pharm.* xx. 603).

Plum'bi Ace'tas.—Ac'etate of Lead.

History.—Raymond Lully and Isaac Hollandus were acquainted with s salt in the 13th century. It has been known by several appellations, *sugar of lead* (*saccharum saturni*), *acetated ceruse* (*cerussa acetata*), d *superacetate of lead* (*plumbi superacetas*).

Preparation.—Though directions are given in the Pharmacopœia its preparation, it is never made by the apothecary, but is procured m persons who manufacture it on a large scale.

It is sometimes made by immersing lead in acetic acid. The metal racts oxygen from the air and combines with the acid. It may also procured by dissolving carbonate of lead in acetic acid, filtering the ution, and evaporating so that it may crystallize. But it is almost clusively obtained now by dissolving oxide of lead (litharge or massicot) acetic (pyroligneous) acid. This process is the one followed in the ndon Pharmacopœia; where four pounds and two ounces of powdered narge are directed to be dissolved, by the aid of a gentle heat, in a xture of four pints of acetic acid and four pints of distilled water. The ution is to be strained, and evaporated so that it may yield crystals. this process, the oxide, in virtue of its affinity for acetic acid, combines h the latter, and forms a definite compound.

Properties.—The primary form of the crystals of this salt is the right ique-angled prism. Their taste is sweetish and astringent. In a dry l warm atmosphere they slightly effloresce. When heated they fuse, e out their water of crystallization, and, at a higher temperature, decomposed; yielding acetic acid, *pyroacetic spirit* (or *acetone*), bonic acid, inflammable gas, and water: the residuum is a mixture of d and charcoal. Acetate of lead is soluble in both water and alcohol. e aqueous solution feebly reddens litmus, though it communicates a en colour to the juice of violets. A solution of the neutral acetate is tially decomposed by carbonic acid: a small quantity of carbonate of l is precipitated, and a portion of acetic acid is set free, which protects remaining solution from further change.

Characters.—When heated with sulphuric acid, the vapour of acetic d is disengaged. Its solution is known to contain lead by the tests this metal already mentioned (*vide* p. 505). If a small quantity of tic acid be added to the solution, a current of carbonic acid occasions precipitate. The ordinary acetate of the shops usually throws down canty white precipitate (carbonate of lead) with carbonic acid. When rred, it readily yields globules of metallic lead on the application of blowpipe flame.

COMPOSITION.—This salt, when properly prepared, has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.
Oxide of Lead	1	112	58·9	58·71
Acetic Acid	1	51	26·8	26·97
Water	3	27	14·3	14·32
Crystall[d] Acetate of Lead	1	190	100·0	100·00

PURITY.—It should be readily and completely soluble in water. Sulphuric acid, or sulphuretted hydrogen in excess, being added to the solution, to throw down the lead, the supernatant liquor should be completely volatilized by heat: any fixed residue is impurity.

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—(*Vide* p. 506.)

(*b.*) *On animals.*—Orfila (*Toxicol. Gén.*) found that in large doses the acetate of lead acted on dogs as an irritant, and caused vomiting, pain, and death. When the action was slower, and absorption took place, an affection of the nervous system was observed, marked by difficult progression, and in some cases convulsive movements. The mucous membrane lining the alimentary canal was found whitened (owing to the chemical influence of the poison), and, where the action was more prolonged, reddened. Injected into the veins, or applied to wounds, it affects the nervous system. Schloepfer (quoted by Dr. Christison, p. 507) produced colica pictonum, paralysis, and convulsions, in dogs, by the repeated use of small doses. Dr. A. T. Thomson (*Lond. Med. Gaz.* x. 691) gave successively, one, two, three, and six drachms to a dog without any ill effect.

(*c.*) *On man.*—Applied to ulcers, mucous membranes, or other secreting surfaces, it acts as a desiccative and astringent. It reacts chemically on the albumen of the secretions and of the living tissues, and forms therewith compounds, which are for the most part insoluble in water and acids (Dr. C. G. Mitscherlich, *Brit. Ann. of Med.* i. 204). Hence the difficulty with which this salt becomes absorbed. Some of its compounds with organic substances are, however, rendered soluble in water by acids (as the acetic, hydrochloric, and lactic). In large quantities, acetate of lead taken into the stomach acts as an irritant, and causes symptoms of inflammation of the stomach, viz. vomiting, burning in the gullet and stomach, and tenderness at the pit of the stomach; but these are usually accompanied with colica pictonum, and are not unfrequently followed by convulsions, coma, or local palsy (Christison, *Treat. on Poisons*, 3d edit. p. 512). Ten grains taken daily for seven days caused tightness of the breast, metallic taste, constriction of the throat, debility, sallow countenance, slow respiration and circulation, gums turgid and tender, ptyalism, tightness and numbness in the fingers and toes, no nausea, pains of the stomach and abdomen, bowels confined (Laidlaw, *Lond. Med. Repos.* N. S. vi. 292). The observations of Dr. A. T. Thomson and others (Van Swieten, Reynolds, Latham, Laidlaw, Daniell, Christison, &c.) have, however, shewn that injurious effects from the use of large doses are very rare. Dr. Christison has given eighteen grains daily for eight or ten days without any unpleasant symptoms whatever, except once or twice slight colic. Whenever this salt gives rise to any obvious effects, they are those of the plumbeous preparations in general, and which have been already described (p. 506.) Its medicinal action, therefore, is sedative and astringent.

Uses.—Acetate of lead is administered *internally* to diminish the diameter of the capillary vessels, and lessen circulation, secretion, and exhalation. Thus we employ it in profuse discharges from the mucous membranes; as from the lungs, alimentary canal, and even the urino-genital membrane. In the mild cholera, so common in this country towards the end of summer, I have found acetate of lead in combination with opium most efficacious where the chalk mixture failed. I have used this combination in a few cases of malignant cholera, and in one or two with apparent benefit. In colliquative diarrhœa and chronic dysentery it occasionally proves serviceable. In phthisis it has been found beneficial, but only as a palliative, namely, to lessen the expectoration, check the night sweats, or stop the harassing diarrhœa. Dr. Latham (*Med. Trans. Coll. Phys.* v. 341) speaks most favourably of the use of sugar of lead and opium in checking purulent or semipurulent expectoration. Though I have repeatedly seen it diminish expectoration, I have generally found it fail in relieving the night sweats, though Fouquier supposed it to possess a specific power of checking them: they are more frequently benefited by diluted sulphuric acid. In sanguineous exhalations from the mucous membranes, as epistaxis, hæmoptysis, and hæmatemesis, and in uterine hæmorrhage, it is employed with the view of diminishing the calibre of the bleeding vessels, and thereby of stopping the discharge; and experience has fully established its utility (Reynolds, *Trans. Coll. of Phys. London*, iii. 217; Davies, *Med. and Phys. Journ.* Jan. 1808, p. 8; also, Mitchell, *ibid.* p. 69; Latham, *op. cit.*). It may be employed in both the active and passive states of hæmorrhage. It is usually given in combination with opium. It has been employed also as a remedy for mercurial salivation (Daniell, *Lond. Med. Repos.* N. S. vi. 308). It had already been applied for this affection in the form of gargle by Sommé (*Archiv. Gén. de Méd.* i. 483). Unless care be taken to wash the mouth carefully after its use, it is apt to blacken the teeth. On the same principles that we administer it to check excessive mucous discharges, it has been employed to lessen the secretion of pus in extensive abscesses attended with hectic fever.

There are some other cases in which experience has shewn acetate of lead is occasionally serviceable, but in which we see no necessary connexion between its obvious effects on the body and its remedial powers; as in epilepsy, chorea, intermittents, &c.

As a *topical* remedy, we use acetate of lead as a sedative, astringent, and desiccative. An aqueous solution of it is applied to inflamed parts, or to secreting surfaces, to diminish profuse discharges. Thus we use it in phlegmonous inflammation, in ophthalmia, in ulcers with profuse discharges, in gonorrhœa, and gleet. In the sloughing and ulceration of the cornea which attend purulent and pustular ophthalmia, its use should be prohibited, as it forms a white compound which is deposited on the ulcer, to which it adheres tenaciously, and in the healing becomes permanently and indelibly imbedded in the structure of the cornea. The appearance produced by this cause cannot be mistaken: its chalky impervious opacity distinguishes it from the pearly semi-transparent structure of even the densest opacity produced by common ulceration (Dr. Jacob, *Dubl. Hosp. Rep.* v. 369). The white compound consists of oxide (acetate?) of lead, animal matter, much carbonate of lead, traces of phosphate, and chloride of the same metal (Dr. Apjohn, *op. cit.* p. 402).

ADMINISTRATION.—Acetate of lead is administered internally in doses of from one grain gradually increased to three, four, or more, even to eight or ten grains, repeated twice or thrice daily. Dr. A. T. Thomson advises its exhibition in diluted distilled vinegar, to prevent its change into carbonate, which renders it more apt to occasion colic. It is usually exhibited in the form of pill, frequently in combination with opium. Acetate of lead and opium react chemically on each other, and produce acetate of morphia and meconate, with a little sulphate of lead. Experience, however, has fully established the therapeutic value of the combination. Sulphuric acid (as in infusion of roses), sulphates (as of magnesia, and soda, and alum), phosphates, and carbonates, should be prohibited. Sulphuric acid, the sulphates, and phosphates, render it inert: the carbonates facilitate the production of colica pictonum. Common (especially spring) water, which contains sulphates, carbonates, and chlorides, is incompatible with this salt. The liquor ammoniæ acetatis is incompatible with it, on account of the carbonic acid usually diffused through this solution.

CERATUM PLUMBI ACETATIS, Ph. Lond.; *Unguentum Plumbi Acetatis*, Ph. Dubl. and Edinb. (Acetate of lead, powdered, ʒij.; white wax, ℥ij.; olive oil, f℥viij. M. Ph. Lond. The *Dublin College* mixes an ounce of the acetate of lead with a pound and a half of ointment of white wax. The *Edinburgh College* uses twenty parts of simple ointment and one part of acetate of lead in very fine powder.)—It is an excellent soothing application to irritable ulcers, painful excoriations, and blistered surfaces.

ANTIDOTE.—*Vide* PLUMBUM.

Li'quor Plum'bi Diaceta'tis.—Solu'tion of Diac'etate of Lead.

HISTORY.—This compound was known to Basil Valentine in the fifteenth century. It owes its reputation, as a medicine, principally to the praises bestowed on it by M. Goulard, in the latter end of the last century. He called it *extract of Saturn* (*extractum Saturni*). It is frequently termed *Goulard's extract*, or *liquor plumbi subacetatis*.

PREPARATION.—In the London Pharmacopœia it is directed to be prepared by boiling together two pounds and three ounces of acetate of lead, one pound and four ounces of oxide of lead (litharge) rubbed to powder, and six pints of water; frequently stirring: when the liquor is cold, add as much distilled water as may be sufficient to measure with it six pints. The acetate of lead combines with an additional equivalent of oxide of lead, to form the diacetate. This process yields a uniform preparation.

In the Dublin Pharmacopœia it is ordered to be prepared by boiling one part of semivitrified oxide of lead with twelve parts of distilled vinegar, until eleven parts of the fluid remain; and when the impurities have subsided, the liquid is to be filtered. The acetic acid of the distilled vinegar combines with the oxide of lead to form a subacetate of lead. This process is objectionable, since the strength of the solution depends on the strength of the vinegar, which is subject to variation.

PROPERTIES.—It is a transparent and colourless liquid. Prepared according to the London Pharmacopœia, its specific gravity is 1·260:

cording to the Dublin Pharmacopœia, it is 1·118. Its taste is sweet nd astringent. By evaporation it yields crystals of the diacetate of lead, hich, according to Dr. Barker, are flat rhomboidal prisms, with dihedral immits.

CHARACTERISTICS.—The presence of lead and of acetic acid in this lution may be known by the tests before mentioned (p. 515) for acetate ' lead.

From the neutral acetate it is distinguished by the more abundant pre- pitate which it produces with carbonic acid, and by the copious preci- tate which it affords with mucilage—an effect not produced with the utral acetate. Solution of the diacetate of lead forms a precipitate ith most vegetable colouring matters.

COMPOSITION.—This liquid is an aqueous solution of the diacetate of ad. The hydrated diacetate has, according to Dr. Thomson, the fol- wing composition:—

	Eq.	Eq. Wt.	Per Cent.
Oxide of Lead	2	224	61·37
Acetic Acid	1	51	13·97
Water	10	90	24·66
Hydrated Diacetate of Lead	1	365	100·00

PURITY.—When this compound has been prepared with common negar it has a brown colour.

PHYSIOLOGICAL EFFECTS.—Its effects are analogous to the acetate. r. A. T. Thomson (*Lond. Med. Gaz.* v. 538; x. 693) asserts, from his xperiments on animals, that it has more tendency to cause colic than e neutral acetate, because it is more readily converted into carbonate of ad. It is employed in medicine as a local astringent and sedative. aralysis is said to have resulted from its external use.

USES.—It is used, when diluted, to promote the resolution of external flammation, to check profuse discharges from suppurating, ulcerated, nd mucous surfaces, and to alleviate local pains. Thus it is applied to arts affected with either phlegmonous or erysipelatous inflammation, to hitloes, to inflamed tendons, aponeuroses, or absorbent glands; in ohthalmia, to contusions, sprains, burns, wounds, whether incised or cerated, to blistered surfaces, ulcers, abscesses, &c.

It is said to have been successful, internally, in hydrophobia.

ADMINISTRATION.—It is employed diluted with water, added to poul- ces, or mixed with fatty matters, and applied as an ointment.

LIQUOR PLUMBI DIACETATIS DILUTUS, Ph. Lond. *Plumbi sub- etatis liquor compositus*, Ph. Dub. (Solution of diacetate of lead, f℥iss.; stilled water, Oj.; proof spirit, ʒij. M.)—This preparation is an imita- on of the *water of Saturn*, or *vegeto-mineral water* of Goulard. It is mmonly termed, in the shops, *Goulard water*. It should be transparent nd colourless; but when prepared with common water it is more or less ilky, owing to the formation of carbonate, sulphate, and chloride of ad. The small quantity of spirit employed can be of no service. The antity of the solution of diacetate of lead employed in making Goulard ater is much too small; it should be, at least, three times, and in some ises I have used six times, as much. I have never seen any ill effects om its use, though it is said to have become absorbed in some cases. he same objection applies to the use of this compound as to that of the utral acetate in ulceration of the cornea (*vide* p. 517.)

Goulard water is used as a cooling, sedative, and astringent wash in the cases already enumerated for the Goulard's extract. A poultice, composed of crumb of bread, boiled in Goulard water, is sometimes a very useful application to phlegmons, painful wounds, irritable ulcers, &c. &c.

Ceratum Plumbi Compositum, Ph. Lond. (Solution of diacetate of lead, f℥iij.; wax, ℥iv.; olive oil, Oss.; camphor, ʒss. M.).—This is the *cerate of Saturn* of M. Goulard, and is commonly called *Goulard's cerate*. It is employed as a dressing to wounds and ulcers, for the purpose of allaying irritation and appeasing pain. With the same views it is also applied to excoriated surfaces, burns, scalds, blistered surfaces, and irritable cutaneous affections. Opium is sometimes advantageously combined with it.

Ceratum Saponis, Ph. Lond.—This contains a subacetate of lead. It has been before described (p. 337).

Emplas'trum Plum'bi.—Plas'ter of Lead.

History.—This compound was known to the ancients: both Pliny (*Hist. Nat.* xxxiv. 53) and Celsus (*De Medicina*, lib. v. cap. xix.) give a formula for a plaster used by the Roman surgeons, which is almost identical with that for the officinal plaster of lead.

It is termed *emplastrum lythargyri* in the Dublin Pharmacopœia, and is commonly sold in the shops as *diachylon* or *diachylum*.

Preparation.—In the London Pharmacopœia it is directed to be prepared by mixing six pounds of oxide of lead (litharge), rubbed to a very fine powder; a gallon of olive oil; and two pints (℥xl.) of water. These are to be boiled together over a slow fire, constantly stirring, to a proper consistence.

In this process the oil becomes saponified, and converted, by the aid of the elements of water, into *glycerine*, *oleic acid*, and *margaric acid*. The glycerine remains in solution in the water, while the two fatty acids combine with the oxide of lead to form the oleo-margarate of lead or plaster of lead.—(For further particulars respecting the theory of saponification, *vide* p. 334).

The water used in this process serves two purposes; it moderates the heat, and facilitates the union of the acids with the oxide of lead.

Properties.—It is met with in the shops in cylindrical rolls, of a greyish or yellowish-white colour, brittle when cold, but softening and ultimately fusing by heat. It is insoluble in water, and nearly so in alcohol. It has no taste, but a slight though peculiar odour.

