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# TABLES

OF

## CHEMICAL EQUIVALENTS,

## INCOMPATIBLE SUBSTANCES,

AND

## POISONS AND ANTIDOTES;

WITH AN

## Explanatory Introduction.

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COLLECTED AND ARRANGED

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LEXINGTON, KY.

PRINTED BY W. W. WORSLEY, -CORNER OF MAIN AND MILL STREETS.

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January, 1825.

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**Students of Medicine**  
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**THE FOLLOWING TABLES,**  
DESIGNED FOR THEIR BENEFIT,  
AND  
PREPARED AT THEIR REQUEST  
ARE  
*RESPECTFULLY AND AFFECTIONATELY*  
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# Introduction.

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THE following tables, having been compiled in haste, will no doubt be found to contain errors; but it is presumed they are, on the whole, sufficiently accurate, to answer the purpose for which they were prepared.

Those which relate to CHEMICAL EQUIVALENTS, are designed to present to students of Medical Chemistry, a comprehensive view of the combining proportions or equivalent numbers of all the elementary bodies, and most of the useful compounds. The truth and value of such tables are entirely independent of the atomic theory, for they contain nothing but expressions of fact.

The atomic theory, as it is called, is an hypothesis invented for the purpose of enabling us to explain these facts; and it certainly does enable us to explain them, in a satisfactory manner. But grant, for a moment, that the hypothesis is untrue; this will not invalidate the facts, nor diminish their utility; it can only deprive us of what appears to me, a rational and philosophical method of explaining them. For example:

## TABLE I,

Contains the names of the ELEMENTARY BODIES at present known; and opposite those names, stand their prime equivalent numbers. These numbers, or some multiple of them, represent the *relative* proportions in which bodies combine with each other. Thus if we look into the 4th group of the 2d division of the 2d class, we find mercury, and opposite to this, its prime

equivalent number, 200; now, if we search in the 1st class for oxygen, we learn that *its* prime equivalent number is 8; this number and its multiple by 2, or 16, are the proportions in which oxygen combines with 200 of mercury.

If we look opposite to chlorine we find its prime equivalent to be 36; this number and its multiple by 2, or 72, are the proportions in which chlorine combines with 200 of mercury.

Again in the 1st division of the 2d class we find sulphur and its prime equivalent 16; this number and its multiple by 2, or 32, represent the proportions of sulphur which combine with 200 of mercury; or thus,

200 parts of mercury	}	8 or with 16 parts of Oxygen,
combine with		36 " 72 " Chlorine,
		16 " 32 " Sulphur.

Now whatever be the *cause* of these elementary bodies combining in the above proportions, the facts themselves are indisputable; for they have been clearly ascertained, both by analytical and synthetical methods of investigation.

Let us enquire how the atomic hypothesis will account for these facts:

We know from experiment, that 208 grains of gray oxide of mercury—the basis of the *pilulæ hydrargyri* of the pharmacopœias—contains 200 grains of mercury and 8 grains of oxygen. The atomic theory of definite proportions supposes, that in this mass of oxide there are an equal number of ultimate particles, or atoms, of mercury and oxygen. Analysis teaches us that 216 grains of the red oxide of mercury—the red precipitate of the shops—contain 200 grains of mercury and 16 of oxygen; and having double the proportion of oxygen contained in the gray oxide, are said, in the language of the atomic theory, to have two particles of oxygen united with each particle of the metal. The former is, therefore, denominated a *protoxide*, and the latter a *deutoxide* of mercury.

In like manner, if 36 grains of chlorine are sufficient to furnish *one* atom of chlorine to every atom of mercury, in 200 grains of that metal, it is evident that *twice* the quantity, or 72 grains of chlorine, are sufficient to furnish *two* atoms of chlorine to every atom of mercury, in 200 grains of the metal; forming in the *first* case, proto-chloride of mercury or calomel; and in the *second*, deuto-chloride of mercury, or corrosive sublimate.

Again, if 16 grains of sulphur are required to furnish *one*

atom to every atom of mercury, in 200 grains of the metal, it is evident that *twice* 16, or 32 grains of sulphur, are capable of furnishing *two* atoms of sulphur to every atom of mercury, in 200 grains of the metal;—constituting in the former case, the *protosulphuret* of mercury or Ethiops mineral; in the latter the *deutosulphuret* or cinnabar.

It must be admitted that we have no direct proof, that bodies do combine atom to atom; nor is it possible that we ever should have—the ultimate particles or atoms of matter not being cognizable by our senses; but it is easy to perceive, that on this supposition we can readily account for the constant and definite proportions, in which we know, both from analysis and synthesis, bodies do unite.

It should be distinctly understood, that the prime equivalent numbers, or, as they are hypothetically called, weights of the atoms, have no reference whatever, to the *absolute* weights, either of the atoms or of the combining masses. They simply express the *relative* proportions in which different bodies are found united.

Whatever quantity, for example, we take of soda, which is a protoxide of sodium, the two elements of the compound will always be found to exist, in the relative proportions expressed by their prime equivalent numbers; that is, the sodium will be to the oxygen in the proportion of 24 of the former to 8 of the latter; in other words, the sodium will always weigh three times as much as the oxygen; for that is the proportion which the prime equivalent numbers of these bodies bear to each other.

Whether then we take 32 grains of soda, made up of 24 grains of sodium and 8 grains of oxygen, or 4 grains of soda, made up of 3 grains of sodium and 1 grain of oxygen, or 1 1-3 grains of soda made up of 1 grain of sodium and 1-3 of a grain of oxygen—the relative proportions are the same; for 24 to 8, 3 to 1, and 1 to 1-3 all bear the same relative proportion to each other; and the combining proportions of bodies, it may be repeated, are all that we mean to express by their prime equivalent numbers.

The reason may not present itself to the student, why the particular numbers which these tables present as prime equivalents, have been adopted. He may enquire why 4 does not stand as the prime equivalent of oxygen, 3 as the prime equivalent of carbon, 100 as the prime equivalent of mercury, &c. seeing that these numbers bear the same proportion to each other, as 3, 6 and 200? This is true; and if all the numbers in the

table were changed in the same proportion, they would still be equivalent to each other: but if we were to divide them all by 2, as in the above example, we should subject ourselves to the inconvenience of being obliged to express the prime equivalent of that substance which combines in the smallest proportion by weight, namely hydrogen, by a number less than unity, that is, by a fraction; and this would not be limited to hydrogen, but the equivalent of many of the elementary bodies, would require to be expressed in broken numbers; which would increase the difficulty of recollecting them, and diminish the facility of combining them in our calculation.

This is a strong objection to making oxygen the standard; or in other words designating its prime equivalent by 1 or unity; as it compels us to express the prime equivalent of many other substances by a fraction or mixed number; thus if we make oxygen 1, hydrogen will be expressed by 0.125, chlorine by 4.5, iodine by 15.625, &c.

In the following tables, hydrogen is taken as the standard or unity, therefore its prime equivalent number is 1.

This prime equivalent 1, or some multiple of it by a whole number, as 2, 3, 4, &c. always represents the proportion in which hydrogen combines with a prime equivalent of another body—that is, with a quantity expressed by the prime equivalent number of that body.

For example, 1 part of hydrogen combines with 8 parts of oxygen to form 9 parts of water—1 part of hydrogen combines with 36 parts of chlorine to produce 37 parts of hydrochloric or muriatic acid gas—1 part of hydrogen combines with 124 parts of iodine to produce 125 parts of hydriodic gas—3 parts of hydrogen (which are a multiple of its prime equivalent by 3) combine with 14 parts of azote to produce 17 parts of ammoniacal gas—1 part of hydrogen combines with 6 of carbon to form 7 parts of hydroguret of carbon—1 part of hydrogen combines with 12 parts of phosphorus to form 13 parts of phosphoretted hydrogen gas—1 part of hydrogen combines with 16 parts of sulphur to form 17 parts of sulphuretted hydrogen gas, &c.

In like manner, the proportions in which all elementary bodies combine, are represented by their prime equivalent numbers, or the proportion of *one* element is represented by its prime equivalent number, and the proportion of the *other* element by some *multiple* of its prime equivalent, by the whole numbers 2, 3, 4, &c. Example. Oxygen combines with azote, in the proportion of 1 prime equivalent of each, to form the

protoxide of azote or nitrous oxide. It also combines with this element in several other proportions, producing a set of compounds in which the numbers representing the proportions of oxygen, are a series of multiples of the prime equivalent of that element, by the numbers 2, 3, 4, and 5, as appears by the following tabular view:

COMPOUNDS	AZOTE.	OXYGEN.
Protoxide of Azote, (nitrous oxide,) - -	14	- - 8
Deutoxide, (nitric oxide or nitrous gas,) 14	- -	16
Hyponitrous Acid, - - - - -	14	- - 24
Nitrous Acid, - - - - -	14	- - 32
Nitric Acid, - - - - -	14	- - 40

Thus we see, that the protoxide of azote contains one atom or prime equivalent of each element, and that the numbers 16, 24, 32, and 40, which represent the proportions in which oxygen combines with 14 parts of azote in the formation of the other compounds, are all exact multiples of 8, the prime equivalent of oxygen, by the numbers 2, 3, 4, and 5.

It is presumed that the *arrangement* of the 1st table requires no particular explanation. The succession of the elementary bodies is that in which they are treated in Thomson's Chemistry; with the exception of the few that have been discovered subsequently to the publication of that part of his system, which contains the classification of elementary bodies. These, which are comparatively of little importance, will be found associated with those bodies, which from a superficial comparison of their chemical properties, they appear most to resemble.

I will here add a few examples of the method of ascertaining by means of proportional or equivalent numbers, the *absolute* quantities of the elementary substances contained in a *given* quantity of any compound.