Characteristics.—When heated it fuses, then decomposes, gives out inflammable gas, and leaves a carbonaceous residue, which, when heated in a close vessel, yields globules of lead. Ether dissolves the oleate but not the margarate of lead.

Composition.—Berzelius (*Traité de Chim.* v. 373) says this compound is to be regarded as a tribasic salt: that is, as consisting of one equivalent of the fatty acids (oleic and margaric) and three of the oxide of lead.

Effects and Uses.—This plaster is employed in surgery, on account of its adhesiveness and the mildness of its local action; for it rarely excites irritation. It is used to keep the edges of wounds together in persons with delicate skins. Spread on calico it forms a good *strap-*

-*ing* for giving support and causing pressure in ulcers of the leg,—a most uccessful mode of treating them, and for which we are indebted to Mr. Bayntou.

In pharmacy it serves as a basis for various other plasters.

Emplastrum Resinæ, Ph. Lond. *Emplastrum Lithargyri cum Resina*, Ph. Dubl. *Emplastrum Resinosum*, Ph. Ed. (Resin, Oss.; plaster of lead, Oiij. M. Ph. Lond. The proportions used in the Dublin and Edinburgh Pharmacopœias are slightly different).—This is the common *adhesive plaster* (*emplastrum adhæsivum*), and is kept in the shops ready spread. It is employed to retain the lips of wounds in contact, as in cuts, surgical operations, &c. It is more adhesive than lead plaster, but at the same time somewhat more irritant, and occasionally causes excoriation. It is sometimes employed as a *strapping* for dressing ulcers, on Baynton's principles.

Emplastrum Saponis, Ph. Lond. and Dub.—The lead plaster is a constituent of the soap plaster already described (p. 338).

Unguentum Plumbi Compositum, Ph. Lond. (Prepared chalk, ℥viij.; distilled vinegar, f℥vj.; plaster of lead, lb. iij.; olive oil, Oj. Mix the chalk with the vinegar, and when the effervescence has ceased, add gradually the solution to the plaster and oil melted with a slow fire, and stir constantly until they are cooled).—By the action of the acetic acid on the chalk, an acetate of lime is procured, and carbonic acid evolved, and the acetate of lime is then mixed with lead plaster and oil. This compound is an imitation of *Kirkland's neutral cerate*, used as a dressing to indolent ulcers. It is employed by Mr. Higginbottom (*Essay on the Use of Nitrate of Silver*, 2d ed. p. 119), under the name of *neutral ointment*, as a defence for ulcers after the application of nitrate of silver.

Order 25.—Zinc and its Compounds.

Zin'cum.—Zinc.

History.—Although the ancients were acquainted with the method of converting copper into brass by means of an ore of zinc, yet they were unacquainted with metallic zinc, one of the constituents of this alloy. Albertus Magnus, who died in 1280, is the first who expressly mentions this metal.

It has various appellations, such as *contrefeyn*, *golden marcasite*, *Indian tin* (*stannum indicum*), *spiaulter*, *speltre* or *spelter* (*speltrum*).

Natural History.—It occurs only in the mineral kingdom. It is found in the form of oxide (*red zinc*), of sulphuret (*blende* or *black jack*), of carbonate (*calamine*), of sulphate (*white vitriol*), of silicate (*electric calamine*), and aluminate (*automalite* or *gahnite*).

Preparation. — It is obtained from the sulphuret, carbonate, and silicate. The sulphuret is roasted, by which part of the sulphur is expelled, and the metal oxidized: it is then mixed with some carbonaceous substance, introduced into an earthen crucible, the bottom of which is perforated by an iron tube which passes into a vessel of water situated in an apartment below. The zinc is reduced in the pot, sublimes, and passes through the tube, dropping into the water beneath. This is called *distillatio per decensum.* Zinc is also procured from the carbonate and silicate of this metal, by treating it as above described for roasted blende.

The zinc used in this country is principally imported in ingots and plates from Silesia, by way of Hamburg, Antwerp, Dantzic, &c. The only zinc-works at present in this country are at Maestag, near Margam, Glamorganshire.

Properties.—It is a bluish-white metal, of considerable lustre. It crystallizes in four-sided prisms and needles; its texture is lamellated and crystalline. Its sp. gr. is from 6·8 to 7·2. At common temperature it is tough; from 212° to 300° it is ductile and malleable, and may be readily rolled into thin leaves (*sheet zinc*); at 400° it is so soluble that it may be reduced to powder. It readily fuses, and, at a white heat, may be volatilized.

Characteristics.—It is soluble in dilute sulphuric acid, with the evolution of hydrogen gas. Ferrocyanide of potassium forms, in this solution, a gelatinous white precipitate (ferrocyanide of zinc): if iron be present the precipitate is bluish-white. If the liquid be neutral, hydrosulphuric acid and the soluble hydrosulphates also occasion a white or yellowish-white precipitate (sulphuret of zinc). Alkalies and their carbonates likewise throw down white precipitates: that occasioned by the alkalies (oxide of zinc) is soluble in excess of alkali. The delicacy of these tests is, according to Devergie (*Méd. Lég.* ii. 787), as follows:—

		Degree of Dilution.
Ferrocyanide of Potassium	stops at . .	4,000
Ammonia	,, . .	6,000
Potash, or Carbonate of Ammonia	,, . .	8,000
Carbonate of Potash, or Hydrosulphate of Ammonia	,, . .	10,000
Hydrosulphuric Acid	,, . .	15,000

Physiological Effects.—In the *metallic* state it is inert. The *compounds of zinc* are somewhat analogous, in their action on the system, to those of copper, silver, and bismuth, but are much less energetic. They act topically, according to their degree of concentration, as desiccatives, astringents, irritants, and caustics. Taken internally, they excite, more or less readily, nausea and vomiting, and in large doses operate as irritant and caustic poisons. They exercise a specific influence over the nervous system, though this is much less obvious than in the preparations of the other metals just referred to. The stupor and inactivity, mentioned by Orfila (*Toxicol. Gén.*), as being produced by the sulphate, are evidence of an affection of the nervous system. The antispasmodic power evinced by zinc, in certain diseases, can only be explained by referring it to the action of this metal on the nervous centres.

Uses.—As *topical* agents we employ the compounds of zinc as caustics, astringents, and desiccatives. Thus the chloride is used as a caustic, the sulphate and acetate as an astringent, and the oxide and carbonate as a desiccative.

Internally, the zincic compounds are administered in large doses to excite vomiting; in smaller doses as tonics and antispasmodics in intermittent diseases and chronic affections of the nervous system.

Zin'ci Ox'ydum.—Ox'ide of Zinc.

History.—The oxide was first prepared by Hellot in 1735. It has eceived various names, some of them of a fantastic nature; as *nihil lbum, lana philosophica, pompholyx, flowers* or *calx of zinc* (*flores* seu *alx zinci*).

Natural History.—Oxide of zinc is found in America, mixed or ombined with the sesquioxide of manganese, and constituting the *red xide of zinc* of the mineralogist. It is also found in various localities, ı combination with carbonic, sulphuric, or silicic acid.

Preparation.—In the Dublin Pharmacopœia it is directed to be btained by throwing zinc into a deep crucible heated to whiteness, and nmediately inverting (loosely) a second crucible over the first one, so as ot to exclude the air. The metal attracts oxygen from the air, and the xide thus formed is deposited on the sides of the crucible.

In the London Pharmacopœia it is ordered to be prepared by mixing . pound of sulphate of zinc dissolved in twelve pints of distilled water, rith six ounces and a half of sesquicarbonate of ammonia, also dissolved ı twelve pints of distilled water. The precipitate is to be frequently rashed and ignited during two hours.

In this process double decomposition takes place; sulphate of ammonia is formed in solution, and carbonate of zinc precipitates. A ortion of the carbonic acid of the sesquicarbonate of ammonia escapes.

REAGENTS.			RESULTS.
eq. Sesquicarb. Ammonia .. 100	1 eq. Carbonic Acid	22	1 eq. Carbonic Acid 22
	2 eq. Carbonic Acid	44	
	2 eq. Ammonia....	34	2 eq. Sulphate of Amm........ 114
eq. Sulphate of Zinc...... 160	2 eq. Sulph. Acid ..	80	
	2 eq. Oxide of Zinc	80	2 eq. Carb. Zinc.. 124

The carbonate of zinc is decomposed by the subsequent ignition, and he carbonic acid expelled, leaving the oxide.

Properties.—The primary form of the crystallized native oxide of inc (containing the oxides of iron and manganese) is a right rhombic rism.

The artificial oxide met with in the shops is a white, or, when ignited, ellowish-white, tasteless, odourless powder. It is fusible, forming a ellow glass, and at a white heat is volatilized. When heated with charoal it is readily reduced. It is insoluble in water, but readily dissolves ı most acids and in alkalies. It forms two classes of salts: one (the *incic salts*), in which it is the base; a second (*zincates*), in which it acts .cts the part of an acid.

Characteristics.—It dissolves in dilute sulphuric acid. The characteristics of the solution have been already detailed (p. 521).

Composition.—Oxide of zinc has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Proust.	Berzelius.
Zinc	1	32	80	80	80·1
Oxygen	1	8	20	20	19·9
Oxide of Zinc	1	40	100	100	100·0

The oxide of the shops is usually the hydrated oxide of zinc, and consists of 1 eq. oxide of zinc = 40 + 1 eq. water = 9.

Purity.—Pure oxide of zinc is completely and readily soluble in ilute sulphuric acid, without effervescence: the precipitate produced ı this solution, by caustic ammonia or caustic potash, should be completely soluble in an excess of the precipitant. Oxide of cadmium has been sometimes found in it, and was once mistaken for arsenious acid (Thomson's *Hist. of Chem.* ii. 219). Iron and manganese (Liebig) are sometimes present in oxide of zinc, and communicate a yellow tinge to it.

Physiological Effects. (*a.*) *On animals.*—Orfila (*Toxicol. Gén.*) gave from three to six drachms of it to small and weak dogs: they were attacked with vomitings, without suffering much.

(*b.*) *On man.*—Applied to ulcerated or other secreting surfaces, it acts as a desiccating and astringent substance. On account of its insolubility, the absorption of it must be very slow. Taken into the stomach in large doses, it acts as a slight irritant, and provokes vomiting, and sometimes purging. It is said to have also caused occasional giddiness and temporary inebriation. In small doses it may be taken for a considerable period without causing any obvious effects. Sometimes, under its employment, certain affections of the nervous system (as epilepsy, chorea, &c.) subside; from which we infer that it exercises some specific influence over this system; and it is, therefore, termed tonic, antispasmodic, and sedative. But the nature of its influence is not very obvious, and is inferred rather from analogy than observation. By long-continued use it acts as a slow poison, and produces tabes sicca. A gentleman, for the cure of epilepsy, took daily, at an average, twenty grains of oxide till he consumed 3246 grains, which must have taken him about five months. At the end of this time he was found of a pale, earthy hue, wasted away, and almost idiotical: his tongue was thickly coated, the bowels were constipated, the inferior extremities cold and œdematous, the abdomen tumid, the superior extremities cold and shrivelled, and their skin dry, like parchment; the pulse was about sixty, thready, and scarcely perceptible. Under the use of purgatives, a light nutritive diet, with tonic and diuretic medicines, he rapidly recovered, but he remained subject to epileptic attacks (*Brit. and For. Med. Rev.* July 1838, p. 221).

Uses.—*Internally* it has been commended in some spasmodic diseases, viz. epilepsy, chorea, hysteria, catalepsy, and hooping-cough; and in some painful affections, as neuralgia and gastrodynia. Though occasionally serviceable in some of these maladies, it has so frequently failed that practitioners have ceased to place much confidence in it.

Externally it is employed in the form of powder, or lotion, or ointment. As a *dusting powder* it is useful, by its mild, absorbent, and desiccative properties, and is applied to impetiginous and other chronic diseases of the skin, attended with profuse secretion. It is also used to allay or prevent excoriation in children and bedridden persons, and to remove chaps and cracks of the nipples. In painful ulcers, with copious discharge, it is not unfrequently beneficial by its desiccative and sedative properties. *Diffused through water* or *a mucilaginous solution* (in the proportion of two drachms of the oxide to six or eight ounces of liquid), it is occasionally useful in chronic ophthalmia, especially *ophthalmi tarsi.* Sommé (*Archiv. Gén. de Méd.* i. 486) employed an injection composed of half an ounce of oxide and two pints of water in gonorrhœa and leucorrhœa, with success.

Administration.—Internally it is administered in the form of pill or powder, in doses of from two or three grains gradually increased to eight, ten, or more.

Unguentum Zinci, Ph. Lond. *Unguentum Zinci Oxydi*, Ph. Dub. and Ed. (Oxide of zinc, ℥j.; lard, ℥vj. M. Ph. Lond. The Edinburgh College substitutes simple liniment for lard; the Dublin College uses eight parts of ointment of white wax to one part of the oxide).—This compound is employed as a mild drying ointment in porrigo, impetigo, and other skin diseases attended with profuse discharges, after extensive burns, blisters, sinapisms, &c.; to painful ulcers with excessive secretion, to chronic inflammation of the eye, &c.

Zinci Oxydum Impurum, Ph. Ed.—This substance is known in the shops under the name of *tutty* (*tutia* seu *tuthia*), or *furnace cadmia* (*cadmia fornacum* seu *factitia*). It is found in the chimney of the furnace in which zinc ores are roasted, or in which zinciferous lead ores are melted. When prepared by levigation and elutriation it is called *prepared tutty* (*oxidum zinci impurum præparatum*, Ph. Ed.; *tutia præparata*.) It is applied as a dusting powder, or as a cooling ointment (*unguentum oxidi zinci impuri*, Ph. Ed.; composed of simple liniment, 5 parts; prepared impure oxide of zinc, 1 part, M.), to excoriated surfaces.

Zin'ci Chlo'ridum.—Chlo'ride of Zinc.

History.—This compound, which has been long known to chemists, was first introduced into medicine by Papenguth (*Russ. Samml. f. Naturw. u. Heilk.* H. i. S. 79, quoted by Richter, *Ausf. Arzneim.* iv. 526), and subsequently has been recommended by Professor Hancke of Breslau, (Rust's *Magazin*, 1826, Bd. 22, S. 373), and by Dr. Canquoin, of Paris (Dr. Alex. Ure, *Lond. Med. Gaz.* xvii. 391). It is termed *muriate*, *hydrochlorate*, or *butter of zinc*.

Preparation.—The easiest and cheapest method of obtaining it is by dissolving zinc, or its oxide, in hydrochloric acid, evaporating to dryness, and fusing in a glass vessel with a narrow mouth, as a Florence flask.

Properties.—It is a whitish grey semi-transparent mass, having the softness of wax. It is soluble in water, alcohol, and ether. It is fusible, and at a strong heat may be sublimed and crystallized in needles. It is very deliquescent. It unites with both albumen and gelatine to form difficultly soluble compounds, and hence it occasions precipitates with liquids containing these principles in solution.

Characteristics.—Dissolved in water it may be recognised to be a chloride by nitrate of silver (*vide* 105). That zinc is the base of the salt may be shewn by the tests already mentioned for this metal (p. 521).

Composition.—Its composition is as follows:—

	Eq.	Eq.Wt.	Per Cent.	J. Davy.
Zinc	1	32	47	50
Chlorine	1	36	53	50
Chloride of Zinc	1	68	100	100

Physiological Effects.—Its *local* action on living tissues is that of a caustic or escharotic, depending partly on its affinity for albumen and gelatine; so that when placed in contact with living parts into whose composition these organic compounds enter, the chloride exercising its affinity, first destroys the life of the part, and then unites with the albuminous and gelatinous matters present, and forms thus an eschar. Other chemical changes of a comparatively unimportant nature are also effected: thus, various salts found in the solids or liquids of the part may be decomposed. For example, when the chloride is applied to a cancerous sore, it decomposes the carbonate and hydrosulphuret of ammonia found in the secretion of the sore. The effects produced by the application of chloride of zinc are the following:—Soon after it has been applied, a sensation of warmth is felt in the part, quickly followed by violent burning pain, which continues for seven or eight hours; that is, until the parts in contact with the chloride are dead. A white eschar is now observed, which usually separates in from eight to twelve days. Unless used in the neighbourhood of loose cellular tissue, there is rarely much swelling.

As a caustic, chloride of zinc is not inferior in power to chloride of antimony; nay, Vogt (*Pharmakodynamik.* i. 363, 2[te] Aufl.) says, it appears to him to be more powerful, and to penetrate deeper. It decomposes the organic tissues as quickly as the nitrate of silver, but excites more burning, and for a longer time, owing to its action extending to parts placed more deeply, for it is well known that the operation of the nitrate is confined to superficial parts. Both Vogt and Canquoin agree that chloride of zinc, besides corroding the parts with which it is in contact, exercises an influence over the vital actions of neighbouring parts. To this circumstance is owing, in great part, the efficacy of the chloride in various diseases in which it has been applied, and the healthy appearance of the sore after the separation of the eschar. There is no danger of any constitutional disorder arising from the absorption of the poison, as is the case with the arsenical and mercurial caustics.

Taken *internally*, in *large doses*, it acts as an irritant or caustic poison, and affects the nervous system. Thus it produces a burning sensation in the stomach, nausea, vomiting, anxiety, short breathing, small quick pulse, cold sweats, fainting, and convulsions. Taken in *very small doses*, no obvious effects are produced, except sometimes the amelioration of certain diseases. It is supposed in these cases to influence the nervous system.

USES.—*Internally* chloride of zinc has been given in small but gradually increased doses in scrofula, epilepsy, chorea, and (in combination with hydrocyanic acid) in neuralgia of the face.

Commonly, however, it is employed *externally:* thus Papenguth used a dilute solution of it as a lotion in fistulous ulcers of a scrofulous nature. As a *caustic* it has been applied by Professor Hanke and Dr. Canquoin to produce an issue, to destroy nævi materni, and as an application to parts affected with malignant diseases, such as fungus hæmatodes and cancer, or to other intractable forms of disease, such as old syphilitic or scrofulous ulcers. The benefit is supposed not to depend merely on the escharotic effect, but on the chloride inducing a new action in the surrounding parts.

ADMINISTRATION.—*Internally*, it may be given in doses of one or two grains. Hufeland recommends it to be taken dissolved in ether; his formula for the *æther zinci*, as it is called, is the following:—℞. Zinci Chlor. ʒss.; Alcoholis, ℥j.; Ætheris Sulph. ℥ij. Post aliquot dies decanta. The dose of this solution is from four to eight drops, taken twice daily.

Externally it has been used as a *lotion*, composed of two grains of the chloride and an ounce of water; or in the form of *paste:* this may be composed of one part of chloride of zinc, and from two to four parts of wheaten flour.

Zin'ci Sul'phas.—Sul'phate of Zinc.

History.—This salt is said by Schwartze (*Pharm. Tabell.* 2te Ausg. 79), to have been known towards the end of the 13th, or at the com- ıencement of the 14th century; but Beckmann affirms it was not known efore the middle of the 16th century (*Hist. of Invent.* iii. 85). It has ad various names, as *sal vitrioli, white vitriol,* and *Gilla Theophrasti.*

Natural History.—It occurs native at Rammelsberg, near Goslar, ı the Harz; at Holywell, in Flintshire; and other places.

Preparation.—It is readily prepared by dissolving zinc in diluted ulphuric acid. The proportions, directed to be used in the London 'harmacopœia, are five ounces of zinc and two pints of diluted sulphuric cid. The solution is to be filtered, evaporated, and crystallized. In iis process 1 equivalent or 9 parts of water are decomposed, an quivalent or 1 part of hydrogen escapes, while an equivalent or 8 parts f oxygen unite with 1 equivalent or 32 parts of zinc, to form equivalent or 40 parts of the oxide, which, with 1 equivalent or 0 parts of sulphuric acid, form 1 equivalent or 80 parts of the sulphate. 'he zinc and the oxide thus formed combines with some sulphuric acid ɔ form the sulphate.

REAGENTS.			RESULTS.
1 eq. Water 9	1 eq. Hydrogen 1		1 eq. Hydrogen 1
	1 eq. Oxygen .. 8	1 eq. *Ox. Zinc* 40	
1 eq. Zinc 32			
1 eq. Sulphuric Acid 40			1 eq. Sulphate of Zinc .. 80

By roasting blende (sulphuret of zinc) in reverberatory furnaces an mpure sulphate is obtained, which is lixiviated, and the solution con- entrated by evaporation, so that on cooling it forms a crystalline mass esembling lump sugar. This is distinguished among druggists by the ame of *white vitriol*, a term which they confine to this commoner kind f sulphate. This impure salt contains iron, and usually copper and lead.

Properties.—The primary form of the crystals of sulphate of zinc is he right rhombic prism: they are transparent and colourless, and have metallic astringent taste. They are soluble in $2\frac{28}{100}$ times their weight f cold water, and less than their own weight of boiling water. They are ısoluble in alcohol. In dry and warm air they effloresce. When eated they undergo the watery fusion; and if the liquid be rapidly ooled, it congeals into a granular, crystalline, white mass: if the heat e continued the salt becomes anhydrous, and, at an intense heat, is ecomposed, leaving a residue of zinc.

Characteristics.—That this salt is a sulphate, is proved by the action f chloride of barium on it; a white precipitate is produced, insoluble in itric acid. Acetate of lead also occasions a white precipitate. The resence of oxide of zinc in the solution is recognized by the tests lready mentioned (p. 999.)

Composition.—This salt has the following composition:—

	Eq.	Eq. Wt.	Per Cent.	Berzelius	Mitscherlich.
)xide of Zinc	1 . .	40 . . .	28 . . .	32·585 .	55·24
ulphuric Acid	1 . .	40 . . .	28 . . .	30·965 .	
Vater	7 . .	63 . . .	44 . . .	36·450 . . .	44·76
'rystallized Sulphate of Zinc	1 . .	143 . . .	100 . . .	100·000 . . .	100·00

Purity.—Ammonia added to a solution of sulphate of zinc throws own the hydrated oxide of zinc; excess of ammonia re-dissolves the oxide, and forms a colourless solution. If any oxide of iron or magnesia be present it remains undissolved; while any oxide of copper would form an azure blue solution. Arsenic or cadmium may be detected by adding excess of sulphuric acid to the solution of the sulphate, and then passing a stream of hydrosulphuric acid through it: the arsenicum and cadmium are thrown down in the form of sulphurets. The impure sulphate called *white vitriol* is in irregular masses, here and there stained yellow with the iron.

Physiological Effects.—In *small and repeated doses* it acts as an astringent on the alimentary canal, checks secretion, and promotes a constipated condition of bowels. It exercises a specific influence over the nervous system; manifested by its power of removing certain spasmodic affections: hence it is reputed antispasmodic. To the same influence is to be referred its power of preventing the recurrence of intermittent maladies, from which it has principally derived its denomination of a tonic. Its astringent effect is not confined to the bowels, but is manifested in the pulmonary and urethral mucous membranes, the secretions from which it diminishes: hence the advantage of its use in catarrhal affections of these parts. It does not appear to possess any power of checking cutaneous exhalation.

In *full medicinal doses* it is a powerful but safe emetic; it excites speedy vomiting without giving rise to that distressing nausea occasioned by emetic tartar, though this statement is not in accordance with the experience of Dr. Cullen (*Treat. of the Mat. Med.*), who observes that "in order to render its effects certain, the dose must generally be large; and if this is not thrown out again immediately it is apt to continue a disagreeable nausea, or even a vomiting, longer than is necessary." But this observation does not agree with the experience of other practitioners.

In *excessive doses* it acts as an irritant poison, causing vomiting, purging, coldness of the extremities, and fluttering pulse.

The *local action* of it is that of an astringent and desiccant, and in a concentrated form it is a powerful irritant and caustic. Its external use is said to have been found fatal in one case, by causing vomiting, purging, and convulsions (Christison, *op. cit.* p. 468).

Uses.—As an *emetic* it is almost exclusively employed in poisoning, especially by narcotics. In these cases it is the best evacuant we can administer, on account of its prompt action. As an *internal astringent* it is administered in chronic dysentery (Impey, *Lond. Med. and Phys. Journ.* ix. 55, 1803) and diarrhœa, in chronic bronchial affections attended with profuse secretion, and in gleet and leucorrhœa. In the latter cases it is usually associated with terebinthinate medicines, and is sometimes decidedly beneficial. As an *antispasmodic* it has been employed with occasional success in epilepsy, chorea, hysteria, spasmodic asthma, and hooping-cough. I have little faith in its efficacy in any of these cases. As a *tonic* it has been sometimes serviceable in agues, but it is far inferior to sulphate of quinia or arsenious acid.

As a *topical astringent* sulphate of zinc is most extensively employed. We use its aqueous solution as a collyrium in chronic ophthalmia, as a wash for ulcers attended with profuse discharge, or with loose flabby granulations; as a gargle in ulcerations of the mouth, though I have found it for this purpose much inferior to a solution of sulphate of copper; as a lotion for chronic skin diseases; and as an injection in gleet and leucorrhœa.

Administration.—As an *emetic* the dose should be from ten to twenty grains; as a *tonic*, *antispasmodic*, or *expectorant*, from one to five grains.

For external use, solutions are made of various strengths. Half a grain of the sulphate to an ounce of water is the weakest. The strongest I ever knew employed consisted of a drachm of sulphate dissolved in an ounce of water: it was used with success as an injection in gleet. But solutions of this strength must be applied with great caution, as they are dangerous.

Solutio Sulphatis Zinci, Ph. Ed. (Sulphate of zinc, gr. xvj.; water, ℥viij.; diluted sulphuric acid, gtt. xvj. M.)—This formula might be very properly omitted.

Antidotes.—Promote the evacuation of the poison by demulcents. Afterwards allay hyperemesis by opium, blood-letting, and the usual antiphlogistic regimen. Vegetable astringents have been advised.

Zin'ci Ace'tas.—Ac'etate of Zinc.

History.—This salt was discovered by Glauber.

Preparation.—It may be procured by dissolving oxide of zinc in acetic acid, and crystallizing the saturated solution; or it may be readily obtained by double decomposition: 143 grains of crystallized sulphate of zinc, dissolved in water, and mixed with 190 grains of the acetate of lead, in solution, will produce 152 grains of sulphate of lead, which, being insoluble, precipitates, while 91 grains of the anhydrous acetate of zinc (equal to 154 grains of the crystallized acetate) are left in solution: or it may be procured by immersing a piece of zinc in a solution of acetate of lead until the liquid forms a white precipitate with hydrosulphuric acid. In this process the lead is reduced to the metallic state (forming the *arbor Saturni* or *lead tree*), while the zinc replaces it in solution.

Properties.—It usually crystallizes in rhomboidal plates, having a pearly or silky lustre, closely resembling talc. The primary form of the crystals is the oblique rhombic prism. The salt is odourless, but has a bitter metallic taste. It dissolves readily in water, and is slightly efflorescent.

Characteristics.—When heated it fuses, and gives out an inflammable vapour, having the odour of acetic acid. When sulphuric acid is added to the salt, the vapour of acetic acid is evolved: this is easily recognized by its odour. These characters show it to be an acetate. That it is a zincic salt is proved by the tests before mentioned for a solution of this salt (p. 522).

Composition.—Its composition is, according to Dr. Thomson, as follows:—

	Eq.	Eq. Wt.	Per Cent.
Oxide of Zinc	1	40	25·97
Acetic Acid	1	51	33·11
Water	7	63	40·90
Crystallized Acetate of Zinc	1	154	99·98

Physiological Effects.—Its effects are analogous to, though milder than, the sulphate of zinc, but more energetic than the oxide. Its local action is astringent. Taken internally, in small doses, it acts as a tonic and antispasmodic; large doses occasion vomiting and purging. Devaux and Dejaer (Orfila, *Toxicol. Gén.*) deny that it is a poison, even in large doses.

Uses.—It is rarely administered *internally*; but is applicable as an emetic, tonic, and antispasmodic, in the same cases in which the oxide or sulphate of zinc is employed.

As a *topical* remedy, it is used on account of its astringent qualities in chronic ophthalmia, gleet, and leucorrhœa. In the latter stages of gonorrhœa I have found it far more successful than the sulphate. Its beneficial effects were first described by the late Dr. Wm. Henry, of Manchester (*Lond. Med. and Phys. Jour.* ix. 53, 1803). Sir A. Cooper (*Lancet*, iii. 199) recommends, as the best injection which can be used in the third week of gonorrhœa, a mixture of six grains of sulphate of zinc and four ounces of liquor plumbi subacetatis dilutus. Of course double decomposition takes place, and the active ingredient is the acetate of zinc.

Administration.—When exhibited internally, as a tonic or antispasmodic, the dose is one or two grains gradually increased. As an emetic the dose is five to ten grains: its operation is very safe. As a lotion or injection it is employed in the form of aqueous solution, containing two or three or more grains of the salt to an ounce of water.

Solutio Acetatis Zinci, Ph. Edinb. (Sulphate of zinc, ʒj.; acetate of lead, ℈iv.; distilled water, ℥xx. [by weight]. Dissolve the salts separately, each in ten ounces of the water. Mix the solutions, and when the precipitate has subsided, filter the liquor.)—Double decomposition is effected, sulphate of lead falls down, and acetate of zinc remains in solution. Each fluidounce contains three grains of the acetate. Used as an injection in gonorrhœa.

Zinci Acetatis Tinctura, Ph. Dubl. (Sulphate of zinc; acetate of potash, āā one part. Triturate them together, and add sixteen parts of rectified spirit; macerate for a week, with occasional agitation, and filter through paper.)—Here also we have double decomposition: sulphate of potash and acetate of zinc are formed. The first is precipitated, being insoluble in spirit, the second remains in solution. One drachm contains a quantity of acetate of zinc equal to about four grains of the crystallized acetate. When diluted with water, it is used as a collyrium and injection.

Zin'ci Car'bonas.—Car'bonate of Zinc.

History.—The native carbonate of zinc was perhaps known to the ancients, though they were unacquainted with its nature. The term *calamine* is applied both to the native carbonate and native silicate of zinc: the latter is termed by way of distinction *electric calamine*.

Natural History.—Native carbonate of zinc (*calamine*) is found in great abundance in several parts of England (in the counties of Somerset, Derby, Durham, &c.), as well as in various parts of the continent of Europe (in Carinthia, Hungary, Silesia, &c.) It occurs crystallized or in compact or earthy masses. Its colour varies, being more or less grey, yellow, or brown. Its sp. gr. is 4·2 to 4·5.

Preparation.—Calamine (*calamina*), or the impure carbonate of zinc (*carbonas zinci impura*, Ph. Lond.) is directed to be calcined, in order to make it pulverizable. But in this process water and more or less of the carbonic acid is expelled. It is then reduced to a very fine powder (usually in mills), and is afterwards submitted to the process of elutriation. By this means we obtain *prepared calamine* (*calamina præparata*, Ph. Lond.; *Zinci carbonas impurum præparatum*, Ph. Dubl.)

Properties.—Prepared calamine is met with in the shops in the form of a heavy pinkish or flesh-coloured powder, or made up into little masses. When pure, it dissolves in nitric, hydrochloric, or sulphuric acid, with effervescence. Various impurities mixed with calamine are insoluble in these acids.

Characteristics.—The effervescence with the mineral acids shews calamine to be a carbonate. The presence of zinc in the solution is determined by the tests before mentioned for this metal (p. 522). The action of these tests, however, is more or less impeded by the presence of foreign matters in calamine.

Composition.—Carbonate of zinc has the following composition:—

	Eq.	Eq. Wt.	Per Cent.	Smithson. (*Mendip Ore.*)		(*Derbyshire Ore.*)
Oxide of Zinc	1	40	64·5	64·8	to	65·2
Carbonic Acid	1	22	35·5	35·2	to	34·8
Carbonate of Zinc	1	62	100·0	100·0	to	100·0

Impurities.—The substance sold in the shops as prepared calamine frequently contains only traces of zinc. If hydrochloric acid be poured on it, effervescence (owing to the escape of carbonic and hydrosulphuric acids) takes place, and a portion is dissolved; but the greater part remains undissolved. Mr. Brett (*Lond. Med. Gaz.* xx. 72) found from 78 to 87·5 per cent. of sulphate of baryta. The remainder of the powder consisted of oxide of iron, carbonate of lime, lead (sulphuret of ?), and mere traces of zinc.

Physiological Effects.—Pure carbonate of zinc is probably similar in its action to the oxide.

Uses.—Calamine is employed as a dusting powder for children, and as a mild desiccant and astringent in excoriations, superficial ulceration, &c.

Ceratum Calaminæ, Ph. Lond.; *Unguentum calaminæ*, Ph. Dubl.; *Ceratum Carbonatis Zinci Impuri*, Ph. Ed. (Calamine; wax, āā lb. ss.; olive oil, f℥xvj. Add the calamine to the melted wax and oil when they begin to thicken, *Ph. Lond.* The *Edinburgh College* uses one part of carbonate to five of lard. The *Dublin College* uses one pound of carbonate and five pounds of ointment of yellow wax.) This is commonly called *Turner's Cerate*, or the *Ceratum epuloticum*. It is an excellent desiccative and astringent application (when prepared with good calamine) to burns, scalds, excoriations, superficial ulcerations, &c.

Zin'ci Cyan'idum.—Cy'anide of Zinc.