Example 1st. Calomel is a protochloride of mercury, or a compound of one prime equivalent or atom of chlorine, equal to 36, and one prime equivalent of mercury, equal to 200: consequently *in any quantity whatever* the chlorine is to the mercury in the proportion of 36 to 200. Now if we wish to ascertain the quantity of each element in 100 grains of calomel, we make the following statement: As 236, the prime equivalent of calomel, are to 36, the prime equivalent of chlorine, so are 100 grains of calomel to 15.25, the number of grains of chlorine which they contain; which subtracted from 100, leave 64,75

of mercury; and hence we find, that 100 grains of calomel	Chlorine	-	-	15.25
contain	Mercury	-	-	84.75
				<hr/> 100.00

The calculation is as follows:

$$236 : : 36 : : 100$$

$$\begin{array}{r} 100 \\ 236 \overline{)3600} \end{array} \begin{array}{l} 15.25 \text{ chlorine, which subtracted from 100 leaves} \\ \underline{236} \\ 84.75 \text{ of mercury.} \end{array}$$

1240

1180

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600

472

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1280

1180

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10

Or we may reverse the statement, and say as 236 the prime equivalent of calomel, are to 200 the prime equivalent of mercury, so are 100 grains of calomel to the quantity of mercury which it contains.

Thus, as  $236 : 200 : : 100 : 84.75$

By either process, allowing for the minute fractional quantities which we reject, the same results are obtained—and if we compare them with the results of the analysis of calomel, as stated in the books, they will be found not materially to differ from each other.

Example 2d. Suppose it were required to ascertain the proportion per centum, of mercury and chlorine in the deutochloride of mercury or corrosive sublimate. Say, as 272, the equivalent of the deutochloride, are to 72 the two equivalents of chlorine which it contains, so are 100, to the quantity of chlorine per centum—equal to 26.47, which subtracted from 100 gives 73.53 for the proportion of mercury. Therefore 100 parts of corrosive sublimate contain

Chlorine : : : : 26.47

Mercury : : : : 73.53

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100.00

If it be required to know the quantity of the metallic base, (potassium) in 100 grains of potash, (protoxide of potassium;) say as 48 the equivalent of potash, are to 40 the equivalent of potassium,—so are 100 grains of potash, to 83.33 of potassium, the answer required. It is proper here to remark, that potash as obtained by ordinary methods, is in the state of a hydrate; or in other words, every 48 parts, or each equivalent of dry oxide of potassium, is combined with 9 parts, or a prime equivalent of water, from which it is almost impossible to separate it: when therefore we say, that 100 grains of potash, contain 83.33 grains of potassium, we do not mean that 100 grains of common hydrate of potash, contain that quantity of metallic base; but allude to the pure dry oxide, produced by burning potassium in oxygen gas. And when we speak of a prime equivalent of potash, we do not mean 48 parts of common hydrate of potash; but that quantity of the hydrate which contains just 48 parts of the dry protoxide of potassium.

## TABLE II.

### PRIMARY COMPOUNDS.

It will be observed that this table contains, comparatively speaking, but few of that important class of primary compounds, the metallic oxides; to have included them all the table must have been extended to an inconvenient size. My object therefore, has been, to include substances used as medicines, or as chemical tests, or in the preparation of medicinal compounds; neglecting those of minor importance to the medical student. This remark applies to all the tables except those of elementary substances, and of gaseous bodies.

In the second column of this table, under the head 'composition,' and opposite to the name of the compound, we find the number of prime equivalents or atoms of elements in that compound, prefixed to the initial letter of the element;—and on the same line, in the column next to the right, we find the prime equivalent number of the compound, or the proportion in which it combines, with equivalent proportions of other substances.

Example. Opposite the words 'protoxide of potassium' or 'potash,' we see 1 P. + 1 O. indicating that potash is composed of one prime equivalent of potassium and one of oxygen.

By referring to the table of elementary substances, we find the prime equivalent of potassium to be 40, and the prime equivalent of oxygen to be 8; hence in the next column stand 48, as the prime equivalent of potash, or the proportion in which that base combines with 54 parts of nitric acid, 40 parts of sulphuric acid, 37 parts of hydrochloric or muriatic acid, 22 parts of carbonic acid, and of every other acid as expressed by its prime equivalent number.

Again, opposite to ammonia, under the head of 'composition,' we find 1 A. + 3. H. by which we are to understand, that ammonia is made up of 1 atom or prime equivalent of azote, and 3 atoms or prime equivalents of hydrogen. From the table of elementary bodies, we perceive the prime equivalent of azote to be 14, and the prime equivalent of hydrogen to be 1; consequently the prime equivalent of ammonia must be 14 added to 3 times 1, or 3, which make 17; in the column of prime equivalents, therefore we find 17 opposite to ammonia; and 17 parts of ammonia will saturate exactly the same quantity of each of the acids as 48 parts of potash, 32 of soda, 28 of lime, 20 of magnesia, or an equivalent quantity of any other base.

Among the salifiable bases, several compounds are included, which in the strict sense of the word are not of that kind; inasmuch as they do not combine with acids without decomposition. They are the peroxides of potassium, sodium, barium, manganese and lead. When any one of these oxides is added to an acid, it is reduced to a protoxide, by giving out part of its oxygen in the gaseous state. If for example we add 40 parts of sulphuric acid to 36 parts of peroxide of barium—composed of 70 parts, or 1 prime equivalent of barium, and 16 parts, or 2 prime equivalents of oxygen—the resulting compound will not be 126 parts of a sulphate, with a peroxide for its base; for during the formation of the salt, 8 parts, or 1 prime equivalent of oxygen will escape in the gaseous form; and we shall have left 116 parts of sulphate of barytes, having the *protoxide* of barium, or barytes for its base.

In like manner, if to 54 parts of nitric acid, we add 64 parts of peroxide of potassium, 16 parts of oxygen gas will escape; and the resulting compound will be 102 parts of nitrate of potash.

There are many of the *peroxides*, however, that do combine undecomposed with acids—such as those of iron, tin, copper, mercury, &c. and in such cases 2 prime equivalents of acid are required to saturate 1 of base.

## TABLE III.

## ACIDS.

Modern discoveries in chemistry, have extended this important class of compounds, until their number amounts to about one hundred.

Although the number contained in this table is comparatively small, none have been omitted with which it is important for the student of medicine to become familiar; and several are inserted, only, as examples of the definite proportions in which bodies combine.

The table of oxides being understood, no difficulty can present itself with regard to that of the acids. It may be well however to give one or two examples.

Suppose it were required to know the composition and prime equivalent number of carbonic acid;—opposite the name we find under the head of 'composition'  $1\text{ C.} + 2\text{ O.}$  by which we are to understand, that carbonic acid is composed of 1 prime equivalent or atom of carbon, and 2 prime equivalents or atoms of oxygen: now in the column of equivalent numbers we find 22 the prime equivalent of carbonic acid;—equal to 6, the prime equivalent of carbon, added to 16, or 2 prime equivalents of oxygen.

Again, we see the composition of hydrocyanic or prussic acid indicated by  $1\text{ H.} + 1\text{ C.}$  which we express thus—1 prime equivalent of hydrogen, added to 1 prime equivalent of Cyanogen. The prime equivalent of hydrogen is 1, the prime equivalent of cyanogen is 26 being composed of 1 prime of azote 14, and 2 primes of carbon each 6, equal 12; hence we find in the column of equivalents 27, as the equivalent of hydrocyanic or prussic acid.

The organic, or as Dr. Thomson calls them, the combustible acids, have not all been analyzed with sufficient accuracy, to enable us, to determine the equivalent proportions of their elements. Perhaps the atomic proportions in which the composition of any of these organic acids are expressed, are not entirely to be depended on. They serve, however, to assist the memory in retaining, what is at least an approximation to the true proportions of their elements; and the combining proportions of the acids themselves, are pretty accurately expressed, in the column of equivalent numbers.

Those organic acids, the combining proportion of whose elements can be referred to prime equivalent numbers, have their composition shown by figures expressing the number of primes

of each element, prefixed to the initial letter of that element, as in the case of other acids.

The composition of the acetic acid, for example, is expressed thus, 3 H. + 4 C. + 3 O. that is, 3 primes of hydrogen, 4 primes of carbon and 3 primes of oxygen; and hence the prime equivalent of the acid is 51, for  $3 \times 1, + 4 \times 6, + 3 \times 8, = 51$ .

## TABLE IV.

### SALTS.

During the last fifty years, a period so fruitful in important chemical discoveries, no class of compounds has been so astonishingly increased as the salts; but notwithstanding the extraordinary zeal with which this department of chemistry has been cultivated, the proportions in which the elements of some saline bodies combine, are still problematical.

The works which I have principally consulted in the compilation of this table, are the latest editions of 'Brande's Manuel of Chemistry,' 'Thomson's System,' 'Henry's Chemistry,' and 'Ure's Chemical Dictionary.' Generally speaking, I have found a tolerably exact coincidence in their statements concerning the composition of the salts: in some instances, however, these eminent authors not only disagree with each other, but are even inconsistent with themselves. Thus for example, Dr. Thomson gives as the composition of nitrate of copper:

Nitric Acid,	- - - - -	100,00
Peroxide of Copper,	- - - - -	148,14

While Mr. Brande declares it to be,

Nitric Acid,	- - - - -	101
Protoxide of Copper,	- - - - -	75

Again Mr. Brande in the body of his work, states the composition of emetic tartar, to be

Tartaric Acid,	- - - - -	125
Oxide of Antimony	- - - - -	105
Potash	- - - - -	55

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275.

And afterwards in his tables gives the following proportions:

Tartaric Acid,	-	-	-	-	-	125
Oxide of Antimony,	-	-	-	-	-	52.5
Potash,	-	-	-	-	-	45
					-	222.5

When such discrepancies exist among authors equally respectable, the choice is difficult; and in some instances I may have made selections, which will ultimately be found erroneous: I have no hesitation, however, in saying, that the composition of the most important medicinal salts is correctly indicated in this table.

That the names by which the different salts are designated may be correctly understood, it will be necessary to explain the nomenclature in which they are expressed; and this is the more important, as they are variously denominated by different authors, and we have not room to give the synonymes.

All the salts formed by the combination of *one* prime equivalent of an acid, having a name ending in *ic*, with *one* prime equivalent of *any protoxide whatever*, are expressed by changing that syllable to *ate*, and prefixing the word thus altered to the name of the base, if that base be an alkali or an earth; or to the name of the metal, if the base be a metallic oxide. Thus, the salt composed of *one* prime of sulphuric acid combined with *one* prime of potash, is called sulphate of potash; and that composed of *one* prime of sulphuric acid, combined with *one* prime of *protoxide* of iron, is called sulphate of iron.

When *two* primes of an acid combine with *one* prime of an alkaline or earthy base, the resulting salt is designated by the prefix *Bi*; which indicates that the salt contains *two* primes of acid to *one* of base. If, for example, we take 88 parts, or one prime of *sulphate of potash*—composed of 40 parts or 1 prime of acid, and 48 parts or 1 prime of base—and add thereto 40 parts, or 1 *additional* prime of acid, a new salt will be produced, the *bisulphate of potash*, which contains precisely twice as much acid as the sulphate: or

The sulphate contains	}	1 prime of acid = - - - 40
		1 prime of base = - - - 48
		Equivalent of the <i>neutral</i> salt 88

The bi-sulphate contains	}	2 primes of acid = 40 + 40 = 80
		1 prime of base = - - - 48
		Equivalent of the <i>bi</i> -salt 128

Salts of this kind are sometimes designated by the prefix *super* or *acid*; but as neither of these conveys the idea of a definite proportion, so well expressed by the prefix *bi*, I think the latter entitled to preference, and have employed it exclusively. When *two or more* prime equivalents of *base* combine with *one* prime equivalent of *acid*, they form a salt designated by the prefix *sub*,\* of which I may name as examples, the *sub-ace-*tate of lead—the basis of Goulard's extract—the *sub-borate* of soda or borax—and the *sub-persulphate* of mercury, or turpeth mineral.

As *all* the *alkaline* and *earthy* salts have *protoxides* for their bases, it is not necessary that the names of these salts, should express that state of oxidation; but as the metallic salts have bases in different states of oxidation, it is of importance that the names of such salts should indicate the proportion of oxygen contained in their respective bases—at least this should be the case with those which do not contain *protoxides*. If the bases of such salts were always *deutoxides*, or combinations of one prime of metal with two primes of oxygen, the prefix *deuto* would correctly express the nature of the salt,—thus *deuto-*nitrate of mercury would indicate a salt, having the deutoxide of that metal for its base; but as the bases of some of the metallic salts, are neither *protoxides*, nor combinations of one prime of metal with two of oxygen—such, for example, as the *per-*oxide of iron, which is a combination of *two* primes of metal with *three* of oxygen—I shall designate all the salts which have *not* *prot-*oxides for their bases by the prefix *per*, of which the *per-*sulphate of iron and the *per-*nitrate of mercury may serve as examples.

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NOTE ON THE SUBSALTS.

\* The *sub salts* are less numerous than the *bi*, or *super-salts*, and many of the compounds considered as such, in the Dispensatories and in various chemical works, are improperly so called. There are, for example, no such compounds as the subcarbonates of ammonia, potash, soda, or magnesia; the salts so called being in fact *carbonates* or combinations of one prime of acid with one of base. It is easy to perceive why the prefix *sub* has been applied to the alkaline carbonates; they do not possess the properties of neutral compounds, but like their bases, change to green the vegetable blues; and possess, though in a less degree, other peculiar properties of the alkalies themselves. But for the same reason, we might regard the *bicarbonates* as *sub-*salts, for no proportion of carbonic acid with which they are capable of combining, can deprive them of their alkaline properties. Since, therefore, we have no *neutral* alkaline carbonates, the prefix *sub*, to salts composed of one prime of acid with one prime of base, is not only superfluous but erroneous.

Some chemists, particularly the French, employ a double prefix to express the *neutral* metallic salts—one to designate the proportion of oxygen in the base, the other to indicate the proportion of acid with which the base is combined: Thus we have the *neutral proto-sulphate* of mercury, to express a salt composed of *one* prime of *prot-oxide* of mercury with *one* prime of sulphuric acid; and the *bi-per-sulphate* or *bi-deuto-sulphate* to indicate a salt composed of *one* prime of *deut-oxide* with *two* primes of acid. This, however, is unnecessary; for since it is a known law in chemistry, that in every *neutral* salt, the quantity of acid is in direct proportion to the quantity of *oxy-gen* in the base, it follows, that in all *neutral* salts having *prot-oxides* for their bases, *one* prime of acid *must* combine with *one* of base; and in all which have *deut-oxides* for bases *two* primes of acid *must* combine with *one* of base: therefore, the same prefix which expresses the state of oxydation of the base, as accurately expresses the quantity of acid, with which that base is combined.

It is certainly of importance to render the language of chemistry as concise as it can be made, without a sacrifice of precision; for nothing is more repulsive to the student of any science, than long and complicated names.

Many of the metallic salts, like the alkaline, exhibit to us an excess either of acid or of base; and this is the case both with the *prot-oxide* and *per-oxide* salts.

According to Dr. Thomson, nitric acid and mercury form no less than six distinct compounds; both the nitrate and *per-nitrate*, combining with excess of acid, and with excess of base: the nitric acid with the *prot-toxide* of mercury forming

Nitrate of Mercury,  
 Sub-nitrate of Mercury,  
 Super-nitrate of Mercury;

And with the *deut-oxide*,

Pernitrate of Mercury,  
 Sub-pernitrate of Mercury,  
 Super-pernitrate of Mercury.

Of these six compounds, the composition of the two *neutral* salts, the *nitrate* and the *pernitrate*, is well known; the former containing one prime of *prot-oxide* combined with *one* prime of

acid, and the latter, one prime of *deut-oxide* with *two* of acid. The other four salts are, no doubt compounds in definite proportions; but they have hitherto been but imperfectly investigated, and further researches are wanting to enable us to determine the multiple and submultiple proportions of acid with which their bases are combined. In the present state of our knowledge we can only express them by the prefixes *super* and *sub*.

Salts which are formed by the union of an acid with two bases, such as alum, tatar emetic, white precipitate, Rochelle salts, &c. are designated by the names of the acids, ending in *ate*, prefixed to the names of both bases. Thus alum is called *sulphate of aluminic and potash*; tartar emetic, *tartrate of anti-mony and potash*; white precipitate, *muriate of mercury and ammonia*; and Rochelle salts, *tartrate of potash and soda*.

It is much to be regretted that such a variety of epithets should have been invented to express these compounds, as they render the subject so embarrassing to the student. Sometimes they are designated by prefixing the name of one of the bases by way of an adjective; thus the muriate of gold and soda, is sometimes called the *soda-muriate* of gold. Sometimes the names of one of the bases altered in its termination, is used as a prefix; thus for phosphate of ammonia and magnesia, we have the *ammoniaco magnesian phosphate* and for sulphate of iron and zinc, we have *ferruginous-sulphate* of zinc.

The phrase *triple salt*, which is a kind of generic expression applied to all saline bodies with compound bases, has been productive of some confusion, by often suggesting the idea that such salts have triple bases; this is especially the case when one of the modes to which I have just referred, is used to designate the particular salt. For example, the species of urinary calculus called the *fusible*, is composed of a mixture of the phosphate of lime and the phosphate of ammonia and magnesia; while another species of calculus is composed of the phosphate of ammonia and magnesia alone: now a student who had been led to suppose that the triple salts have bases composed of three substances, upon hearing the latter species of calculus called the *ammoniaco-magnesian phosphate*, might imagine that the former or *fusible* calculus was meant; and that the name of one of its bases—*lime*—had been omitted by mistake. We might avoid this confusion, by discarding the expression, *triple salts*, and substituting the phrase, *salts with double bases*.

## TABLE V.

## CHLORIDES.

Many of this important class of compounds are somewhat ambiguous in their chemical constitution. When they exist in the state in which they are produced by the combustion of their bases in chlorine gas, they are completely analogous to the oxides; being primary compounds of electro-positive bodies with an electro-negative element; or in the language of Dr. Thompson, 'of combustible substances with a supporter of combustion.' In this state they must be regarded as chlorides. But some of those which are soluble yield on evaporating their solutions, crystals containing water; in this state they may either be regarded as *hydrated* chlorides or as *muriates*. Dr. Ure under the head Muriatic Acid observes, 'the muriates when in a state of dryness, are actually chlorides, consisting of chlorine and the metal; but since moisture makes them instantly pass to the state of muriates, we shall describe them under this article.' He goes on to describe common salt as a muriate; but, under the head, Decrepitation, positively declares, that this substance contains *no water*, and this is probably correct; there are however, unequivocal examples of crystallized chlorides which *do* contain water; of which the chloride of calcium or muriate of lime may be cited as one. Now it is impossible to say, whether muriate of lime and all similar compounds, are combinations of metallic oxides with muriatic acid, or of chlorides with water; for the ultimate elements of which they are composed, are capable of producing either set of primary compounds. Muriate of lime, for example, has for its ultimate elements, calcium, oxygen, chlorine and hydrogen; we may either suppose the calcium to exist combined with the oxygen, forming lime; the chlorine with the hydrogen constituting muriatic acid, and these primary compounds united into a secondary—the muriate of lime; or we may suppose the calcium to exist combined with the chlorine (chloride of calcium) and the oxygen with the hydrogen (water,) and those primary compounds forming by their union hydrated chloride of calcium. For the sake of brevity it would be better to call such compounds muriates; but as they may be regarded either as muriates or chlorides they are inserted in both tables.