History.—This salt, sometimes called *hydrocyanate* or *cyanuret of zinc*, has been introduced, by the German physicians, as a substitute for hydrocyanic acid.

Preparation.—It is prepared by adding recently-made oxide of zinc to hydrocyanic acid; or by adding a solution of sulphate of zinc to a solution of cyanide of potassium.

Properties.—Cyanide of zinc is a white powder, insoluble in water or alcohol.

Characters.—If a strong mineral acid be added to it, hydrocyanic acid is developed, and a soluble salt of zinc obtained. The latter is recognized by the tests before mentioned for a solution of zinc (p. 522).

Composition.—Its composition is as follows:—

	Eq.	Eq. Wt.	Per Cent.
Zinc	1	32	55·2
Cyanogen	1	26	44·8
Cyanide of Zinc	1	58	100·0

Physiological Effects.—Its effects have not been carefully ascertained, but they are supposed to be similar to those of hydrocyanic acid.

Uses.—It has been used principally in affections of the nervous system, as epilepsy, hysteria, and chorea. It has also been employed in cardialgia and cramps of the stomach, and as an anthelmintic in children.

Administration.—We may give it in doses of from a quarter of a grain to a grain and a half three times a day. It may be taken in the form of powder mixed with calcined magnesia.

Order 26.—Iron and its Compounds.

Fer'rum.—I'ron.

History.—This metal (called by the alchymists *Mars*) was known in the most ancient times. It was employed medicinally at a very early period, namely, above 3200 years ago. Indeed, it appears to have been the first mineral used internally; and a curious anecdote is given of its introduction into medicine. Melampus (a shepherd supposed to possess supernatural powers) being applied to by Iphicles, son of Philacus, for a remedy against impotence, slaughtered two bulls, the intestines of which he cut to pieces, in order to attract birds to an augury. Among the animals which came to the feast was a vulture, from whom Melampus pretended to learn that his patient, when a boy, had stuck a knife wet with the blood of some rams into a consecrated chestnut-tree, and that the bark had subsequently enveloped it. The vulture also indicated the remedy, namely, to procure the knife, scrape off the rust, and drink it in wine, for the space of ten days, by which time Iphicles would be lusty, and capable of begetting children. The advice thus given by Melampus is said to have been followed by the young prince with the most perfect success! (Le Clerc, *Hist. de la Médecine.*)

Natural History.—Iron is met with in both kingdoms of nature.

(*a.*) *In the inorganic kingdom.*—Few minerals are free from iron. It is found in the metallic state (*native iron*), in combination with oxygen (*hæmatite, micaceous iron, brown iron stone*, and *magnetic iron ore*), with sulphur (*iron pyrites*, and *magnetic pyrites*), with chlorine (*pyrosmalite*), with oxygen and an acid (*carbonate, phosphate, sulphate, arseniate, tungstate, tantalate, titaniate, chromate, oxalate*, and *silicate*.)

(*b.*) *In the organic kingdom.*—It occurs in the ashes of most plants, and in the blood and some other parts of animals.

Extraction.—In Sweden, iron is extracted from magnetic iron ore and micaceous iron: in England, principally from clay iron ore (carbonate of iron.)

Clay iron ore (technically called *mine*) is burned with coal in large heaps, by which it loses carbonic acid, water, and sulphur. It is then smelted with a flux (in South Wales this is limestone; in the forest of Dean, clay;) and coke. The smelted iron is run into moulds, and is then called *cast iron* (*ferrum fusum*), or *pig iron*. This contains carbon, oxygen, silicon, and often sulphur and phosphorus. To separate these, it is submitted to several processes (called refining, puddling, and welding,) by which it is converted into *wrought iron* (*ferrum cusum*), (*Manufacture of Iron*, in the *Library of Useful Knowledge;* also, *Treatise on Iron and Steel*, in *Lardner's Cyclopædia*).

PROPERTIES.—The primary form of the crystals of native iron is the regular octahedron. Pure iron has a whitish grey colour, or, according to Berzelius, is almost silver white. When polished it has much brilliancy: its taste is peculiar and styptic; when rubbed it becomes odorous. Its ductility and tenacity are great; its malleability comparatively small. Its sp. gr. is 7·788, but diminishes by rolling or drawing. It is attracted by the magnet, and several of its compounds are capable of becoming permanent magnets; but pure iron retains its magnetic property for a short time only. It requires a very intense heat to fuse it; and it is not volatile at any known temperature; while in the softened state, previous to melting, it is capable of being welded. Its equivalent or atomic weight is 28.

CHARACTERISTICS.—Iron readily dissolves in diluted sulphuric acid, with the evolution of hydrogen gas. The solution contains the protosulphate of iron, and produces, on the addition of caustic potash or soda, a greenish-white precipitate (the hydrated protoxide): this precipitate, by exposure to the air, attracts oxygen, and is converted into the red or sesquioxide. Auro-chloride of sodium forms a purple precipitate with the protosalts of iron. By boiling the solution with a little nitric acid, we obtain a persulphate of iron, recognized by ferrocyanide of potassium causing a blue precipitate; sulphocyanic or meconic acid, a red colour; gallic or tannic acid, or infusion of galls, a purple or bluish black; and succinate, or benzoate of ammonia, a yellowish precipitate.

PHYSIOLOGICAL EFFECTS. (*a.*) *Of the metallic iron.*—Iron is probably inert so long as it retains its metallic form, but it readily oxidizes in the alimentary canal, and thereby acquires medicinal power. As acids promote this chemical change, acid wines and fruits assist in rendering the metal active, while alkalies and their carbonates have an opposite effect. The oxidizement of the iron is attended with the evolution of hydrogen gas, which gives rise to unpleasant eructations. If sulphur be taken along with iron, hydrosulphuric acid is developed. Like the ferruginous preparations generally, the internal employment of iron causes blackening of the stools. The nature of the effects produced by oxide of iron formed in the alimentary canal will be best examined hereafter, under the head of ferruginous preparations. I may, however, remark here, that it is one of the few metals which by oxidizement is not rendered more or less poisonous.

(*b.*) *Of the ferruginous compounds. α. On vegetables.*—Most of the compounds of iron do not appear to be hurtful to plants: at least this is the case with the oxides (Decandolle, *Phys. Vég.* 1337.) The sulphate, however, is said to be injurious (*vide* p. 551.)

β. On animals.—The effects of the ferruginous compounds on animals generally are similar to those on man. It is stated that in animals to whom iron has been given for a considerable time, the spleen has been found smaller, harder, and denser—an effect which is supposed to be owing to the increased contractile power experienced by the veins of the abdomen. The liver is also said to have been affected in a similar manner, though in a somewhat slighter degree.

γ. *On man.*—The *local* effects of the sulphate and chloride of iron are those of irritants, and these preparations accordingly rank among poisons; but they are not equal in power to the mercurial or cupreous salts. Most of the ferruginous preparations are astringent; that is, they constringe the parts with which they are in contact, and thereby diminish secretions and check sanguineous discharges. Thus, when swallowed, they repress the secretions and exhalation of the gastro-intestinal membrane, and thereby render the alvine evacuations more solid, and even occasion costiveness. The sulphate and chloride of iron are the most powerful of the ferruginous astringents. Administered in large quantities, or when the alimentary canal is in an irritable condition, all the compounds of iron are capable of exciting heat, weight, and uneasiness at the præcordia, nausea, and even vomiting, and sometimes purging.

The constitutional or *remote* effects of the chalybeates are principally observed in the alteration induced in the actions of the vascular and muscular systems, and are best seen in that state of the system denominated *anæmia*, or more properly *hypæmia*, in which both the quantity and quality of the blood appear defective. We have a good illustration of this state in chlorotic patients. The skin appears pale and almost exsanguineous, the cellular tissue is œdematous, and, after death, the larger vessels as well as the capillaries are found to be imperfectly supplied with blood. Patients with this condition of system are affected with great feebleness, loss of appetite, and palpitation; and in females the catamenial secretion is frequently, but not invariably, defective. That the want of uterine action is not the cause, but in some cases is, perhaps, the effect of this condition of system, seems tolerably clear from the circumstance of the same constitutional symptoms of anæmia sometimes occurring with a perfect regularity of the uterine functions; moreover, we occasionally meet with anæmia in men. It is sometimes the consequence of hæmorrhages—at other times it occurs spontaneously, and without any known cause (Andral, *Pathol. Anat.* by Townsend and West, i. 97).

If in this condition of system we administer iron, the appetite increases, digestion is promoted, the pulse becomes fuller and stronger, the skin assumes its natural tint, the lips and cheeks become more florid, the temperature of the body is increased, the œdema disappears, and the muscular strength is greatly augmented. The alvine evacuations assume a black colour, as they always do under the use of the ferruginous preparations. After continuing the use of iron for a few weeks, we frequently find excitement of the vascular system (particularly of the brain); thus we have throbbing of the cerebral vessels, and sometimes pain in the head, a febrile condition of system, with a tendency to hæmorrhage. Mr. Carmichael (*Essay on the Effects of Carbonate of Iron on Cancer*, Dubl. 1806, p. 396) considers the *sanguine* temperament (marked by a high complexion, celerity of thought, remarkable irritability of fibre, and a quick pulse) as depending on an excess of iron in the system; whereas the *leucophlegmatic*, or *relaxed*, temperament (characterized by a pale bloated countenance, dull eyes, mind heavy and slow in receiving and forming ideas, little irritability of fibre, and pulse small and feeble) as depending on a deficiency of iron.

When by the use of iron the state of the general system improves, the secretions resume their natural condition, and thus at one time we observe this metal promoting the uterine discharge, at another checking it, according as chlorosis or menorrhagia had been previously present; we cannot, therefore, regard the preparations of this metal as having any direct emmenagogue effect, as some have supposed.

Some refer all the other symptoms of anæmia to the abnormal state of the blood, and ascribe the beneficial influence of iron to the improvement in the quality of this liquid. It is certain that, under the use of the preparations of this metal, the blood frequently acquires a more scarlet colour, owing, as it has been fancied, to an increase in the quantity of its colouring particles; and it is said that the crassamentum becomes firmer and more solid, and even increased in quantity. This alteration of the physical and chemical properties of the blood is supposed to render it more stimulating, and thus the different organs, receiving a fluid of a more healthy character, resume their normal condition, and perform their functions in a proper manner. Tiedemann and Gmelin (*Vers. üb. d. Wege auf. welch. Subst. aus d. Magen u. Darmk.*) have detected it in the serum of the blood of the portal and mesenteric veins of horses and dogs, to whom they administered either the sulphate or chloride; occasionally, too, the urine has been found to contain it. Moreover, Menghini (*De ferrearum particul. progressu ad sanguinem.* In *Com. Acad. Bonon.* t. ii. pt. iii. p. 475) asserts the quantity of iron in the blood of dogs is increased by feeding them on substances mixed with this metal. Furthermore, it is not to be forgotten, that iron exists in no inconsiderable quantity in healthy blood, and is supposed to contribute to its colour, and probably to its stimulant properties; so that it is not unlikely any variation in the quantity of this metal would be attended with an alteration in the action of every organ.

Iron is a substance not readily absorbed, for it remains in the stomach and intestines many days after it is swallowed: in order, therefore, that the ferruginous preparations should have much effect on the general system, it is necessary that they be employed for some considerable time. It does not, like most other metals, act as a poison when it gets into the blood. Another circumstance connected with the operation of iron is likewise deserving of notice; namely, that it has no primary or specific effect on the nervous system, as arsenic, mercury, copper, zinc, bismuth, silver, and many other metals. It must not, however, be imagined from these remarks, that the preparations of iron never operate injuriously. On the contrary, we see them sometimes acting as local irritants on the alimentary canal, as already noticed; and by the use of them in too large quantities, or for too long a period of time, they bring on a hypersthenic or phlogistic diathesis.

Uses. (*a.*) *Of metallic iron.*—Iron filings have been used in those cases where the chalybeate preparations generally have been administered, and which will be presently noticed. In some instances, however, the efficacy of iron depends on its being employed in the uncombined state. Thus, when used as an antidote to poisoning by the salts of copper, it is necessary that the iron be administered in the metallic state, in order to reduce the cupreous salts (*vide* p. 494). Iron filings have been regarded as anthelmintic, especially in the small thread-worm (the *Ascaris vermicularis*); they have been used also as an astringent application, to repress fœtid secretion of the feet.

(*b*.) *Of the ferruginous compounds.*—By a careful attention to the known physiological effects of the ferruginous compounds, the indications and contra-indications for their employment may be in great part learned. Thus, the impropriety of administering them where there is irritation or inflammation of the alimentary canal, in plethoric habits, and in persons disposed to inflammatory diseases, or to apoplexy, will be obvious from the foregoing remarks. On the other hand, in all cases characterized by feebleness and inertia of the different organs of the body, by a soft lax condition of the solids, and by a leucophlegmatic state of the system — where the patient appears to be suffering from a state of general anæmia, already described—the preparations of iron are indicated. It is hardly within the scope of my present object to instance particular diseases where this metal may be used, but rather to point out those conditions of system which affect the employment of iron in diseases generally. I may notice a few cases by way of illustration.

As *external* or *local* agents we rarely employ the preparations of iron, since we have other more efficacious and powerful remedies. Occasionally, however, they have been used as astringents, styptics, and caustics. Thus solutions of the sulphate and chloride have been used in the form of injection, in discharges from the urethra and vagina: and the tincture of the chloride is now and then applied as a styptic, or to repress the growth of spongy granulations.

The ferruginous preparations are principally resorted to with the view of affecting the general system. The are frequently given *to promote the uterine functions*, as in chlorosis, amenorrhœa, dysmenorrhœa, and menorrhagia, and often with success. When chlorosis depends on, or at least is accompanied by, that condition of the system before described under the name of anæmia, the ferruginous preparations are frequently useful; but if it occur in patients of a full habit, or if it arise from inflammation of some organ (as the lungs, stomach, or bowels), chalybeates will do harm. In cases of impotence, connected with or arising from general feebleness, it may be now and then useful; but in nine out of ten cases which we are called on to treat, this condition arises from indulgence in bad habits, which no medicine can affect. Sometimes iron is resorted to in sterility (though Dioscorides says the rust of iron hinders women from conceiving), but the conditions under which it is likely to be useful are precisely those before mentioned for other diseases. In discharges from the genital organs, as gleet and leucorrhœa, the internal employment of the tincture of the chloride of iron, sometimes conjoined with the tincture of cantharides, has been found useful.

In some *periodical diseases*—namely, ague, asthma, and tic douloureux—the ferruginous preparations have gained considerable repute. In the first of these diseases (that is, ague), the sulphate has been used by Marc (*Recherches sur l'Emploi du Sulf. de Fer dans le Traitement des Fièvres Interm.* Paris, 1810) and others, the subcarbonate by Buchwald, the ammoniacal chloride by Hartmann; but it has been almost wholly uperseded, of late years, by the sulphate of quinine and by arsenic. In sthma, Dr. Bree (*On Asthma*), who was himself a sufferer from the isease, regards iron as preferable to all other remedies. However, the xperience of others has not confirmed his favourable opinion of it. 'he sesquioxide of iron has latterly been extensively employed, at the ecommendation of Mr. B. Hutchinson (*Cases of Tic Doulour. successfully eated*), in tic douloureux, and with variable success; in some cases cting in a most extraordinarily beneficial manner, in others being of o avail.

In *diseases of the spleen and liver*, the ferruginous compounds are ccasionally found useful. I have already alluded to the influence which ey are supposed to possess over these organs; a supposition the more robable from the occasional remarkable effects produced by them in iseases of these organs. "I regard iron as a *specific*," says Cruveilhier, *Dict. de Méd. et de Chir. Prat.* t. viii. p. 62), "in *hypertrophy of the leen*, or *chronic splenitis;* whether primitive or consecutive to inter-uittent fevers." After noticing the symptoms attending this con-ition (such as paleness of the lips, &c. great lassitude, abdominal and ephalic pulsations, brought on by the slightest exertion; pain at the left de, disordered state of the digestive organs, accelerated pulse, and eart easily excited), he goes on to remark, "By the aid of iron I ave obtained the complete resolution of enlargements of the spleen, hich have occupied half, or even two-thirds, of the abdomen." In ypertrophy of the liver, iron has not been equally serviceable.