There is at least one muriate, which it is impossible to regard as a chloride, this is the muriate of ammonia, or salamoniac; which is perhaps the only body, in this class, destitute of all ambiguity of character.

As the term *equivalent*, may lead the student to suppose, that reciprocal saturation would result from mixing together, in the proportions expressed by their prime equivalent numbers, all bodies capable of mutual chemical action; some remarks on this subject, although out of place, may not prove unacceptable.

A reciprocal saturation will always result from the mutual action of any two *neutral* salts, whose bases are in the same state of oxidation. Thus, if we mix together prime equivalent proportions of acetate of lead and sulphate of zinc—both neutral salts having *prot-oxides* for their bases, and of course each containing one prime of acid—two new salts equally neutral—acetate of zinc and sulphate of lead, will result. In like manner, if two neutral salts capable of acting on each other, having *deut-oxides* for their bases, and each of course containing *two* primes of acid, were mixed together, two new salts, equally neutral, would be produced: but if we decompose a salt having a *deut-oxide* for its base, by another having a *prot-oxide* for its base, *two* prime equivalents of the latter, must be added to the former. For example, persulphate of copper, has a *deut-oxide* for its base; and, as in all neutral salts, the quantity of acid is directly proportional to the quantity of oxygen in the base, a prime equivalent of persulphate of copper is composed of *one* prime of *deut-oxide* of copper and *two* primes of sulphuric acid: the nitrate of lead is a neutral salt, having a *prot-oxide* for its base, and consequently containing *one* prime of acid; now that we may decompose the whole of the persulphate of copper, by the nitrate of lead, *two* primes of the latter, must be mixed with *one* prime of the former salt,—for as the protoxide of lead will combine with but one prime of acid, it follows that *two* primes of nitrate of lead are required to furnish *two* primes of *prot-oxide* to the *two* primes of sulphuric acid contained in the single prime of persulphate of copper, which by their union, form *two* primes of sulphate of lead; while the *two* primes of nitric acid, afforded by the *two* primes of nitrate of lead, combine with the single prime of deutoxide of copper, to form *one* prime of pernitrate of copper.

Again, if to a solution containing a prime equivalent quantity of any metallic salt, having a *prot-oxide* for its base, we

add a prime equivalent quantity of any other metal capable of decomposing it, and at the same time forming a protoxide-salt; the whole of the original salt will be decomposed, the pure metal contained in its base precipitated, while the metal used as a precipitant will take its place and form a new salt also perfectly neutral. This takes place when we add metallic zinc to a solution of acetate of lead; the lead is revived and exhibits itself in a beautiful arborescent form, while acetate of zinc is produced: but to decompose a salt having a *deut*-oxide for its base, by means of a metal that forms with the acid a *prot*-oxide salt only, *two* primes of the latter are required to decompose *one* prime of the former: Thus, *two* primes of lead would be necessary to decompose *one* prime of pernitrate of mercury.

A similar rule applies to the chlorides. Calomel which is a *proto*-chloride of mercury, requires but *one* prime of an alkali for its decomposition; while corrosive sublimate which is a *deuto*-chloride requires *two*. If, for example, we add to 236 parts or *one* prime of *proto*-chloride of mercury, 28 parts or *one* prime of lime in solution, they react upon each other, the chlorine of the calomel combines with the calcium of the lime, while the oxygen of the lime combines with the mercury of the calomel; 208 parts or *one* prime of *prot*-oxide of mercury and 56 or *one* prime of chloride of calcium are produced. But to decompose 272 parts or *one* prime of deutochloride, *two* primes or 56 parts of lime are requisite: for it requires *two* primes of calcium to deprive *one* prime of *deuto*-chloride of its *two* primes of chlorine; and, at the same time, the single prime of mercury combines with the two primes of oxygen, furnished by the two primes of lime; and hence the resulting compounds are 216 parts or *one* prime of *deut*-oxide of mercury, and 112 parts or *two* primes of chloride of calcium.

## TABLE VI.

COMPOUNDS WHOSE GENERIC NAMES TERMINATE IN *uret*.

But few of the substances contained in this table are of much practical importance to the physician; but some of them are interesting in a theoretical point of view; this is particularly the case with the sulphurets, as will appear by the following quotations from M. Gay Lussac. This excellent philosopher observes, 'when we precipitate a metallic solution, by sulphuretted hydrogen, either alone or combined with an alkaline

base, we obtain a sulphuret or a metallic hydrosulphuret.\* In the first case, the hydrogen of the sulphuretted hydrogen combines with all the oxygen of the oxide, and the sulphur with the metal; in the second case, the sulphuretted hydrogen combines directly with the oxide, without being decomposed, and its proportions are such, that there is sufficient hydrogen to saturate all the oxygen of the oxide. The quantity of hydrogen neutralized or capable of being so, depends, therefore, on the oxidation of the metal; as well as the quantity of the sulphur, which can combine with it. Of consequence, the same metal forms as many distinct sulphurets, as it is susceptible of distinct stages of oxidation in its acid solutions. And as these degrees of oxidation are fixed, we may also obtain sulphurets of definite proportions, which we can easily determine, according to the quantity of oxygen to each metal, and the proportions of sulphuretted hydrogen.

These interesting facts are in exact accordance with the atomic theory, and they enable us to understand in the most satisfactory manner, the phenomena which result from the mutual action of sulphuretted hydrogen, and the various metallic solutions. We see, for example, why, when we add sulphuretted hydrogen to a solution of arsenious acid, a bisulphuret of arsenic is formed: arsenious acid is composed of *one* prime of arsenic combined with *two* primes of oxygen; it therefore requires *two* primes of sulphuretted hydrogen to decompose it; the *two* primes of hydrogen of the sulphuretted hydrogen, combine with the *two* primes of oxygen of the acid, to form *two* primes of water; while the single prime of arsenic, combines with the *two* primes of sulphur, furnished by the *two* primes of sulphuretted hydrogen, to produce a *single* prime of bisulphuret of arsenic. And in like manner they enable us to anticipate the results in all similar cases.

The alkaline sulphurets, as they are usually called, have generally been regarded as combinations of sulphur and the

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\*As sulphuretted hydrogen is not known to combine with the *metals* but with their *oxides*, it is regarded by some as an acid; and the compounds which it forms with the salifiable bases, as salts. M. Gay Lussac gave it the name of hydrosulphuric acid, and to its compounds with salifiable bases, hydrosulphates. They are compounds of little importance; the alkaline hydrosulphurets are sometimes used as tests, but their proneness to spontaneous decomposition is an objection to their use. The hydrosulphuret of ammonia and the hydrosulphuret of antimony or, kermes mineral, are, I believe, the only bodies of this class used as medicines.

alkalies; I have long entertained the opinion, however, that they are combinations of sulphur with the *metallic bases* of the alkalies, and am gratified to find, that the same opinion has been advanced by Vauquelin and countenanced by Brande; in this table therefore, their compositions are stated conformably with that supposition.

## TABLE VII.

GENERAL TABLE OF GASEOUS BODIES, BY DR. URÉ.

This table is introduced for the purpose of illustrating M. Gay Lussac's theory of gaseous combinations. He discovered by a series of well conducted experiments, that all gaseous bodies in their mutual action, uniformly combine in some simple ratio by volumes; that is, one volume of one gas, combines with one, or with two, or with three volumes of another; and, moreover, that the volume of mixed gases either remains unchanged by combination, or the contraction it experiences, has a simple relation with the volumes of the original gases, or rather with the volume of one of them. If for example, to one volume of chlorine gas, we add one volume of hydrogen gas, and explode the mixture, two volumes of muriatic acid gas will be produced; here we perceive that no condensation takes place during combination; but if to 13 volumes of hydrogen gas we add 1-2 a volume of oxygen gas, on exploding the mixture, 1 volume of vapour of water will be formed; in this case the condensation is equal to the whole bulk of the oxygen, or 1-3 of the bulk of the original gases.

It is needless here to multiply examples, since they are furnished by the table itself; it is proper, however, to state, that but few of the compounds there expressed, are produced by the direct combination of their constituent elements; it is generally by analysis and not by synthesis that we arrive at a knowledge of their composition. If for instance we add together 1-2 a volume of oxygen and 1 volume of chlorine (the elements of protoxide of chlorine) we can by no means effect their union; but if we gently heat 1 volume of protoxide of chlorine, it explodes into 1 1-2 volumes; 1 volume of which is found to be chlorine, and the 1-2 volume oxygen; and hence we infer, that protoxide of chlorine is composed of 1 volume of chlorine and 1-2 a volume of oxygen (equal to 1 prime of

each) condensed into 1 volume. In like manner, ammoniacal gas cannot be formed by the direct union of its gaseous elements; but if we pass 2 volumes through a red hot porcelain tube, we find its bulk augmented to 4 volumes, 3 of hydrogen and 1 of azote; and hence we infer that ammoniacal gas is composed of 3 volumes of hydrogen and 1 of azote condensed into 2 volumes. As the atomic theory is based upon hypothesis, it would be better, as Berzelius has proposed, to make all our numerical expressions of the combining proportions of bodies, refer to their volumes than to their atoms, if all elementary substances were capable, at ordinary temperatures, of being reduced to the gaseous state; but as this cannot be done, it is equally as hypothetical to speak of gaseous volumes of bodies which have never been known to exist in that state, as to speak of their atoms. Comparatively, there are but few elementary substances capable of existing, uncombined with other ponderable matter, in the gaseous state; and many do not enter into gaseous combination; all our reasoning, therefore, with reference to such bodies in a gaseous state is based upon assumption. For some very ingenious speculations on the relation between the specific gravities of bodies in their gaseous state and the weight of their atoms, I beg leave to refer the reader to a memoir of Dr. Prout, as quoted in the appendix to the 3d vol. of Thomson's System of Chemistry.

Whether simple or combined, the gases are unquestionably, in a theoretical point of view, the most interesting class of chemical bodies. Every thing, therefore, which facilitates our investigations respecting them, is of the utmost importance to the chemical philosopher. Now, the theory of volumes as developed by Gay-Lussac, is certainly susceptible of useful practical applications; it enables us to solve with perfect ease, an important problem of frequent occurrence in our chemical researches, the specific gravity of gaseous compounds and their elements; and, which is extremely interesting, results thus obtained are often more to be depended upon, than those derived from experiment. My limits will only permit me to give a few examples of its application, which I shall do without entering into a particular explanation of its principles. The prime equivalent numbers of all the elementary bodies, except oxygen, represent their specific gravities compared with hydrogen, whose equivalent number is 1, or the standard of comparison; consequently, the weight of a volume of any other elementary body in a gaseous state, is to the weight of a volume

of hydrogen, as the equivalent number of that body is to 1, the equivalent number of hydrogen. For example, the equivalent number of chlorine is 36, therefore its specific gravity compared to hydrogen is, as 36 to 1, or 1 volume of chlorine weighs 36 times as much as an equal volume of hydrogen. The specific gravity of oxygen gas is double its equivalent number, or 16; because, according to the atomic hypothesis, the gaseous compounds which contain 1-2 a volume of oxygen combined with 1 volume of any other elementary gas, are composed of 1 atom, or prime equivalent, of each element: 16 is therefore the *specific gravity* of oxygen, while its prime equivalent number is 8. To ascertain the specific gravity of an elementary gas, compared with atmospheric air, we have only to multiply the equivalent number of the body, if it be not oxygen, and if it be, twice its equivalent number by 0.0694 the number representing the specific gravity of hydrogen compared with air, and we obtain the desired result. For instance, 6 is the prime equivalent number of carbon, and of course its specific gravity compared with hydrogen; this number multiplied into 0.0694 gives 0.4164 the specific gravity of gaseous carbon compared to atmospheric air; or thus, as 1, the prime equivalent of hydrogen, is to 0.0694, its specific gravity compared to air, so is 6 the prime equivalent of carbon to 0.4164 its specific gravity referred to the same standard. To ascertain the specific gravity of a compound gas, the only data required, are a knowledge of the equivalent numbers, the combining volumes of its elements, and the condensation, if any, which results from their union. For instance, ammoniacal gas is composed of 3 volumes of hydrogen and 1 volume of azote, condensed into 2 volumes. Now 3 volumes of hydrogen weigh 3, and 1 volume of azote weighs 14; these numbers added together make 17, the prime equivalent of ammoniacal gas; if no condensation had taken place, 1 volume of this gas would weigh 4.25 which would be its specific gravity compared to hydrogen; for 17 the weight of 4 volumes, divided by 4, gives 4.25 as the weight of 1 volume; but by combination the 4 volumes are condensed into 2, and hence the specific gravity of ammoniacal gas, is double the mean specific gravity of its elementary gases or 8.5, hydrogen being 1. To find its specific gravity compared with atmospheric air, multiply 8.5 by 0.0694 the specific gravity of hydrogen, compared to the same standard, and we have .5899 the specific gravity of ammoniacal gas, air being 1; or thus, as 1:0.0694::8.5:.5899.

To be prepared to ascertain the weight of 100 cubic inches,

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and consequently of any other quantity by bulk, of any elementary gaseous body, we have only to bear in mind the weight of 100 cubic inches of hydrogen gas, which is 2.118 grains; as this number multiplied into the prime equivalent number of any gas, gives the weight in grains of 100 cubic inches. Thus, the prime equivalent of azote is 14, which multiplied by 2.118, gives 29.652 grains as the weight of 100 cubic inches of azote; or thus, as 1:2.118::14:29.652. To ascertain the weight of 100 cubic inches of a compound gas, first ascertain by the rule above given, its specific gravity compared to hydrogen, this multiplied by the weight of 100 cubic inches of that gas, will give the answer. Thus we have found the specific gravity of ammoniacal gas compared to hydrogen, to be 3.5, which number multiplied by 2.118, the weight of 100 cubic inches of hydrogen, gives 18.003 grains, for the weight of 100 cubic inches of ammoniacal gas. Or, if we suppose the volume to be 47.21435 cubic inches, the prime equivalent numbers will also represent the number of grains which this quantity of each gas, except oxygen, will weigh; and double the prime equivalent of oxygen or 16, will represent the number of grains in an equal volume of that gas.

## TABLE VIII.

### INCOMPATIBLE SUBSTANCES.

The excellent Pharmacologia of Dr. Paris is the source from which the materials of this table were principally drawn. I am conscious that it is imperfect, and in some respects erroneous; but in the very limited time allowed me for its preparation, it would have been impossible to test by experiment, the accuracy of the statements it contains; and I could not feel myself justified in attempting to correct them, from theoretical views alone. I have no hesitation, however, in saying, that its errors are on the safe side, and that it will be found practically useful. A reliance, however, upon tables, or upon the memory, for particular facts, is empirical; and as the scientific practitioner would depend more upon conclusions drawn from the general laws of chemical action, some illustration of these laws, will probably be as acceptable as the table itself.

Whether we consider solubility as a cause or an effect, whether we regard it as modifying affinity, or as modified by affinity, this much is certain, that a knowledge of the solubili-

ty of chemical compounds, will generally enable us to predict what new combinations will be established, when substances capable of mutual action are added together in a state of solution. To the chemist, therefore, this knowledge is most important; and when we take into view how much the activity of medicinal substances, is influenced by their degree of solubility, this subject becomes doubly interesting to the practitioner of medicine.

Dilution, according to the very philosophical views of the late Dr Murray, has also a powerful effect in determining chemical combinations; the united effects of solubility and dilution, are expressed in the following propositions:

*Proposition 1.* When the elements of two or more salts exist, together, in a quantity of fluid sufficient to dissolve the most insoluble compound they are capable of producing, these elements generally exist in that state of combination in which they are most soluble; but when the quantity of fluid is diminished by evaporation, until it is sufficient to hold in solution the most insoluble compound which the elements can produce, that insoluble compound will begin to form, and its quantity will increase in proportion to the diminution of the fluid.

*Proposition 2.* When solutions of two substances, containing the elements of a compound insoluble in the quantity of fluid present, are mixed, that insoluble compound will be formed.

*Illustration of Proposition 1.*

Four hundred and sixty parts of water at  $60^{\circ}$  are capable of dissolving 1 part of sulphate of lime. Now if to any quantity of water greater than 460 parts, say 470, we add such quantities of nitrate of lime and sulphate of potash, as are capable, by their reaction, of producing 1 part only of sulphate of lime, no action, according to the terms of the proposition, will take place; because the quantity of water present, is capable of holding in solution that quantity of sulphate of lime; but if, by evaporation, we reduce the quantity of water to less than 460 parts, a mutual action will take place, sulphate of lime and nitrate of potash will be produced, and the former precipitated; and this action will keep pace with the evaporation of the fluid, until the whole of the salts (if their proportions are equivalent) will mutually decompose each other. Whether Dr. Murray's views be correct or not, the visible effects would be the same.

in this and every similar case; for if the whole of the salts reacted on each other in their diluted state, no precipitation could take place as long as the quantity of fluid was sufficient to dissolve the most insoluble salt; but for reasons, which my limits will not permit me to give, I have adopted the views of that gentleman on this subject.\*

The *Second proposition*, which is of more practical importance, may be illustrated by reference to the substances to which I have just alluded. Thus, if we mingle together concentrated solutions of those salts, a copious precipitate of sulphate of lime will instantly take place.

The precipitates which are formed by the mixture of incompatible solutions, are always less active, as medicinal agents, than the salts from which they are produced; but the reverse is the case, when by combination, an insoluble substance is made an element of a soluble compound; and when bodies by their mutual action, produce new compounds, not differing materially from the original in point of solubility, the change in their active properties is correspondingly small. Hence we perceive that chemical incompatibility may operate in three ways;—first, it can render active substances inert; secondly, convert innocent substances into poisons; and thirdly, change the chemical without materially altering the medicinal properties of bodies. We have an example of the first effect, in the action of common salt upon the nitrate of silver, which it renders comparatively inert, by converting it to an insoluble chloride. If nitric acid and the blue pill were taken simultaneously, they would furnish an example of the second, as the protoxide of mercury (the basis of the blue pill) by its combination with the nitric acid, would form the nitrate of mercury, a poisonous salt. The third effect may be understood by referring to the ammonia upon calomel, which it converts to the protoxide of mercury, a substance nearly analagous to calomel in solubility, activity, and medicinal properties generally.

The new body, moreover, which remains in solution, may often be a useful medicinal compound, and more conveniently prepared by mixing the solutions of incompatible salts, than in any other mode. For example, an excellent collyrium is prepared by mixing together in solution, sulphate of zinc and ace-

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\*The reader will find an interesting note on this subject in the 2d vol. of Paris's Pharmacologia, under the article Sea Water.

tate of lead; these substances are chemically incompatible, but the object is to produce a solution of acetate of zinc; which we can only thus obtain, as it is not an article of commerce.

This table refers only to *chemical* incompatibility. The physician must decide for himself, on the propriety of combining those substances which it designates as incompatible with each other.

## TABLE IX.

### POISONS AND ANTIDOTES.

On his late return from Paris, Professor Brown brought out for the benefit of the Medical Class, the 12th edition of Dr. De Salle's Synoptic Tables of Poisons and Asphyxies. The first of these being purely chemical, seemed a proper associate for the preceding tables; and as Professor Drake was kind enough to translate it for that purpose, I have included it in this little publication. Independently of its value to the clinical practitioner and medical jurist, it will serve in some degree as an exemplification of several parts of the other tables, and especially that of incompatible substances.