Some years ago the preparations of iron were strongly recommended in *ancer* by Mr. Carmichael (*op. cit.*) The grounds on which he was led the use of them were the probability that cancer had an independent fe—in other words, that it was a kind of parasite, as some preceding riters, more particularly Dr. Adams, had presumed; and secondly, the ficacy of iron in destroying intestinal worms, which led him to hope at it would be equally destructive to other parasites. With these views e employed (externally and internally) various ferruginous compounds—amely, the ferrotartrate of potash, the subcarbonate (sesquioxide) of iron, d the phosphates. Whatever hopes may have at one time been enter-ined of these remedies as curative agents, in this most intractable disease, ey are now completely destroyed. That these medicines are occasionally seful as palliatives may perhaps be admitted; but they have no cura-ve powers. Indeed this might have been suspected, from the hypo-etical grounds on which they were introduced into use. The proofs of e parasitical nature of cancer must be much stronger than any yet ffered, ere we can admit this hypothesis. Moreover, the preparations iron, though useful, are not so "very effectual" in worms as Mr. armichael's remarks would lead us to imagine.

In certain affections of the digestive organs, the preparations of iron e occasionally used with benefit; as in some forms of dyspepsia, but ly in the conditions of system already noticed. In some *affections the nervous system* which occur in weak debilitated subjects, it is also seful; for example, in epilepsy, chorea, hysteria, and the shaking palsy oduced by the vapour of mercury.

These are the most important diseases for which we employ the rruginous compounds. There are many other diseases for which chaly-eates are occasionally beneficial; but the general principles regulating their use will be readily comprehended from the foregoing remarks, and I have only to add, in all diseases attended by debility and marked by atony and inertia of organs, more especially in those indicating a disordered state of the hæmatose functions, the preparations of iron will be found in most instances more or less serviceable. Furthermore, I may enumerate scrofula, rickets, dropsy, and gout, as diseases in which iron has been at times used with advantage.

Fer'ri Sesquiox'ydum.—Sesquiox'ide of I'ron.

History.—Gebert (*Invent. of Verity*, 280) was acquainted with this substance, which he calls *crocus martis*. It was probably known long before his time It is the *red* or *peroxide of iron* of some chemists.

Natural History. — It is found native in the crystallized state (*specular iron* or *iron glance*) and in globular and stalactitic masses (*red hæmatite*): the finest specimen of the first occur in the Isle of Elba; the second is found near Ulverstone in Lancashire, and in Saxony. The hydrated sesquioxide of iron (*brown iron stone*) is met with in Scotland and at Shotover Hill, Oxfordshire. *Yellow ochre* is a hydrated sesquioxide of iron.

Preparation.—There are several modes of preparing this compound. One method is to calcine crystallized sulphate of iron, by which, first the water and afterwards the sulphuric acid are expelled: the protoxide of iron of the sulphate is peroxidized at the expense of the oxygen of part of the sulphuric acid, and a portion of sulphurous acid gas is developed. The sesquioxide thus procured constitutes the *ferri oxidum rubrum* of the Dublin and Edinburgh Pharmacopœias: in commerce it is called *colcothar*, *caput mortuum vitrioli*, *trip*, *brown-red*, or *rouge*.

Rust of iron (*rubigo ferri*, Ph. Dubl.; *ferri subcarbonas*, Ph. Ed.) is the hydrated sesquioxide sometimes mixed with a little carbonate of the protoxide. It is directed to be prepared by exposing moistened iron (cuttings of wire or filings) to the air, whereby it attracts oxygen both from the air and water. It is then to be reduced to an impalpable powder, by levigation and elutriation. In the shops it is found in little conical masses.

Another mode of preparing sesquioxide of iron is by precipitation. In the London Pharmacopœia it is directed to be procured by mixing a solution of four pounds of sulphate of iron in three gallons of water, with a solution of four pounds and two ounces of carbonate of soda, also in three gallons of water. The precipitated powder, when washed and dried is a hydrated sesquioxide of iron, mixed with a portion of the protocarbonate. It is the *ferri sesquioxydum* of the London Pharmacopœia, (*ferri carbonas*, Ph. Dubl.; *carbonas ferri præcipitatus*, Ph. Ed.) When procured according to the above directions, its colour is reddish chocolate brown; but the greater part of that met with in the shops has been calcined, and is of a brownish red colour.

The *theory* of the last mentioned process is as follows:—One equivalent or 76 parts of sulphate of iron are decomposed by one equivalent or 54 parts of carbonate of soda; one equivalent or 58 parts of carbonate of the protoxide of iron precipitate, while one equivalent or 72 parts of sulphate of soda remain in solution.

REAGENTS.			RESULTS.
1 eq. Carbon. Soda 54	1 eq. Soda	32	1 eq. Sulphate Soda 72
	1 eq. Carbc. Acid-	22	
1 eq. Sulphate Iron 76	1 eq. Sulphc. Acid	40	
	1 eq. Ox. Iron ..	36	1 eq. Carbonate Iron 58

By exposure to the air during the washing and drying, the carbonate of the protoxide of iron is decomposed, the oxygen of the air combines with the protoxide, and thereby converts it into sesquioxide, while carbonic acid is disengaged. A portion of protocarbonate usually escapes decomposition.

Properties.—The primary form of the crystals of native sesquioxide of iron is the rhombohedron; that of the native hydrated sesquioxide is the cube.

The artificial sesquioxide of the shops is a brownish red powder: when it has been exposed to an intense heat it sometimes has a purplish tint; the hydrated sesquioxide has a chocolate brown tint. It is odourless, insoluble in water, and not magnetic. Prepared according to the London Pharmacopœia it has a styptic taste; when calcined it is tasteless. When free from carbonate of iron, it dissolves in hydrochloric acid without effervescence.

Characteristics.—Its hydrochloric solution affords a deep blue precipitate with the ferrocyanide of potassium; a purplish black precipitate with tincture of nutgalls; a brownish red precipitate with the alkalies; and a red colour with sulphocyanic or meconic acid.

Composition.—Sesquioxide of iron has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Gay-Lussac.	Berzelius.
Iron	1	28	70	70·27	69·22
Oxygen	1½	12	30	29·73	30·78
Sesquioxide of Iron	1	40	100	100·00	100·00

When prepared by precipitation, it usually contains some carbonate of the protoxide; and, when digested in hydrochloric acid, some carbonic acid evolves. According to Mr. Phillips, the quantity of carbonate in the preparation of the shops is only 4 per cent.

Purity.—Adulteration is hardly to be apprehended. If it should contain copper, its hydrochloric solution will deposit this metal on a bright rod of iron. After the sesquioxide has been thrown down by ammonia from the hydrochloric solution, the supernatant liquor should give no indications of containing any other metal in solution; and chloride of barium ought not to occasion any precipitate.

Physiological Effects.—It is termed alterative, tonic, and emmenagogue. Its obvious effects on the body are very slight. It produces blackness of the stools; and in large doses occasions nausea, a sensation of weight at the pit of the stomach, and sometimes dyspeptic symptoms. It possesses little or no astringency. The constitutional effects, arising from the continued use of it, are those produced by the ferruginous compounds generally, and which have been before described (p. 534).

Uses.—It may be employed in any of the before mentioned cases (p. 536) in which the ferruginous tonics are indicated.

It has been strongly recommended by Mr. Benjamin Hutchinson (*Cases of Tic Douloureux successfully treated*, 1820) as a remedy for neuralgia, and in some cases it gives complete, in others partial, relief. But in many instances no benefit whatever is obtained from its use, and in one case in which I prescribed it, the patient fancied it increased her sufferings.

Mr. Carmichael, as I have before mentioned (p. 537), has recommended it as a remedy for cancerous diseases.

The use of the hydrated sesquioxide of iron, as an antidote for arsenious acid, has been before noticed (p. 396).

Administration.—The usual dose of this preparation, as a tonic and emmenagogue, is from ten grains to half a drachm, combined with aromatics, to enable it to sit more easily on the stomach. In tic douloureux it is given in much larger doses, as from half a drachm to two, three, or four drachms.

Emplastrum Oxidi Ferri Rubri, Ph. Ed.; *Emplastrum Thuris*, Ph. Dub. (Litharge plaster, ℔ij.; frankincense [concrete juice of Pinus Abies] ℔ss.; red oxide of iron, ℥iij. M. Ph. Dub. In the Edinburgh Pharmacopœia, resin, wax, and oil, are substituted for the frankincense, and the quantity of oxide is nearly three times as much).—This is the old *emplastrum roborans* or *strengthening plaster*, and is employed, spread on a leather, as a mechanical support and slight stimulant, in muscular relaxation, lumbago, weakness of the joints, &c.

Fer'ri Ox'ydum Ni'grum.—Black Ox'ide of I'ron.

History.—It was first employed as a medicine by Lemery in 1735. It is the *martial Ethiops* (*Æthiops martialis*) of some writers, and the *oxydum ferroso-ferricum* of Berzelius. It is sometimes termed the *magnetic oxide.*

Natural History.—It occurs in the mineral kingdom under the name of *magnetic iron ore,* the massive form of which is called *native loadstone.* It is found in Cornwall, Devonshire, Sweden, &c.

Preparation.—In the Dublin Pharmacopœia it is directed to be procured by washing and drying the scales of the oxide of iron (*ferri oxydi squamæ*), and then separating them from impurities by means of a magnet. They are afterwards to be reduced to a very fine powder by levigation and elutriation.

Other modes of preparing this compound are described in chemical works. The above is a cheap method, and yields a product sufficiently pure for the purposes of medicine. The process of the Paris Codex is regarded as a superior one. It consists in covering filings of iron with water, and exposing the mixture to the air; then, by elutriation, separating the black powder.

Properties.—It is a velvet-black powder, soluble in hydrochloric acid without effervescence, and magnetic.

Characteristics.—Its hydrochloric solution affords a green or greenish-brown precipitate with a caustic alkali, and a greenish or blue precipitate with ferrocyanide of potassium. Its other characteristics are the same as those of the ferruginous compounds generally.

Composition.—It is a mixture or compound of protoxide and sesquioxide of iron. According to Mosander (Turner's *Elemetns of Chemistry*), scales of iron have the following composition:—

	Outer layer. Eq.	Outer layer. Eq.Wt.	Inner layer. Eq.	Inner layer. Eq.Wt.
Protoxide of Iron	2	72	3	108
Sesquioxide of Iron	1	40	1	40
Scales of Iron	1	112	1	148

PURITY.—It should be readily soluble in hydrochloric acid, without ·fervescence, by which the absence of metallic iron is shown.

PHYSIOLOGICAL EFFECTS.—Its general effects are the same as the ·rruginous compounds already described (p. 534). It is a more valuable ·reparation than the sesquioxide, in consequence of being more readily ·luble in the fluids of the stomach. When it contains metallic iron it ·auses eructations of hydrogen gas.

USES.—It is employed in the same cases as other chalybeates (*vide* . 536).

ADMINISTRATION.—The dose of it is from five grains to a scruple twice · thrice daily.

Tinc tura Fer'ri Sesquichlo'ridi.—Tinc'ture of Sesquichlo'ride of Iron.

HISTORY.—This compound has been long in use, and is commonly ·rmed the *tincture of the muriate of iron.* It is the *liquor of muriate ·f iron* (*muriatis ferri liquor*) of the Dublin Pharmacopœia.

PREPARATION.—In the *London Pharmacopœia* it is prepared by pour·ig a pint of hydrochloric acid upon six ounces of sesquioxide of iron · a glass vessel, and digesting for three days, frequently shaking; ·en adding three pints of rectified spirit, and straining. In the *Dublin ·harmacopœia*, one part of rust of iron, six parts of hydrochloric acid, ·d six parts of rectified spirit, are used; the hydrochloric solution is ·aporated to one-third before the spirit is added, by which the excess · hydrochloric acid is driven off. In the *Edinburgh Pharmacopœia*, ·ree ounces of the black oxide of iron, ten ounces(or as much as may · sufficient) of hydrochloric acid, and sufficient alcohol to make the ·hole amount two pounds and a half: this solution is more apt to ·ecompose, owing to the presence of a larger quantity of protochloride, ·d the subsequent formation of sesquioxide.

By digestion in hydrochloric acid the sesquioxide becomes the sesqui·loride of iron, and some water is formed.

REAGENTS.				RESULTS.	
·q. Hydrochloric Acid	111	3 eq. Hydrogen	3	3 eq. Water	27
		3 eq. Chlorine	108		
·q. Sesquioxide of Iron	80	3 eq. Oxygen	24		
		2 eq. Iron	56	2 eq. Sesquichlorde Iron	164

As the sesquioxide of iron employed in the London and Dublin Phar·acopœias contains a small portion of protocarbonate of iron, a little ·otochloride of iron is formed, and slight effervescence, owing to the ·cape of carbonic acid, takes place. Both the chlorides of iron are ·luble in water as well as in spirit.

PROPERTIES.—This tincture is of a reddish brown colour, and stains ·hite paper yellow. It has a sour styptic taste, and an odour of hydro·loric ether, so that it would appear that a mutual reaction takes place ·tween the hydrochloric acid and the alcohol. It reacts on vegetable ·lours as an acid. "Its sp. gr. is about 0·992, and a fluidounce yields, when decomposed by potash, nearly 30 grains of sesquioxide of iron," (Mr. R. Phillips, *Transl. of the Lond. Pharm.*)

Characteristics.—Its reaction on vegetable colours, its inflammability, its remarkable odour, its affording chloride of silver when treated by nitrate of silver, and its reaction, like the other ferruginous compounds (p. 533), are properties sufficient to characterize it. It forms a brown semitransparent jelly with mucilage of gum arabic.

Composition.—This tincture consists of *rectified spirit*, a small portion of *hydrochloric ether*, *hydrochloric acid*, *sesquichloride of iron*, and a little *proto-chloride of iron*. Unless excess of hydrochloric acid be present, sesquioxide of iron is thrown down when the tincture is exposed to the air, owing to the iron of the chloride attracting oxygen, and becoming sesquioxide.

Sesquichloride of iron has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	J. Davy.
Iron	1	28	34·15	35·1
Chlorine	$1\frac{1}{2}$	54	65·85	64·9
Sesquichloride of Iron	1	92	100·00	100·0

Purity and Strength.—The commercial tincture of sesquichloride of iron varies in its strength, owing to the varying strength of the hydrochloric acid employed. Moreover, a diluted spirit is frequently substituted for rectified spirit. These differences can only be discovered by examining the colour and specific gravity of the tincture, as well as the quantity of oxide which it yields.

Physiological Effects.—This is, in its local action, one of the most powerful of the preparations of iron. It acts as an energetic astringent and styptic, and in large doses as an irritant. The large quantity of free hydrochloric acid which the tincture of the shops frequently contains, contributes to increase its irritant properties; and in Dr. Christison's *Treatise on Poisons* is a brief notice of a case in which an ounce and a half of this tincture was swallowed, and death occurred in about six weeks—the symptoms during life, and the appearances after death, being those indicative of inflammation of the alimentary canal. When swallowed in large medicinal doses it readily disorders the stomach. The general or constitutional effects of this preparation agree with those of other ferruginous compounds. It appears to possess, in addition, powerfully diuretic properties. Indeed it would seem to exercise some specific influence over the whole of the urinary apparatus; for on no other supposition can we explain the remarkable effects which it sometimes produces in affections of the kidneys, bladder, urethra, and even of the prostate gland. It colours the fæces black, and usually constipates the bowels.

Uses.—It is sometimes, though not frequently, used as a topical agent. Thus it is applied as a *caustic* to venereal warts, and to spongy granulations. As an *astringent* it is sometimes employed as a local application to ulcers attended with a copious discharge; or as a *styptic* to stop hæmorrhage from numerous small vessels.

Internally it may be employed as a *tonic* in any of the cases in which the other ferruginous compounds are administered, and which I have already mentioned. It has been especially commended in scrofula.

In various affections of the urino-genital organs it is frequently used with great success. Thus, in retention of urine, arising from spasmodic stricture, its effects are sometimes beneficial. It should be given in doses of ten minims every ten minutes until benefit is obtained, which frequently does not take place until nausea is excited. It has been used with success by Mr. Cline (*Med. Records and Researches*, Lond. 1798); by Mr. Collins (*Med. and Phys. Journ.* xvi. 250); by Drs. Thomas, Eberle, and Francis (*Eberle's Treat. on Mat. Med.* ii. 270, 2d ed.); and by Dr. Davy (Paris's *Pharmacologia*, ii. 478, 6th ed.) However, Mr. Lawrence (*Lond. Med. Gaz.* vi. 845), alluding to Mr. Cline's recommendation of it, observes, "I believe general experience has not led others to place any very great confidence in the use of this remedy." In gleet and leucorrhœa it is sometimes serviceable. I have found it occasionally successful, when given in conjunction with the tincture of cantharides, in the latter stage of gonorrhœa, after a variety of other remedies had failed. In passive hæmorrhage from the kidneys, uterus, and bladder, it is likewise employed with benefit.

Administration.—The dose of it is from ten to thirty minims gradually increased to one or two drachms, and taken in some mild diluent.

Antidotes.—In a case of poisoning by it the treatment should be the same as for the mineral acids (*vide* pp. 154 and 208.)

Fer'ri Ammo'nio-Chlo'ridum.—Ammo'nio-Chlo'ride of I'ron.