To the tests enumerated for some of the poisons which are most likely to occasion accidents in the United States, I have made such additions as appeared necessary, to enable practitioners, with no other resources than those existing in a new country, to detect them.

To his translation of this Table, Professor Drake has added a catalogue of the vegetable poisons of the United States, with such of those belonging to other countries, as are either kept in our shops or are celebrated in toxicology; and concluded the whole with a summary of the symptoms and treatment of the diseases which they produce—an addition which cannot fail to interest the medical class.

**TABLE I.**  
**Elementary Substances.**

CLASSIFICATION	SUBSTANCES	Specific Gravity.	Equivalent Nos.			
		Water 1,000.	HYD. 1.	OXY 1.		
<b>I. Electro-negative or Vitriopolar Elements.</b> These are always in a negative state in respect to every substance in the other Class.	Oxygen		8	1		
	Chlorine		36	4,5		
	Iodine	4,948	124	15,625		
	Fluorine		16	2		
	Acidifiable Bases—	Azote		14	1,75	
		Hydrogen		1	,125	
		Carbon	3,5	6	,75	
		Boron		6	,75	
		Silicon		8	1	
		Phosphorus	1,77	12	1,5	
		Sulphur	1,99	16	2	
		Selenium		40	5	
		Arsenic	5,7633	38	4,75	
		Tellurium	6,115	32	4	
		Potassium	,85	40	5	
		Sodium	,972	24	3	
		Lithium		9	1,25	
		Bases of the Alkalies.	Calcium		20	2,5
			Barium		70	8,75
	Strontium			48	6	
Magnesium			12	1,5		
Yttrium			32	4		
Bases of the Alkaline earths	Glucinum			18	2,25	
	Aluminum			9	1,125	
	Zirconium			37	4,625	
	Thorinum					
	Bases of the Earths proper.		Iron	7,8	28	3,5
Nickel		8,82	28	3,5		
Cobalt		8,7	28	3,5		
Manganese		8,013	36	4,7		
Cerium			92	11,5		
Metals whose oxides form Salifiable Bases.		Uranium	9	96	12	
		Zinc	7,1998	32	4	
		Cadmium		56	7	
		Lead	11,352	104	13	
		Tin	7,299	60	7,5	
		Copper	8,895	64	8	
		Bismuth	9,822	71	8,875	
		Mercury	13,568	200	25	
		Silver	10,474	110	13,75	
		Gold	19,3	199	24,875	
Bases of the compounds to which the term metallic oxide, is usually confined.	Platinum	21,47	181	22,625		
	Palladium	12	56	7		
	Rhodium	10,649	120	15		
	Iridium	19,28	48	6		
	Antimony	6,712	45	5,625		
	Chromium	5,90	28	3,5		
	Molybdinum	8,611	48	6		
	Tungsten	17,6	96	12		
	Columbium	5,918	144	18		
	Titanium	4,2	144	18		
Acidifiable Bases, incapable of entering into any gaseous combinations.	Osmium					
	An anomalous substance.					

## TABLE II.

### Primary Compounds.

*Oxides and Ammonia.*

		Composition.	Equivalent Numbers.
Unsalifiable Oxides.	{	CHLORINE. protoxide (euchlorine)	1 C. + 1 O. 44
		“ peroxide	1 C. “ 40. 68
		AZOTE. atmospheric air	2 A. “ 1 O. 36
		“ protoxide, (nitrous oxide)	1 A. “ 1 O. 22
		“ deutoxide, (nitric oxide,)	1 A. “ 2 O. 30
Salifiable Base without oxygen.	{	HYDROGEN. protoxide, (water)	1 H. “ 1 O. 9
		CARBON. carbonic oxide	1 C. “ 1 O. 14
Salifiable Oxides or Bases.	{	AMMONIA. trihydroguret of azote	1 A. “ 3 H. 17
		POTASSIUM. protoxide, (potash)	1 P. “ 1 O. 48
		“ peroxide	1 P. “ 3 O. 64
		SODIUM. protoxide, (soda)	1 S. “ 1 O. 32
		“ peroxide	2 S. “ 3 O. 72
		CALCIUM. oxide, (lime)	1 O. “ 1 O. 28
		BARIUM. protoxide, (barytes)	1 B. “ 1 O. 78
		“ peroxide	1 B. “ 2 O. 86
		MAGNESIUM. oxide, (magnesea)	1 M. “ 1 O. 20
		ALUMINUM. protoxide, (alumina)	1 A. “ 1 O. 17
		IRON. protoxide	1 I. “ 1 O. 36
		“ peroxide	2 I. “ 3 O. 80
		MANGANESE, protoxide	1 M. “ 1 O. 36
		“ peroxide, (black oxide)	1 M. “ 2 O. 44
		ZINC. oxide	1 Z. “ 1 O. 40
		LEAD. protoxide, (litharge)	1 L. “ 1 O. 112
		“ peroxide	1 L. “ 2 O. 120
		TIN. protoxide	1 T. “ 1 O. 68
		“ peroxide	1 T. “ 2 O. 76
		COPPER. protoxide	1 C. “ 1 O. 72
“ peroxide	1 C. “ 2 O. 80		
BISMUTH. oxide	1 B. “ 1 O. 79		
MERCURY. protoxide	1 M. “ 1 O. 208		
“ peroxide, (red precipitate)	1 M. “ 2 O. 216		
SILVER. oxide	1 S. “ 1 O. 118		
GOLD. protoxide	1 G. “ 1 O. 207		
“ peroxide	1 G. “ 3 O. 223		
ANTIMONY. protoxide,*	1 A. “ 1 O. 53		

\*It has not been ascertained with certainty whether the oxide of antimony which acts the part of a salifiable base, be a *prot* or a *deut*-oxide; it is here set down as a protoxide, in conformity with the views of Thomson and Brande. If, with Dr. Ure, we regard it as a *deut*-oxide, we must double the prime equivalent of metallic antimony.

TABLE III.  
**Primary Compounds.**  
*Acids.*

		Composition.	Equivalent Numbers.
Oxygen Acids.	Chloric . . . . .	1 C. + 5 O.	76
	Perchloric . . . . .	1 C. " 8 O.	100
	Iodic . . . . .	1 I. " 5 O.	164
	Nitric (Aqua Fortis) . . . . .	1 A. " 5 O.	54
	Nitrous . . . . .	1 A. " 4 O.	46
	Hyponitrous . . . . .	1 A. " 3 O.	38
	Carbonic . . . . .	1 C. " 2 O.	22
	Phosphoric . . . . .	1 P. " 2 O.	28
	Phosphorus . . . . .	1 P. " 1 O.	20
	Hypophosphorous . . . . .	2 P. " 1 O.	32
	Sulphuric (oil of vitriol) . . . . .	1 S. " 3 O.	40
	Sulphurous . . . . .	1 S. " 2 O.	32
	Hyposulphurous . . . . .	1 S. " 1 O.	24
	Arsenic . . . . .	1 A. " 3 O.	62
	Arsenious, (white arsenic) . . . . .	1 A. " 2 O.	54
Chromic . . . . .	1 C. " 3 O.	52	
Hydrochloric, (Muriatic) . . . . .	1 H. " 1 C.	37	
Hydrogen acids, these contain no oxygen.	Hydriodic . . . . .	1 H. " 1 I.	125
	Hydrofluoric . . . . .	1 H. " 1 F.	17
Acids of organic origins.	Hydrocyanic or Prussic . . . . .	1 H. " 1 C.	27
	Ferrocyanic,* (cyanogen & Iron)	1 C. " 1 I.	54
	Acetic, hydrogen, carbon, oxygen	3 H. + 4 C. " 3 O.	51
	Benzoic, hydrogen 5.16, carbon 74.41, oxygen 20.43, per cent.		120
	Citric, hydrogen, carbon, oxygen,	3 H. " 4 C. " 4 O.	59
	Gallic, 5 hydrogen, 56.64 carbon, 38.36 oxygen, per cent.		64
	Oxalic, 1 carbonic oxide + 1 carbonic acid, or	3 O. " 2 C.	36
	Tartaric, hydrogen, carbon and oxygen	3 H. " 4 C. " 5 O.	67

\*Cyanogen is a bicarburet of azote, or a compound of two primes of carbon and 1 of azote; when uncombined with other ponderable matter it is a gaseous body. It is an essential constituent of four distinct acids, the hydrocyanic and ferrocyanic, whose compositions are stated in the table, the sulphocyanic containing 1 prime of cyanogen and 3 of sulphur, and the chlorocyanic composed of 1 prime of cyanogen and 1 prime of chlorine.

Cyanogen is also capable of combining with electro-positive or combustible bodies, and forming compounds, which are neither acids, bases, nor salts; by some chemists they are considered analogous to the oxides, chlorides, &c. and are hence called cyanodides; but the analogy is certainly more complete between them and the hydrosulphurets, and hence they are with more propriety called cyanurets.

TABLE IV.

## Salts.

GENERA.	SPECIES.	Composition		Equivalent Numbers.
		Acid.	Base.	
	Chlorate of Potash, -	1 A. = 76	1 P. = 48	124
	Iodate of Potash, -	1 A. " 164	1 P. " 48	212
	Nitrate of Ammonia, -	1 A. " 54	1 A. " 17	71
	— Potash, -	1 A. " 54	1 P. " 48	102
	— Soda, - -	1 A. " 54	1 S. " 32	86
	— Lime, - -	1 A. " 54	1 L. " 28	82
	— Barytes, - -	1 A. " 54	1 B. " 78	132
	— Lead, - -	1 A. " 54	1 Ox. " 162	116
Per-	— Copper, - -	2 A. " 108	1 PrOx. " 80	188
	— Bismuth, - -	1 A. " 54	1 Ox. " 79	133
	— Mercury, - -	1 A. " 54	1 Ox. " 208	262
Per-	— " - -	2 A. " 108	1 PrOx. " 216	324
	— Silver, - -	1 A. " 54	1 Ox. " 118	172
	Carbonate of Ammonia, - -	1 A. " 22	1 A. " 17	39
Bi-	— " - -	2 A. " 44	1 A. " 17	61
	— Potash, - -	1 A. " 22	1 P. " 48	70
Bi-	— " - -	2 A. " 44	1 P. " 48	92
	— Soda, - -	1 A. " 22	1 S. " 32	54
Bi-	— " - -	2 A. " 44	1 S. " 32	76
	— Lime, - -	1 A. " 22	1 L. " 28	50
	— Barytes - -	1 A. " 22	1 B. " 78	100
	— Magnesia, - -	1 A. " 22	1 M. " 20	42
Bi-	— " - -	2 A. " 44	1 M. " 20	64
	— Zinc, - -	1 A. " 22	1 Ox. " 40	62
	— Lead, - -	1 A. " 22	1 Ox. " 112	134
	Phosphate of Ammonia, - -	1 A. " 28	1 A. " 17	45
	— Soda, - -	1 A. " 28	1 S. " 32	60
	— Copper, - -	1 A. " 28	1 Ox. " 72	00
Per-	— " - -	2 A. " 56	1 PrOx. " 80	136
	— Iron, - -	1 A. " 28	1 Ox. " 36	164
	— Lead, - -	1 A. " 28	1 Ox. " 112	140
	Sulphate of Ammonia, - -	1 A. " 40	1 A. " 17	57
	— Potash, - -	1 A. " 40	1 P. " 48	88
Bi-	— " - -	2 A. " 80	1 P. " 48	128
	— Soda, - -	1 A. " 40	1 S. " 32	72
	— Lime, - -	1 A. " 40	1 L. " 28	68
	— Barytes, - -	1 A. " 40	1 B. " 78	118
	— Magnesia, - -	1 A. " 40	1 M. " 20	60
	— Iron, - -	1 A. " 40	1 Ox. " 36	76
Per-	— " - -	3 A. " 120	1 PrOx. " 80	200
	— Manganese, - -	1 A. " 40	1 Ox. " 36	76
	— Zinc, - -	1 A. " 40	1 Ox. " 40	80
	— Lead, - -	1 A. " 40	1 Ox. " 112	152
Per-	— Copper, - -	2 A. " 80	1 PrOx. " 80	160
	Sulphate of Mercury, - -	1 A. " 40	1 Ox. " 208	248
Per-	— " - -	2 A. " 80	1 POx. " 216	296
Subper-	— " (Tur. Min.)	1 A. " 40	1 PrOx. " 216	256
	— Silver, - -	1 A. " 40	1 Ox. " 118	158
	Arsenite of Potash, - -	1 A. " 54	1 P. " 48	102
	Muriate of Ammonia, - -	1 A. " 37	1 A. " 17	54
	— Potash, - -	1 A. " 37	1 P. " 48	85
	— Soda, - -	1 A. " 37	1 S. " 32	69

## Salts—Continued.

Muriate of Lime	- - -	1 A. = 37	1 L. = 28	65
— Barytes	- - -	1 A. " 37	1 B. " 78	115
— Magnesia	- - -	1 A. " 37	1 M. " 20	57
— Iron	- - -	1 A. " 37	1 Ox. " 36	73
Per- — " (Goulard's ext)	- - -	3 A. " 111	1 PrOx. " 80	191
— Manganese	- - -	1 A. " 37	1 Ox. " 36	73
— Lead	- - -	1 A. " 37	1 Ox. " 112	149
— Gold	- - -	1 A. " 37	1 Ox. " 207	244
Acetate of Ammonia	- - -	1 A. " 51	1 A. " 17	68
— Potash	- - -	1 A. " 51	1 P. " 48	99
— Soda	- - -	1 A. " 51	1 S. " 32	83
— Lime	- - -	1 A. " 51	1 L. " 28	79
— Zinc	- - -	1 A. " 51	1 Ox. " 40	91
— Lead	- - -	1 A. " 51	1 Ox. " 112	163
Sub- — " (Goulard's ext)	- - -	1 A. " 51	3 Ox. " 336	386
Per- — Copper,	- - -	2 A. " 102	1 PrOx. " 80	182
Subper- * " "	- - -	1 A. " 51	1 PrOx. " 80	131
Benzoate of Ammonia	- - -	1 A. " 120	1 A. " 17	137
Citrate of Lime	- - -	1 A. " 59	1 L. " 28	87
Oxalate of Ammonia	- - -	1 A. " 36	1 A. " 17	53
— Lime	- - -	1 A. " 36	1 L. " 28	64
— Lead	- - -	1 A. " 36	1 Ox. " 112	148
SALTS WITH DOUBLE BASES.				
Phosphate of Ammonia & Magnesia	2 Ac. = 56, +	1 A. = 17, +		
	M. = 20			93
Sulphate of Alumine and Potash	1 Bi-Sul. Pot. = 128, +	2 Sul. of		
	Alu 114			242
Tartrate of Potash and Soda (Rochelle Salt)	2 A. = 134, +	1 P. =		
	48 + 1 S. = 32			214
Tartrate of Potash and Antimony, (Emetic Tartar),	2 A. = 134, +			
	2 Ox Ant. = 106 + 1 P. = 48			288
Muriate of Mercury and Ammonia	2 A. = 74, +	1 PrOx. = 216,		
	+ 1 A. = 17			307
Super-muriate of Mercury and Ammonia	3 A. = 111, +	1 PrOx. =		
	216, + 1 Am. = 17			344
Tartrate of Potash and Iron	2 A. = 134, +	1 Pot. = 48 +	1 PrOx. =	
	= 80?			262

\*Verdigris is a mixture of the peracetate and sub-peracetate of copper; the former a soluble and the latter an insoluble salt; and hence we perceive, why verdigris is only partially soluble in water, but soluble in vinegar, the latter fluid converting the subperacetate to the peracetate.

TABLE V.  
Chlorides.

		Composition.		Equiv <sup>l</sup> ent Numbers.
	Chloride of Azote	4 C. = 144	1 A. = 14	158
—	Phosphorus	1 C. " 36	1 P. " 12	58
—	Sulphur	1 C. " 36	1 S. " 16	52
—	Arsenic	2 C. " 72	1 A. " 38	110
—	Potassium	1 C. " 36	1 P. " 40	76
—	Sodium	1 C. " 36	1 S. " 24	60
—	Calcium	1 C. " 36	1 C. " 20	56
Proto	Iron	1 C. " 36	1 I. " 28	64
Per	"	3 C. " 108	2 I. " 56	164
—	Zinc	1 C. " 36	1 Z. " 32	68
—	Lead	1 C. " 36	1 L. " 104	140
Proto	Tin	1 C. " 36	1 T. " 60	96
Per	"	2 C. " 72	1 T. " 60	132
Proto	Copper	1 C. " 36	1 C. " 64	100
Per	"	2 C. " 72	1 C. " 64	136
—	Bismuth	1 C. " 36	1 B. " 71	107
Proto	Mercury ( <i>calomel</i> )	1 C. " 36	1 M. " 200	236
Per	" ( <i>corro. sub.</i> )	2 C. " 72	1 M. " 200	272
—	Silver	1 C. " 36	1 S. " 110	146
—	Gold	1 C. " 36	1 G. " 199	235
—	Antimony	1 C. " 36	1 A. " 45	81

\*The prime equivalents of the chlorides and muriates are mutually convertible, by adding or subtracting as the case may be, a prime equivalent of water for each prime of chlorine or muriatic acid, which the chloride or salt contains. For example, we convert the prime equivalent of protochloride of iron into that of the protomuriate, by adding one prime equivalent of water, and vice versa; and we convert the prime equivalent of perchloride into that of the permuriate, by the addition of three primes of water, while to convert the permuriate to the perchloride we subtract three primes of water.

TABLE VI.

Compounds whose Generic names terminate in *uret*

		Composition.		Equivalent Numbers.
	Hydroguret of Carbon (olifient gas)	1 H. = 1	1 C. = 6	7
Bi-	— " (light carb'd. hyd.)	2 H. " 2	1 C. " 6	8
	— Phosphorus (phosphr'd. hy.)	1 H. " 1	1 P. " 12	13
Bi-	— " "	2 H. " 2	1 P. " 12	14
Bi-Carburet of	Azote (cyanogen) :	2 C. " 12	1 A. " 14	26
—	Phosphorus	1 C. " 6	1 P. " 12	18
	Phosphuret of Calcium	1 P. " 12	1 C. " 20	32
Bi-Sulphuret of	Carbon	2 S. " 32	1 C. " 6	38
Bi-	Arsenic (Realgar)	2 S. " 32	1 A. " 38	70
—	Potassium	1 S. " 16	1 P. " 40	56
—	Sodium	1 S. " 16	1 So. " 24	40
Proto-	Iron	1 S. " 16	1 I. " 28	44
Per-	"	3 S. " 48	2 I. " 56	104
—	Zinc	1 S. " 16	1 Z. " 32	48
—	Lead	1 S. " 16	1 L. " 104	120
Proto-	Copper	1 S. " 16	1 C. " 64	80
Bi-	"	2 S. " 32	1 C. " 64	96
—	Bismuth	1 S. " 16	1 B. " 71	87
Proto-	Mercury (Ethiops Mineral)	1 S. " 16	1 M. " 200	216
Bi-	" (Cinnabar)	2 S. " 32	1 M. " 200	232
—	Silver	1 S. " 16	1 S. " 110	126
—	Antimony	1 S. " 16	1 A. " 45	61
Bi-Cyanuret of	Mercury	2 Cy. " 52	1 M. " 200	252

TABLE VII.