History.—This compound, which was known to Basil Valentine, has had various appellations, such as *flores salis ammoniaci martiales*, *ferrum ammoniacale*, or *ferrum ammoniatum*.

Preparation.—In the London Pharmacopœia it is directed to be prepared by digesting three ounces of sesquioxide of iron with half a pint of hydrochloric acid in a sandbath for two hours; afterwards adding two pounds and a half of hydrochlorate of ammonia dissolved in three pints of distilled water. The liquor is to be strained and evaporated, and the residue rubbed to powder.

By the mutual reaction of sesquioxide of iron and hydrochloric acid we obtain sesquichloride of iron and water, as explained at p. 541. A small portion of protochloride of iron must also be produced by the action of hydrochloric acid on the carbonate of the protoxide of iron usually contained in the sesquioxide of the Pharmacopœia. By evaporating the solution of the two chlorides with a solution of hydrochlorate of ammonia, we obtain a mixture of these bodies. There is no reason to believe that any chemical combination takes place.

Properties.—It is met with in the shops in the form of reddish orange-coloured crystalline grains, having a feeble odour and a styptic saline taste. It is deliquescent, and is soluble in both water and alcohol.

Characters.—Rubbed with quicklime or caustic potash, ammonia is evolved. Its solution affords chloride of silver when mixed with the nitrate of silver. It reacts as a ferruginous salt (p. 533).

Composition.—It is a mechanical mixture of hydrochlorate of ammonia and sesquichloride of iron, in the following proportions:—

Sesquichloride of Iron	15
Hydrochlorate of Ammonia	85
Ferri Ammonio-Chloridum	100

It yields about 7 per cent. of sesquioxide of iron when decomposed by an alkali (Phillips).

The yellow bands sometimes found in cakes of hydrochlorate of ammonia are probably a true chemical compound of sesquichloride of iron and hydrochlorate of ammonia (*vide* p 180; also Mr. Jackson, *Lond. Med. Gaz.* Aug. 4, 1837).

Physiological Effects.—It produces the general effects of the ferruginous preparations; but, on account of the small and variable quantity of iron present, it is a compound which is of little value. The hydrochlorate of ammonia, which it contains, renders it alterative, and in large doses aperient.

Uses.—It has been employed as a deobstruent in glandular swellings, in amenorrhœa, and other cases where the preparations of iron are usually employed.

Administration.—It may be given in substance in doses of from four to twelve grains.

Tinctura Ferri Ammonio-Chloridi, Ph. Lond. (Ammonio-chloride of iron, ℥iv.; proof spirit, Oj. M.)—"A fluidounce yields by decomposition 5·8 grains of sesquioxide of iron," (Phillips, *op. cit.*) It should be expunged from the Pharmacopœia.

Fer'ri Io'didum.—I'odide of I'ron.

History.—We are indebted to Dr. A. T. Thomson for the introduction of this substance into medicine (*Observat. on the Preparation and Medicinal Employment of Ioduret and Hydriodate of Iron*, 1834).

Preparation.—In the London Pharmacopœia it is directed to be prepared as follows:—Mix six ounces of iodine with four pints of water, and to these add two ounces of iron filings. Heat them in a sand-bath and when it has acquired a greenish colour, pour off the liquor. Wash the residue with half a pint of boiling water. Evaporate the mixed and strained liquors at a heat not exceeding 212° in an iron vessel, that the salt may be dried. Keep it in a well-stoppered vessel, the access of light being prevented. In this process one equivalent or 126 parts of iodine combine with one equivalent or 28 parts of iron to form one equivalent or 154 parts of iodide of iron. Dr. Thomson has "found the soft iron wire used for stringing pianofortes preferable to the filings."

Properties.—It is an opaque iron grey crystalline mass, with a faint metallic lustre and a styptic taste. It may be obtained in acicular crystals. It is fusible, volatile, very deliquescent, and very soluble in both water and alcohol. It readily attracts oxygen from the air, and forms sesquioxide and sesquiodide of iron.

Characteristics.—By the application of heat the violet vapour of iodine is evolved, and sesquioxide of iron is left. If this be dissolved in an acid (hydrochloric, nitric, or sulphuric), the liquid reacts as a solution of a ferruginous salt (*vide* p. 533). Thus, ferrocyanide of potassium strikes a blue, tincture of galls a bluish black, meconic or sulphocyanic acid a red, colour. Furthermore, the alkalies throw down from it the reddish brown sesquioxide of iron.

Composition.—The composition of crystallized iodide of iron, according to Mr. Phillips (*Transl. of the Pharm.*), is as follows:—

	Eq.	Eq. Wt.	Per Cent.
Iron	1	28	14
Iodine	1	126	63·3
Water	5	45	22·7
Hydrated Iodide of Iron	1	199	100·0

PURITY.—It should be perfectly soluble in water. By exposure to the air it forms sesquioxide and sesquiodide of iron: the latter is soluble, the former is insoluble, in water. To preserve a solution of this salt, a coil of soft iron wire is to be kept immersed in it: this prevents the formation of sesquiodide of iron, though it does not that of sesquioxide.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—Three drachms of iodide of iron were administered to a dog: vomiting and purging were produced, but in three days the animal was well. One drachm dissolved in a drachm of water killed a rabbit in three hours and a half, with the appearance of gradually-increasing debility: the stomach was found congested, and its lining membrane decomposed. Forty grains injected into the jugular vein of a dog killed the animal within twelve hours: the symptoms were dilatation of the pupils, staggering, vomiting, and bloody stools, (Cogswell, *Essay on Iodine and its Compounds*, p. 128, et seq.)

(*b.*) *On man.*—In *small and repeated doses* its effects are not very obvious, save that of blackening the stools. It passes out of the system in the urine, and both of its constituents may be detected in this fluid. When it does not purge, it frequently acts as a diuretic. In *full doses*, as ten grains, it on one occasion caused uneasy sensation at the epigastrium, nausea, slight headache, copious black stool, and, in two hours, a larger quantity of urine, containing both iron and iodine (Dr. A. T. Thomson, *op. cit.*) Its medicinal influence on the body seems to be stimulant, tonic, and alterative or deobstruent. Dr. Thomson regards it as possessing the combined properties of iron and iodine.

USES.—In scrofulous affections the united influence of iodine and iron is sometimes beneficial. In chlorosis, and in atonic amenorrhœa, Dr. Thomson found it serviceable; and his testimony of its good effects has been supported by that of others. Its operation must be promoted by exercise and an invigorating diet. In a case of anæmia, without any disturbance of the uterine function, I found it useless; while the compound iron mixture was of essential service. In secondary syphilis occurring in debilitated and scrofulous subjects, it is in some cases, according to the testimony of both Dr. Thomson and Ricord (*Journ. de Pharm.* xxiii. 303), a valuable remedy. The last-mentioned writer employed it in the form of injection (composed of from a half drachm to a drachm of iodide dissolved in eight ounces of water) in blenorrhœas, and in that of lotion in venereal and carious ulcers. Dr. Pierquin (quoted by Dierbach, *Neueste Entd. in d. Mat. Med.* 2te Ausg.) employed it internally and externally in leucorrhœa and amenorrhœa. It has also been used in incipient cancer and in atonic dyspepsia (Thomson).

ADMINISTRATION.—The dose of it is three grains gradually increased to eight or ten. Ricord has given forty grains per day. It may be exhibited in the form of tincture or of aqueous solution, flavoured with a little tincture of orange-peel. It must be remembered that acids, alkalies, and their carbonates, most metallic salts, all vegetable astringents, and many organic solutions, decompose it. Pierquin gave it in chocolate, Bourdeaux wine, distilled water, diluted spirit, or made into lozenges with saffron and sugar. In leucorrhœa and amenorrhœa he employed an ointment (composed of a drachm of iodide to an ounce of lard), by way of friction in the upper part of the thighs.

Fer'ri Fer'ro-sesquicyan'idum.—Fer'ro-sesquicy'anide of I'ron.

History.—This compound was accidentally discovered at the commencement of the last century by Diesbach and Dippel. It was termed *Prussian* or *Berlin blue* (*cæruleum Borussicum* seu *Berolinense*). In the London Pharmacopœia it is called *percyanide of iron* (*ferri percyanidum*); in the Dublin Pharmacopœia, *cyanuret of iron* (*ferri cyanuretum*); in the United States Pharmacopœia, *ferrocyanate of iron* (*ferri ferrocyanas*). It is sometimes termed *ferroprussiate of iron.*

Preparation.—It may be prepared by mixing a solution of persulphate or perchloride of iron with a solution of ferrocyanide of potassium.

In commerce it is procured by adding a mixture of two parts of alum and one of sulphate of iron to an impure solution of ferrocyanide of potassium (called *lixivium sanguinis*). A dingy-green precipitate falls, which, by repeated washing with very dilute hydrochloric acid, and exposure to the air, becomes gradually of a deep blue. It is then collected and drained in a cloth, and afterwards dried. By the reaction of ferrocyanide of potassium on sulphate of the protoxide of iron, sulphate of potash is formed in solution, and a white precipitate (cyanide of iron) subsides, which, by exposure to the air, becomes blue (ferrosesquicyanide of iron), in consequence of part of its iron combining with oxygen to form sesquioxide of iron. Ferrocyanide of potassium, with sulphate of the sesquioxide of iron, forms sulphate of potash and ferrosesquicyanide of iron. The green colour of the precipitate above alluded to depends on the presence of sesquioxide (thrown down by the carbonate of potash of the lixivium sanguinis), which is removed by hydrochloric acid. Commercial Prussian blue contains alumina (derived from the alum), and usually some sesquioxide of iron.

The following diagram illustrates the reaction of ferrocyanide of potassium on sulphate of the sesquioxide of iron:—

REAGENTS.					RESULTS.
4 eq. Sesquisulph. Iron...... 400	6 eq. Sulphuric Acid		240		6 eq. Sulphate of Potash .. 528
	4 eq. Sesquiox. Iron 160	6 eq. Oxyg.	48	6 eq. *Potash* 288	
		4 eq. Iron..	112		
3 eq. Ferrocyanide Potassium 568	6 eq. Cyanide Potasm = 396	6 eq. Potm	240		
		6 eq. Cyan.	156	4 eq. *Sesquicy. Iron* 268	
	3 eq. Cyanide Iron		162		1 eq. Ferrosesquicyande Iron 430

Properties.—Prussian blue occurs in masses of a rich dark blue colour. It is tasteless and inodorous. When broken it has a copper or bronze tint, somewhat like that of indigo, but which is distinguished from that of the latter by its being removed by rubbing with the nail. It is insoluble in water, alcohol, and the diluted mineral acids. Strong sulphuric acid forms with it a white pasty mass, from which water again separates Prussian blue. Both nitric acid and chlorine decompose it. Hydrochloric acid abstracts part of its iron.

Characteristics.—Its colour and copper tint above described form part of its characteristics. Boiled with water and binoxide of mercury yields bicyanide of mercury (*vide* p. 487). Boiled with solution of ·tash it forms ferrocyanide of potassium (*vide* p. 547). Heated in a tort it yields water, hydrocyanate of ammonia, then carbonate of nmonia, and leaves a black, carbonaceous, and ferruginous mass.

COMPOSITION.—The following is the composition of pure and an- drous Prussian blue:—

	Eq.	Eq.Wt.	Per Cent.			Eq.	Eq.Wt.	Per Cent.
Iron	7	196	45·5	or	Protocyanide of Iron	3	162	37·8
Cyanogen	9	234	54·5		Sesquicyanide of Iron	4	268	62·2
Ferrosesquicyanide of Iron	1	430	100·0			1	430	100·0

PURITY.—Prussian blue of commerce usually contains alumina and squioxide of iron. These may be detected by boiling the suspected mpound with diluted hydrochloric acid, which dissolves both the ipurities. Caustic ammonia added to the filtered solution will throw wn the impurities; excess of the alkali will redissolve the alumina.

PHYSIOLOGICAL EFFECTS. (*a.*) *On animals.*—Coullon gave it to dogs d sparrows without killing them; and Schubarth states that the only ect produced on a dog by two drachms was dejection (Wibmer, *Wirk. Arzneim*, ii. 356).

(*b.*) *On man.*—Its effects on man are not very obvious. It is reputed erative, tonic, and febrifuge. Sachs (*Handwört d. prakt. Arzneim*, ii. 7) calls it a resolvent tonic.

USES.—It has been recommended by Dr. Zollickoffer (*Treatise on e Use of Prussian Blue in Intermitting and Remitting Fevers*, Mary- nd, 1822) as a more certain, prompt, and efficacious remedy for inter- tting and remitting fevers than cinchona; and particularly adapted for ildren, on account of its insipidity and smallness of dose. It may be ministered during the paroxysm as well as in the intermission, and es not disagree with the most irritable stomach. Hosack (*New rk Medical and Physiological Journal*, 1823, quoted by Richter, *Ausf. zneim*), Eberle (*Mat. Med.* i. 233), and others, have borne testimony to good effects. Subsequently, Zollickoffer found it useful in dysentery. rkhoff (*Froriep's Notizen*, Bd. xvij. 340) used it for many years in ilepsy, with the best results, having cured some cases of several years' nding. It has also been employed by Dr. Bridges, of Philadelphia, *nited States Dispens.*) in a case of severe and protracted facial neuralgia, th very considerable relief. Lastly, it has been used in the form of ntment, as an application to foul ulcers.

In pharmacy it is employed in the manufacture of bicyanide of murcury.

ADMINISTRATION.—The dose of commercial Prussian blue is from four six or more grains every four hours. The *ointment* above referred to y be prepared with a drachm of Prussian blue and an ounce of lard.

Potas'sii Fer'ro-cyan'idum.—Fer'ro-cy'anide of Potas'sium.

HISTORY.—This salt was accidentally discovered at the commence- nt of the last century. It has had a variety of appellations, such as *ussiate of potash*, *ferro-prussiate of potash*, and *ferrocyanate of potash.*

PREPARATION. — The usual method of obtaining it is the follow- ;:—"Into an egg-shaped iron pot, brought to moderate ignition, project nixture of good pearl-ash and dry animal matters, of which hoofs and ns are the best, in the proportion of two parts of the former to five of the latter. Stir them well with a flat iron paddle. The mixture, as it calcines, will gradually assume a pasty form, during which transition it must be tossed about with much manual labour and dexterity. When the conversion into a chemical compound is seen to be completed by the cessation of the fœtid animal vapours, remove the pasty mass with an iron ladle. If this be thrown, while hot, into water, some of the prussic acid will be converted into ammonia, and of course the usual product diminished. Allow it to cool, dissolve it in water, clarify the solution by filtration or subsidence, evaporate, and on cooling, yellow crystals of the ferroprussiate of potash will form. Separate these, re-dissolve them in hot water, and by allowing the solution to cool very slowly, larger and very regular crystals may be had," (Ure's *Dictionary of Chemistry*.)

PROPERTIES.—This salt crystallizes in large, beautiful, lemon-yellow, transparent, permanent, inodorous crystals, whose primary form is an octahedron with a square base. They have a peculiar toughness or flexibility somewhat analogous to selenite. Their sp. gr. is 1·832. They have a sweetish, yet somewhat bitter, saline taste. They are insoluble in alcohol, but dissolve readily in both hot and cold water. When moderately heated they evolve about 13 per cent. of water of crystallization, and are converted into a white friable powder (anhydrous ferrocyanide of potassium.) When heated to redness in contact with air, the cyanide of iron of the salt is decomposed and the residuum consists of cyanide of potassium, oxide of iron, and carbon: by a more continued heat hydrocyanic acid and ammonia are evolved, while the residue consists of sesquioxide of iron and carbonate of potash.

CHARACTERISTICS.—A solution of this salt throws down, with the protosalts of iron, a white precipitate, which by exposure to the air becomes blue. With the persalts of iron it forms a deep blue; with the salts of copper a deep brown; and with those of lead a white precipitate: the precipitates are ferrocyanides of the respective metals. Heated with dilute sulphuric acid, hydrocyanic acid is evolved, and a white precipitate formed, which, by exposure to the air, becomes blue (*vide* p. 236.) Hydrosulphuric acid, the sulphurets, alkalies, or tincture of galls, give no precipitate with a solution of this salt; shewing that the iron which it contains is in some remarkable state of combination. If a solution of the ferrocyanide of potassium be boiled with binoxide of mercury, bicyanide of mercury is formed in solution, and sesquioxide of iron precipitated. The presence of potassium is best shown by calcining the salt, and detecting potash by the usual tests in the residuum. If chlorine be passed through a solution of ferrocyanide of potassium, it abstracts one equivalent of potassium from every two equivalents of the ferrocyanide, by which one equivalent of the ferrosesquicyanide of potassium is formed in solution, and by evaporation this salt may be obtained in the form of red crystals, which throw down a blue precipitate with the protosalts of iron, but occasion no change with the persalts of iron.

COMPOSITION.—Crystallized ferrocyanide of potassium has the following composition:—

	Eq.	Eq.Wt.	Per Cent.
Cyanide of Iron	1	54	25·35
Cyanide of Potassium	2	132	61·97
Water	3	27	12·67
Cryst^d. Ferrocyanide Potassium	1	213	99·99

Physiological Effects. (*a.*) *On animals.* — Schubarth (Wibmer, *irk. d. Arzneim.*) gave two drachms to one dog, and half an ounce to other, without observing any injurious consequences. Callies Vibmer, *op. cit.*, also Christison's *Treat. on Poisons*) found the com- ercial ferrocyanide of potassium slightly poisonous, but when prepared ith care he remarked that several ounces might be given with impunity. hese and other experiments show that this salt possesses very little tivity. The rapidity with which it is absorbed and gets into the cretions, as the urine, is most remarkable. Westrumb (*Müller's Phy- ology*, by Baly, i. 247) recognised it in the urine, in from two to ten inutes after it was taken into the stomach. Hering (*Lond. Med. Gaz.* . 250) has shown the amazing rapidity with which it traverses the ody when it once gets into the blood. Thus, when it was placed in one gular vein of a horse, he recognised it in the opposite one in from venty to thirty seconds.

(*b.*) *On man.*—It has no great influence on man. D'Arcet swallowed alf a pound of a solution of this salt, prepared as a test, without any ill fects (Merat and De Lens, *Dict. Mat. Méd.* ii. 532). "Similar sults," observes Dr. Christison (*Treatise*, p. 699), "were obtained reviously with smaller doses by Wollaston, Marcet,. Emmert, as well s afterwards by Dr. Macneven and Schubarth, who found that a rachm or even two drachms might be taken with impunity by man and ie lower animals."

Dr. Smart (*Amer. Journ. of Med. Sciences*, xv. 362), however, regards as possessed of some activity. He asserts that its primary action is iat of a sedative, softening and diminishing the fulness and frequency f the pulse, and allaying pain and irritation. In a healthy person, he ys, a full dose will often reduce the number of pulsations ten beats in a iinute, in a few minutes after being taken; and in a diseased state of ie system, accompanied with increased arterial action, the sedative effects re much more striking. Occasionally also it acts as a diaphoretic (in ases accompanied with excessive vascular action and increased heat of kin) and astringent, as seen in its power of diminishing excessive dis- harges. In some cases, he says, it caused ptyalism, with redness, welling, and tenderness of the gums, but unaccompanied with swelling of the salivary glands or fœtor. An over-dose, he tells us, occasions ertigo, coldness, and numbness, with a sense of gastric sinking; ometimes universal tremors, as in an ague fit. Further evidence, iowever, is required to confirm these statements, which do not accord vith the observations before reported.

Uses. — Hitherto it has rarely been employed in medicine. Dr. Smart employed it as a sedative in diseases of increased action of the ascular system and morbid sensibility of the nerves, as in erysipelas, o allay pain, in cephalalgia, in inflammation of the brain, in chronic ronchitis, &c. In the last-mentioned disease it lessened the frequency of pulse, the sweating, the cough, and the dyspnœa. As an anodyne, ie gave it in neuralgia. In hooping-cough he speaks highly of it. As in astringent, he administered it to check colliquative sweating in chronic ronchitis and phthisis, to diminish leucorrhœal discharge and to allay liarrhœa. Rau (Dierbach, *Neueste Entd. in d. Mat. Med.* i. 371, 1837) employed it in calculous complaints.

Administration.—The dose, according to Dr. Smart, is from ten to fifteen grains, given in the form of solution every four or six hours. Rau gave as much as forty grains at a dose, and I have no doubt that very much larger doses may be given with safety.

Fer'ri Sul'phas.—Sul'phate of I'ron.

History.—Sulphate of iron is one of the substances which Pliny (*Hist. Nat.* xxxiv. 32) termed *chalcanthum.* This is evident from the circumstance of his statement that the Romans called it *atramentum sutorium*, or *shoe-maker's black.* It is frequently termed *copperas*, and in consequence has been sometimes confounded with the salts of copper (Dr. Cummin, *Lond. Med. Gaz.* xix. 40): *green vitriol* (*vitriolum viride*), *vitriol of Mars* (*vitriolum martis*), *salt of Mars* (*sal martis*), *vitriolated iron* (*ferrum vitriolatum*), are other names by which it has been known.

Natural History.—It is found dissolved in some mineral waters (*sulphated chalybeates*, vide p. 145), as those of the Hartfell Spa, Scotland. In the *aluminous chalybeate* waters it is associated with sulphate of alumina; as in the water of Sand Rock, Isle of Wight. The strong Moffatt chalybeate, and Vicar's Brig chalybeate, contain the sulphate of the sesquioxide of iron. Sulphate of iron is also found in the waters of several copper mines.

Sulphate of the protoxide of iron is rarely met native in the crystallized state. It occurs, however, in Rammelsberg mine, near Goslar; at Schwartzenburg, in Saxony; at Hurlet, near Paisley; and in New England (Phillips's *Mineralogy*, by Allan).

Dr. Thomson (*Mineralogy*) has described two native sulphates of the sesquioxide of iron, and an aluminous protosulphate.

Preparation.—Sulphate of the protoxide of iron is prepared by dissolving clean unoxidized iron in diluted sulphuric acid. The proportions employed in the London Pharmacopœia are eight ounces of iron filings, fourteen ounces of sulphuric acid, and four pints of water. The Dublin Pharmacopœia employs two pints more water.

In this process an equivalent or 28 parts of iron decompose one equivalent or 9 parts of water, combine with an equivalent or 8 parts of oxygen, and set free an equivalent or 1 part of hydrogen, which escapes in the gaseous form. The equivalent or 36 parts of protoxide iron, thus formed, combines with an equivalent or 40 parts of sulphuric acid, to form an equivalent or 76 parts of sulphate of iron.

REAGENTS.				RESULTS.
1 eq. Water 9	1 eq. Hydrogen	1		1 eq. Hydrogen 1
	1 eq. Oxygen ..	8	1 eq. *Protoxide Iron* 36	
1 eq. Iron		28		
1 eq. Sulphuric Acid		0		1 eq. Sulphate of Iron 76

The *common green vitriol*, or *copperas* of the shops, is prepared by exposing heaps of moistened iron pyrites (bisulphuret of iron) to the air for several months. In some places the ore is previously roasted. The moistening is effected by rain or by manual labour. The pyrites attracts oxygen, and is converted into a supersulphate of iron, which is dissolved out by lixiviation; and to the solution thus obtained old iron is added to saturate the free acid. It is then concentrated in leaden boilers, and run off into large vessels (lined with lead) to crystallize.

Properties. — Sulphate of the protoxide of iron crystallizes in nsparent pale bluish green crystals, the primary form of which is the ique rhombic prism. Their sp. gr. is 1·82. They have an acid, styp- taste, and redden litmus. By exposure to the air oxygen is absorbed, d they acquire, first, a yellowish and darker green tint (sulphate of the ack oxide), then slightly effloresce, and become covered with a yellow ust, which subsequently becomes a brownish (sulphate of the sesqui- ide of iron). When heated the crystals undergo the watery fusion, e out water, and become white and pulverent: at an intense heat they deprived of their acid. They are soluble in water, but insoluble in ohol. They require two parts of cold, and three-fourths of their ight of boiling water, to dissolve them. The solution has a bluish een colour, but by exposure to the air it attracts oxygen, becomes ddish yellow, and deposits a tetrasulphate of the sesquioxide of iron.

CHARACTERISTICS.—It is known to be a sulphate by chloride of barium *de* p. 265). Binoxide of nitrogen communicates a deep olive colour a solution of this salt (*vide* p. 160). Ferrocyanide of potassium causes white precipitate, which, by exposure to the air, becomes blue with a lution of the sulphate of the protoxide: if any sesquioxide be present, bluish precipitate is obtained. Alkalies throw down the greenish white drated protoxide of iron (*vide* p. 533).

COMPOSITION.—The composition of this salt is as follows:—

	Eq.	Eq.Wt.	Per Cent.	Berzelius.	Thomson
otoxide of Iron	1	36	25·9	25·7	26·7
lphuric Acid	1	40	28·8	28·9	28·3
ater	7	63	45·3	45·4	45·0
ystallized Sulphate of the Protoxide of Iron	1	139	100·0	100·0	100·0

PURITY.—This salt is frequently mixed with sulphate of the sesqui- xide: this may be known by the yellowish green colour of the crystals, nd by the blue colour produced on the addition of ferrocyanide of otassium.

The *common green vitriol*, or *copperas* of the shops, is a mixture of the ulphates of the protoxide and sesquioxide of iron. It sometimes con- ains copper, which may be recognized by immersing a clean iron spatula a solution of it; the iron becomes incrusted with copper: or it may be etected by adding excess of caustic ammonia, and filtering the liquor. f copper be present, the liquor will have an azure blue tint. The am- noniacal liquid should yield, by evaporation, no fixed residuum.

PHYSIOLOGICAL EFFECTS. (*a.*) *On vegetables.*—Sir H. Davy (*Agricult. Chem.* 4th ed. 186) ascribes the sterility of a soil to the presence of sul- phate of iron.

(*b.*) *On animals.*—C. G. Gmelin (*Vers. ü. d. Wirk.* &c. 84) found that wo drachms given to a dog caused vomiting only; that forty grains had o effect on a rabbit; and that twenty grains, thrown into the jugular ein of a dog, produced no effect. Dr. Smith (quoted by Wibmer and y Christison), however, found that two drachms proved fatal to a dog when taken into the stomach or applied to a wound. Orfila (*Toxicol. Gén.*) obtained similar results. The effects were local inflammation and specific affection of the stomach and rectum. According to Weinhold quoted by Richter, *Ausf. Arzneim.* v. 55), the spleen of animals fed with t becomes remarkable small and compact.

(*c*.) *On man.*—This salt acts locally as a powerful astringent, and, when employed in a concentrated form, as an irritant. The latter effect depends on its chemical action on the organic constituents (albumen, &c.) of the tissues. The remote effects of sulphate of iron are analogous to those of other ferruginous compounds, and which have been already described.

Swallowed *in small doses* it has an astringent operation on the gastro-intestinal mucous membrane, and thereby diminishes the quantity of fluids secreted or exhaled; hence its continued use causes constipation. It blackens the stools like other compounds of iron. It becomes absorbed, and operates on the system as a tonic, stimulant, emmenagogue, and astringent. *In large medicinal doses* it readily excites pain, heat, or other uneasiness at the pit of the stomach, and not unfrequently nausea and vomiting: this is especially the case in irritable conditions of this viscus. *In excessive doses* it operates as an irritant poison. A girl took, as an emmenagogue, an ounce of it in beer, and was seized, in consequence, with colic pains, constant vomiting and purging for seven hours. Mucilaginous and oily drinks soon cured her (Christison, from *Rust's Magazin*, xxi. 247).

Uses.—Sulphate of iron is to be preferred to other ferruginous compounds where there is great relaxation of the solid parts with immoderate discharges. Where the long-continued use of ferruginous compounds is required, it is less adapted for administration than some other preparations of iron, on account of its local action on the alimentary canal.

It is employed in lump, powder, or solution, as a styptic, to check hæmorrhage from numerous small vessels. A solution of it is applied to ulcerated surfaces, and to mucous membranes, to diminish profuse discharges; as in chronic ophthalmia, leucorrhœa, and gleet.

Internally it is administered in passive hæmorrhages, on account of its supposed astringent influence over the system generally: also in immoderate secretion and exhalation; as in humid asthma, chronic mucous catarrh, old dysenteric affections, colliquative sweating, diabetes, leucorrhœa, gleet, &c. In intermittents it has been employed as a tonic. It has also been found serviceable against tape-worm. Its other uses are the same as the ferruginous compounds generally (*vide* p. 536).

Administration.—The dose of it is from one to five grains, in the form of pill. If given in solution the water should be recently boiled, to expel the atmospheric air dissolved in it; the oxygen of which converts this salt into a persulphate. For local purposes, solutions of it are employed of various strengths, according to circumstances. In chronic ophthalmia we may use one or two grains to an ounce of water: as an injection in gleet, from four to ten grains.

Fer'ri Car'bonas.—Car'bonate of I'ron.

History.—This compound must not be confounded with the sesquioxide of iron, which is frequently termed carbonate of iron.

Natural History.—It occurs native in the crystallized state, constituting the mineral called *spathose iron*. It is also found in most chalybeate waters (*vide* p. 145.)

Preparation.—It is prepared by adding a solution of an alkaline carbonate to a solution of a protosalt (as the sulphate) of iron, the atmosıeric air being carefully excluded. The carbonate of the protoxide of ›n is precipitated. When we attempt to collect and dry it, decomposi- ›n takes place; oxygen of the air is absorbed, carbonic acid escapes, ıd sesquioxide of iron remains (*ferri sesquioxydum*, Ph. L. *vide* p. 538). ence when employed in medicine it must be prepared extempo- neously.

PROPERTIES.—Native protocarbonate of iron is yellow: the primary rm of its crystals is the obtuse rhombohedron. Carbonate of iron pre- ıred as above directed is a white precipitate, which by exposure to the r becomes at first greenish, then brown (sesquioxide). It is insoluble water, but dissolves in sulphuric or hydrochloric acid with effervescence. also readily dissolves in carbonic acid water: the acidulo-chalybeate aters are natural solutions of this kind (*vide* p 145.)

CHARACTERISTICS.—It dissolves in diluted sulphuric acid with efferves- nce. The solution possesses the before-mentioned properties of the rruginous solutions (*vide* p. 533).

COMPOSITION.—Carbonate of the protoxide of iron is thus com- ›sed:—

	Eq.	Eq.Wt.	Per Cent.	Stromeyer. (Native.)
Protoxide of Iron	1	36	62	59·6276
Carbonic Acid	1	22	38	38·0352
Carbonate of Iron	1	58	100	97·6628

PHYSIOLOGICAL EFFECTS.—It is one of the most valuable of the ferru- nous compounds, on account of the facility with which it dissolves in e fluids of the stomach and becomes absorbed. Its local effects are ry mild.

MISTURA FERRI COMPOSITA, Ph. Lond. and Dubl. (Myrrh, ›wdered, ℥ij.; carbonate of potash, ℥j.; rose-water, f℥xviij.; sulphate iron, powdered, ℈iiss.; spirit of nutmeg, f℥ij.; sugar, ℥ij. Rub gether the myrrh with the spirit of nutmeg and the carbonate of potash, ıd to these, while rubbing, add first the rose-water with the sugar, then e sulphate of iron. Put the mixture immediately into a proper glass ssel, and stop it).—This is a professed imitation of Dr. Griffith's lebrated antihectic or tonic mixture (Dr. M. Griffith, *Observ. on the ıre of Hectic and Slow Fevers, and the Pulm. Consump.* 1776): hence is frequently termed *Griffith's Mixture* (*mistura Griffithii*).

In the preparation of it, double decomposition takes place: by the utual reaction of carbonate of potash and sulphate of iron we obtain lphate of potash, which remains in solution, and carbonate of pro- xide of iron, which precipitates. To prevent the latter attracting more ygen, it is to be preserved in a well-stoppered bottle. As more rbonate of potash is used than undergoes decomposition, the excess ›mbines with the myrrh, and forms a kind of saponaceous compound, hich assists in suspending the carbonate of iron in the liquid.

When first made, this mixture has a greenish colour, owing to the rruginous carbonate; but by exposure to the air it becomes reddish, ving to the absorption of oxygen, by which sesquioxide of iron is rmed, and carbonic acid evolves: hence it should only be prepared hen required for use.

It is one of the most useful and efficacious ferruginous preparations, ıd which is supposed to be owing to its being readily soluble, and consequently easy of digestion and absorption. Its constitutional effects are analogous to those of the ferruginous compounds in general, and which have been already described. Its tonic and stimulant operation is promoted by the myrrh: the excess of alkaline carbonate must not be forgotten in estimating the sources of activity of this medicine.

It is admissible in most of the cases in which ferruginous remedies are indicated; but it is especially serviceable in anæmia, chlorosis, atonic amenorrhœa, and hysterical affections. It is also employed with benefit in the hectic fever of phthisis and chronic mucous catarrhs. It is contra-indicated in inflammatory conditions of the gastro-intestinal membrane.

The dose of it is one or two fluidounces three or four times a day. Of course acids and acidulous salts, as well as all vegetable astringents which contain gallic or tannic acid, are incompatible with it.

Pilulæ Ferri Compositæ, Ph. Lond. and Dubl. (Myrrh, powdered, ℥ij.; carbonate of soda; sulphate of iron; treacle, āā ʒj. Rub the myrrh with the carbonate of soda; then, having added the sulphate of iron, rub them again; afterwards beat the whole in a vessel previously warmed, until incorporated).—This preparation is analogous in its composition, effects, and uses, to the preceding one. Double decomposition takes place between the two salts employed, aad the products are sulphate of soda and carbonate of iron. The carbonate of soda is preferred to the carbonate of potash, on account of the deliquescence of the latter. These pills, like the mixture, should only be made when required for use.

Twenty grains of this compound contain about one grain of protoxide of iron, or $1\frac{7}{10}$ grs. of protocarbonate. The effects and uses are precisely the same as the *mistura ferri composita*. The dose is from ten to twenty grains.

Carbonated Chalybeate Waters. — A most agreeable and efficacious mode of administering carbonate of the protoxide of iron is in the form of the carbonated chalybeate waters, as those of the Islington Spa, near London, of Tunbridge Wells, of Oddy's saline chalybeate at Harrowgate, and of the Spa in Belgium. The last-mentioned water contains a considerable excess of carbonic acid (*vide* p. 145). A convenient extemporaneous mode of administering carbonate of iron in imitation of these waters, is by intimately mixing equal parts (as 10 or 12 grains) of sulphate of iron and sesquicarbonate of soda, and dissolving in a tumblerful of carbonic acid water (soda water of the shops): the solution is to be taken in a state of effervescence.

Potas'sæ Fer'ro-Tar'tras.—Fer'ro-Tar'trate of Pot'ash.

History.—This preparation was first described by Angelus Sala at the commencement of the seventeenth century. It is sometimes termed *chalybeated tartar* (*tartarus chalybeatus* seu *ferratus*), *tartarized iron* (*ferrum tartarizatum*); *ferri tartarum*, Ph. Ed.; *tartras potassæ et ferri*, Ph. Dub.; *ferri potassio-tartras*, Ph. Lond.

Preparation.—Soubeiran (*Nouv. Traité de Pharm.* ii. 486) directs it to be prepared thus:—Boil together one part of powdered bitartrate of potash, six parts of water, and as much moist hydrated sesquioxide of iron as the liquid will dissolve. Filter and evaporate to dryness by a gentle heat.

The London Pharmacopœia professes to follow Soubeiran's process, it the formula which is given is much more complex; it is as follws:—Mix three ounces of sesquioxide of iron with half a pint of drochloric acid, and digest for two hours in a sand bath. Add to ese two gallons of water, and set aside for an hour; then pour off the pernatant liquid. Four pints and a half, or as much as may be fficient, of solution of potash being added, wash what is precipitated quently with water, and, while moist, boil it with eleven ounces and a lf of bitartrate of potash, previously mixed with a gallon of water. the liquor should be acid when tried by litmus, drop into it solution of squicarbonate of ammonia until it is saturated. Lastly, strain the uor, and with a gentle heat let it evaporate, so that the salt may main dry.

The *theory* of this process is as follows:—By the reaction of sesquiide of iron and hydrochloric acid we obtain water and sesquichloride iron (*vide* p. 541). On the addition of caustic potash, the sesquiloride is decomposed, hydrated sesquioxide of iron is precipitated, and loride of potassium is left solution. These changes are illustrated by e following diagram:—

REAGENTS.		RESULTS.	
. Potash 144	3 eq. Potassium......120	3 eq. Chloride Potassium 228	
	3 eq. Oxygen 24		
. Sesquichloride Iron ..164	3 eq. Chlorine 108		
	2 eq. Iron 56	2 eq. Sesquioxide Iron. 80	*Hydrated Sesquioxide of Iron.*
ter			

When the hydrated sesquioxide of iron is boiled with bitartrate of tash, one equivalent or 40 parts of sesquioxide combine with one uivalent or 66 parts of tartaric acid of the bitartrate of potash, and m an equivalent or 106 parts of tartrate of sesquioxide of iron, which mbine with an equivalent or 114 parts of tartrate of potash, to form e equivalent or 220 parts of ferrotartrate of potash.

REAGENTS.			RESULTS.
. Sesquioxide of Iron.............	40	1 eq. *Tartrate of Sesquiox. Iron* 106	1 eq. Ferro-tartrate of Potash, 220
. Bitartrate otash.... 180	1 eq. Tartaric Acid 66		
	1 eq. Tartrate Potash 114		

The processes of the Dublin and Edinburgh Colleges are much ferior to the above, and need not be minutely described. A mixture iron, bitartrate of potash, and water, is exposed to the air, by which e iron is converted into sesquioxide, and combines with the bitartrate.

PROPERTIES.—It is an olive-brown inodorous powder, with a styptic y taste. It reacts on vegetable colours, mildly alkaline. It is slightly liquescent, probably from the tartrate of potash which it contains. It ssolves in about four times its weight of water, and slightly in alcohol.

CHARACTERISTICS.—Ferrocyanide of potassium does not occasion any ue colour with it, unless a few drops of acid be added. Potash, soda, and eir carbonates, do not decompose it at ordinary temperatures, nor does nmonia or its carbonate even by the aid of heat. Tincture of nutgalls uses a dark-coloured precipitate. Sulphuric, nitric, or hydrochloric id, throws down the sesquioxide of iron from a solution of this salt; excess of acid redissolves it: the solution has then a very astringent ste. Tartaric acid causes the formation of crystals of tartar. Heated a covered crucible, ferrotartrate of potash yields charcoal, carbonate potash, and protoxide of iron.

Composition.—The following table exhibits the composition of this salt, according to Soubeiran (*op. cit.*) and Phillips (*Transl. of Pharmacopœia*).

		Phillips.		Soubeiran.	
Tartrate of Sesquioxide of Iron	1	106	48·18	Sesquitartrate of Sesquioxide	45
Tartrate of Potash	1	114	51·82	Tartrate of Potash	55
Ferro-tartrate of Potash	1	220	100·00	"	100

Soubeiran says it contains 13 per cent. of sesquioxide of iron; whereas, according to Mr. Phillips, the quantity is 18·18 per cent.

The ferro-tartrate of potash is to be regarded as a double salt, in which tartrate of iron is the acid or electro-negative ingredient, and tartrate of potash the basic or electro-positive constituent. On this view, we comprehend why ferrocyanide of potassium and the alkalies refuse to act on it in the way they do on the ordinary ferruginous salts, until an acid be added. Geiger (*Handb. d. Pharm.*) regards it as a combination of tartrate of iron and ferrate of potash.

Purity. — In commerce we frequently meet with an imperfectly prepared compound, in which none or only part of the sesquioxide of iron is in chemical combination with bitartrate of potash. In this state it is only partially soluble in water, and the solution strikes a blue colour with the ferrocyanide of potassium, and throws down a reddish-brown precipitate with solution of potash.

Physiological Effects.—In its effects on the system it agrees, for the most part, with other ferruginous compounds. Its taste, however, is comparatively slight, its astringency is much less than the sulphate or sesquichloride, and consequently its constipating effects are not so obvious, and its stimulant influence over the vascular system is said to be somewhat milder. These peculiarities in its operation are supposed to depend on the tartaric acid and potash with which it is in combination.

Uses.—It is not frequently employed, yet it is a very eligible preparation of iron, and may be employed wherever the ferruginous tonics are indicated.

Administration.—The dose of it is from ten grains to half a drachm, in the form of solution or bolus, combined with some aromatic.

Ammo'niæ Fer'ro-tar'tras.—Fer'ro-tar'trate of Ammo'nia.

This salt, commonly termed *tartrate of iron and ammonia*, or *ammonio-tartrate of iron*, is occasionally employed in medicine. It was first noticed by Mr. Aikin (*Lond. Med. Gaz.* viii. 438).

It may be prepared by adding caustic ammonia to a solution of tartrate of iron (prepared by digesting together, for two or three days, one part of tartaric acid, dissolved in hot water, with two or three parts of iron filings). The green solution thus obtained is to be evaporated to dryness by a gentle heat (Aikin, *op. cit.*)

It is in the form of shining brittle fragments of a deep red colour, not very unlike pieces of very deep-coloured shell-lac. It is very soluble in water. Its taste is strongly saccharine.

Its general effects are analogous to those of the other ferruginous compounds, except that it has very little of any astringency. Its advanages over other chalybeates are its ready solubility in water, its palatable taste, and the facility with which it may be mixed with various saline substances, without undergoing decomposition. It contains more oxide of iron than the same quantity of sulphate. The dose for an adult is five or six grains in powder, pill, or solution. It may be exhibited in porter without being detected by the taste. It may be added to the compound decoction of aloes without suffering decomposition.

Fer'ri Acé'tas.—Ac'etate of I'ron.

History.—A solution of iron in acetic acid has long been known and used in the arts. It constitutes the *iron liquor* of the dyer.

Preparation.—In the Dublin Pharmacopœia acetate of iron is directed to be prepared by digesting, for three days, one part of carbonate of iron (sesquioxide) in six parts of acetic acid, and then filtering.

Properties.—It is a deep-red liquid, having an acid chalybeate taste. It reddens litmus.

Characteristics.—When heated, it yield acetic acid. Ferrocyanide of potassium strikes a blue colour with it; infusion of galls a purplish black.

Composition.—It consists of the acetate of the protoxide and acetate of the sesquioxide of iron.

The Physiological Effects and Uses are the same as other ferruginous compounds. The Dose is from ten to twenty-five drops, in water.

Ferri Acetatis Tinctura, Ph. Dubl. (Acetate of potash, two parts; sulphate of iron, one part; rectified spirit, 26 parts. Rub together the acetate and sulphate, then dry, and add the spirit. Digest for seven days, then filter.)—In this process sulphate of potash and acetate of iron are formed: the latter, as well as the excess of the acetate of potash, dissolves in the spirit. It is a claret-coloured tincture. It possesses the usual properties of a ferruginous compound. It is said to be an agreeable chalybeate, and was introduced into the Dublin Pharmacopœia by Dr. Perceval. The dose is from half a drachm to a drachm.

Tinctura Acetatis Ferri cum Alcohol, Ph. Dubl. (Sulphate of iron; acetate of potash, āā ℥j.; alcohol, ℥xxxij. Triturate together the sulphate and acetate, then dry, and when cold add the alcohol. Digest for twenty-four hours.)—The dose is twenty drops to a drachm.

Order 27.—Binoxide of Manganese.

Mangane'sii Binox'ydum.—Binox'ide of Man'ganese.

History.—Native binoxide of manganese has been long known and used in the manufacture of glass (*magnesia vitriariorum*); but until Kaim, in 1770, succeeded in extracting a peculiar metal from it, it was usually regarded as an ore of iron. It is commonly termed *native black* or *peroxide of manganese*, or for brevity *manganese*.

Natural History.—The oxide of manganese used in chemistry and pharmacy is the native anhydrous binoxide, called by mineralogists *pyrolusite*. It is found in great abundance in Cornwall, Devonshire, Somersetshire, and Aberdeenshire, from whence most of what is met with in commerce in this country is obtained. The principal mines of it are in the neighbourhood of Launceston, Lifton, and Exeter. The Upton Pyne mine, once celebrated for its oxide of manganese, has yielded scarcely any for several years past, if, indeed, it be not completely worked out. Pyrolusite is also found in Saxony, Hungary, France, and other countries of Europe.

PREPARATION.—Native binoxide of manganese after being raised from the mine is broken into small pieces, about the size of peas, and then washed to separate the earthy impurities. It is afterwards ground in mills to an impalpable powder.

PROPERTIES.—This mineral occurs massive, columnar, crystallized, and pulverent: the primary form of the crystals is the right rhombic prism. The massive variety has sometimes a metallic lustre, but is generally dull and earthy: its colour is iron black or brownish: it soils the fingers in handling it: its sp. gr. varies from 4·6 to 4·9: it is tasteless, odourless, and insoluble in water: it yields a black powder.

CHARACTERISTICS.—When heated it yields oxygen gas. Mixed with common salt and sulphuric acid it gives out chlorine. Heated with sulphuric acid it evolves oxygen, and forms a sulphate of the protoxide of manganese. It is infusible before the blow-pipe; dissolves in fused borax with effervescence, and colours the globule of an amethystine colour. If it be digested in hydrochloric acid until chlorine cease to be evolved, and the solution slightly supersaturated with ammonia, we get rid of the sesquioxide of iron: the filtered liquid throws down a white precipitate with ferrocyanide of potassium.

COMPOSITION.—Pure binoxide of manganese has the following composition:—

	Eq.	Eq.Wt.	Per Cent.	Forchhammer	Berzelius & Arfvedson.
Manganese	1	28	63·5	63·75	64·02
Oxygen	2	16	36·5	36·25	35·98
Binoxide of Manganese	1	44	100·0	100·00	100·00

The native binoxide is, however, never pure: it usually contains oxide of iron, carbonate of lime, sulphate of baryta, and argillaceous matter. Its purity is judged of by the quantity of oxygen or of chlorine which it is capable of yielding. The brown varieties are inferior to the black ones.

PHYSIOLOGICAL EFFECTS.—The effects of this substance are imperfectly known. Kapp (*Hufeland's Journ.* Bd. xix. St. 1, S. 176) first employed it internally. He regards it as a permanent stimulant, and says it promotes the appetite and digestion. Vogt (*Pharmakodynamik*) places it among the tonics, and considers it to be intermediate between iron and lead, but his views are altogether theoretical, as he does not seem to have employed it. Dr. Coupar (*Brit. Ann. of Med.* Jan. 13, 1837, p. 41) has described several cases of disease which took place among the men engaged in grinding it at the chemical works of Messrs. Tennant and Co. in Glasgow: from these it appears, when slowly introduced into the system, to produce paralysis of the motor nerves. The disease commences with symptoms of paraplegia. It differs from lead in not causing colica pictonum or constipation, and from mercury in first affecting the lower extremities, and in not exciting tremors of the affected part. C. G. Gmelin (*Versuche ü. d. Wirkungen,* &c.) tried the effect of the sulphate of the protoxide of manganese on animals, and found that it caused vomiting, paralysis, without convulsions, and inflammation of the stomach, small intestines, liver, spleen, and heart. Gmelin observes, as remarkable, "the extraordinary secretion of bile produced by it, and which was so considerable that nearly all the intestines were coloured yellow by it, and the large intestines had a wax yellow colour communicated to them," (*op. cit.* 90.) It deserves notice, in connexion with this effect, that the *sel désopilant* of Rouvière, used as a quack remedy to evacuate bile, contains chloride of manganese. (*Journ. de Chim. Méd.* v. 534.)

Dr. Thomson has seen an ounce of the sulphate swallowed without any effect, except the free action of the bowels, (Coupar, *op. cit.*) Hünefeld (*Horn's Archiv f. Med.* Erf. 1830, quoted by Wibmer, *Wirk. d. Arzn.*) gave to a rabbit nearly two drachms of manganesic acid, in three days, in doses of ten or fifteen grains. The only obvious effect was increased secretion of urine. The animal being killed, the peritoneum and external coat of the colon was found of a greenish colour [protoxide of manganese is green], the muscles were readily lacerated and pale, the liver was inflamed, the bile increased. Wibmer (*op. cit.*) gave six grains daily of the carbonate of the protoxide of manganese to a rabbit during many weeks. No disturbance of function was observed. The animal was killed, but neither in the blood nor the muscles could the least trace of manganese be detected.

Uses.—It is rarely employed in medicine. Kapp (*op. cit.*) administered it, as well as the salts of manganese, internally as well as externally in the various forms of syphilis. In herpes, scabies, and the scorbutic diathesis, he used it with benefit. Brera (Harless, *Neues Journ. d. Ausl. Med. Lit.* Bd. viii. St. 2, S. 57) used it in chlorosis, scorbutus, hypochondriasis, hysteria, &c. Otto (*Frorieps Notizen*, Bd. xii. No. 22, S. 347) administered it in cachectic complaints with favourable results. Odier (*Handb. d. pr. Arzneiwiss.* quoted by Richter) employed it in cardialgia. It has been applied as an absorbent in the treatment of old ulcers, as a depilatory, and as a remedy for skin diseases, especially itch and porrigo (Rayer, *Treat. on Skin Diseases*, by Willis, p. 58.)

Administration.—Internally it has been given in the form of pills, in doses varying from three grains to a scruple, three or four times in the day. As a local agent it has been used in the form of gargle, composed of two or three drachms of the oxide diffused through five or six ounces of barley water. An ointment, consisting of one or two drachms of oxide to an ounce of lard, has also been used.

In chemistry and pharmacy it is employed in the manufacture of oxygen, chlorine, and iodine. In the arts it is used by the bleacher for the production of chlorine; by the glass-maker to destroy the brown colour communicated to glass by iron; and to give an amethystine tint to plate glass; and by the potter for colouring earthenware.

END OF PART I.

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