## General Table of Gaseous Bodies, by Dr. Ure.

NAMES.	Sp. gr. air = 1.00	Weight of 100 cubic inches	Weight of prime equiv. hydrog. = 1	Constituents. by volume.	Resulting volume.	Constituent prime equivalents.
Hydrogen	0.0694	2.118	1			
Carbon	0.4166	12.708	6			
Subcarb. hydrogen	0.5555	17.000	8	2 hyd. + 1 carb.	1	2 hyd. + 1 carb.
Ammonia	0.5902	18.000	17	3 hyd. " 1 azote	2	3 hyd. " 1 azote
Steam of water	0.625	19.062	9	2 hyd. " 1 oxy.	2	1 hyd. " 1 oxyg.
Phosphorus	0.833	25.42	12			
Phosphur. hydrogen	0.902	27.47	13	1 phos. " 1 hyd.	1	1 phos. " 1 hyd.
Subphos. hydrogen	0.9722	29.65	14	1 phos. " 2 hyd.	1	1 phos. " 2 hyd.
Carbonous oxide	0.9622	29.65	14	2 carb. " 1 oxy.	1½	1 carb. " 1 oxyg.
Carburetted hydrogen	0.9722	29.65	7	1 carb. " 1 hyd.	½	1 carb. " 1 hyd.
Azote	0.9722	29.65	14			
Prussic acid	0.9374	28.59	27	1 cyan. " 1 hyd.	2	1 cyan. " 1 hyd.
Atmospheric air	1.0000	30.519	36	1 oxy. " 4 azote	5	1 oxyg. " 2 azote
Deutoxide of azote	1.0416	31.77	30	2 oxy. " 1 azote	2	1 oxyg. " 1 azote
Oxygen	1.1111	33.888	8			
Sulphur	1.1111	33.888	16			
Sulphuretted hydrogen	1.1805	36.006	17	1 hyd. " 1 sulph.	1	1 hyd. " 1 sulph.
Muriatic acid	1.2840	39.183	37	1 hyd. " 1 chlo.	2	1 hyd. " 1 chlor.
Carbonic acid	1.5277	46.596	22	1 carb. " 1 oxy.	1	1 carb. " 2 oxyg.
Protoxide of azote	1.5277	46.596	22	1 oxy. " 2 azote	1½	1 oxyg. " 1 azote
Alcohol vapour	1.6133	49.20	23	1 ol. gas " 1 wat.	1	2 ol. gas " 1 water
Cyanogen	1.8055	55.07	26	2 carb. " 1 azot.	1	2 carb. " 1 azote
Chloroprussic acid	2.1527	65.69	62	1 cyan. " 1 chlo.	2	1 cyan. " 1 chlor.
Muriatic ether	2.219	67.68	83	1 mur. " 2 alco.	2	1 mu. acid " 2 alc.
Sulphurous acid	2.222	67.77	32	1 oxy. " 1 sulph.	1	2 oxyg. " 1 sulph.
Deutoxide of chlorine	2.361	72.0	68	2 oxy. " 1 chlo.	2	1 chlor. " 4 oxyg.
Fluoboric acid	2.371	72.312	22			
Protoxide of chlorine	2.44	74.42	44	2 oxy. " 4 chlo.	4	1 oxyg. " 1 chlor.
Chlorine	2.500	76.25	36			
Sulphuric ether vapour	2.586	78.87	37	2 olef. " 1 wat.	1	4 olef. " 1 water
Nitrous acid	2.638	80.48	46	4 oxy. " 2 azote	2	3 oxyg. " 1 azote
Sulphuret of carbon	2.644	80.66	38	2 carb. " 4 sulph.	2	2 sulph. " 1 carb.
Sulphuric acid	2.777	84.72	40	3 oxy. " 2 sulph.	2	3 oxyg. " 1 sulph.
Chlorocarbonous acid	3.472	205.9	50	1 chl. " 1 car. ox.	2	1 chlor. " 1 car. ox.
Sal ammoniac	3.746	114.3	54	2 am. " 2 mur.	1	1 am. " 1 mu. acid
Nitric acid	3.75	114.37	54	5 oxy. " 2 azote	2	5 oxyg. " 1 azote
Hydriodic acid	4.340	132.37	125	1 hyd. " 1 iodine	2	1 hyd. " 1 iodine
Oil of turpentine	5.013	152.9				
Chloric acid	5.277	160.97	76	3 oxy. " 2 chlo.	2	5 oxyg. " 1 chlor.
Fluoborate of ammonia	5.902	180.	39	2 am. " 2 flou.	1	1 am. " 1 fluobor.
Subfluob. ammonia	7.10	216.7	56	4 am. " 2 flou.	1	2 am. " 1 fluobor.
Tritosubfluob. ammonia	8.26	252.	73	6 am. " 2 flou.	1	3 am. " 1 fluobor.
Fluosilicate of ammonia				2 am. " 1 acid.		

## TABLE VIII.

### Incompatible Substances.

HARD WATER,	Sulphuric and Citric Acids; Tartrate of Potash and Antimony; Tartrate of Potash and Iron; Nitrate of Silver; Sulphates of Iron and Zinc; Muriate of Barytes; Acetate and Subacetate of Lead, Deutochloride of Mercury; Ammoniated Copper; Potash and Ammonia.
AMMONIA,	Acids generally; all acidulous salts; Sulphates of Magnesia, Iron, and Zinc; Tartrate of Potash and Antimony; the acetates of Lead; and the Chlorides of Mercury.
POTASH,	All the Acids; the soluble salts generally; and the Chlorides of Mercury.
LIME,	Alkaline carbonates and the metallic salts generally; Sulphur; spiritous preparations, and the infusions of all astringent vegetables.
MAGNESIA,	The Acids, and the metallic salts generally.
METALLIC OXIDES,	The Acids generally.
PROTOCHLORIDE OF MERCURY, ( <i>Calomel.</i> )	Nitro-muriatic Acid; Alkalies and their carbonates; Lime water; Soaps, and water impregnated with sulphuretted hydrogen.
DEUTOCHLORIDE OF MERCURY, ( <i>Corrosive Sublimate.</i> )	Alkalies and their carbonates; Lime water; Tartrate of Potash and Antimony; Nitrate of Silver; the Acetates of Lead; Water impregnated with Sulphuretted Hydrogen; Soaps; Iron; Lead; Copper; Zinc; and albuminous substances.
NITRIC,	ACIDS.
SULPHURIC,	Alkalies, Earths, and their carbonates; metallic oxides, and substances containing them uncombined with acids, such as Blue pill, Plenck's solution, <i>Hydragyrum cum creta</i> ; and the soluble salts generally, except the sulphates and nitrates.
MURIATIC,	Alkalies, Earths and their Carbonates; all the salts whose bases form insoluble chlorides, and the soluble salts generally, except the sulphates and nitrates.
NITRO-MURIATIC,	Protochloride of Mercury and the same substances that are incompatible with muriatic acid.
HYDROCYANIC OR PRUSSIC,	Most of the metallic oxides, particularly those of mercury and antimony; nitrate of sil-

# Incompatible Substances—Continued.

	ver; the salts of Iron; Mineral acids and chlorine.
CITRIC, (Contained in Lime juice and Tamarinds.)	Alkaline and Earthy substances; Alkaline and Metallic Salts; Sulphurets of Earths and Alkalies, and Alkaline Soaps.
SALTS. NITRATE OF POTASH,	Sulphuric Acid; Alum; Sulphates of Magnesia, Zinc, Copper, and Iron.
" SILVER,	Fixed Alkalies and their carbonates; Alkaline Earths, Muriatic, Sulphuric, Tartaric and Arsenious acids, and all the salts which contain them; the soluble chlorides; soaps; water impregnated with sulphuretted hydrogen; astringent vegetable infusions; and undistilled water.
CARBONATES OF POTASH AND SODA.	Acids and acidulous salts; Borax; Muriate of Soda; Sulphates of Magnesia; Alum; Lime water; Acetate of Ammonia; Tartrate of Potash and Antimony; Tartrate of Potash and Iron; all the metallic salts, and the Chlorides of Mercury.
" AMMONIA,	Acids; Fixed Alkalies; Lime water; Magnesia; Alum; Bi-tartrate of Potash; all the Acidulous Salts, Sulphates of Magnesia, Iron, Zinc, and Copper; Salts and Chlorides of Mercury; Tartrate of Potash and Antimony; and Tartrate of Potash and Iron.
" LIME, (Creta preparata)	The acids generally.
" MAGNESIA.	Acids, and Acidulous Salts; Nitrate of Silver; Acetates of Mercury and Lead; Sulphates of Zinc, Copper, and Iron; and Deutochloride of Mercury.
" IRON,	The Acids generally.
PHOSPHATE OF SODA,	Ammonia; Lime Water; Nitric and Muriatic Acids; Sulphate of Magnesia; Nitrate of silver and the soluble salts of Iron, Zinc, Lead, and Copper.
SULPHATE OF POTASH,	Nitric and Muriatic Acids; Lime and its compounds; Deutochloride of Mercury; Nitrate of Silver; and the Acetates of Lead.
" SODA,	Potash and its Carbonates; Muriate of Barytes; the Acetates of Lead, and Nitrate of Silver.
" MAGNESIA,	Like the last, with the addition of Soda, Ammonia, and their carbonates.

## Incompatible Substances—Continued.

<p>SULPHATE OF ALUMINE AND POTASH, (<i>Alum.</i>)</p>	<p>Alkalies and Alkaline Salts generally; Carbonate and Muriate of Ammonia; Carbonate of Magnesia; Tartrate of Potash; Lime water; Acetate of Lead, and the Salts of Mercury.</p>
<p>“ IRON,</p>	<p>Every salt whose base forms an insoluble Salt with Sulphuric Acid; the Alkalies, Earths, and their carbonates; Borax; Nitrate of Potash; Muriate of Ammonia; Tartrate of Potash and Soda; Acetate of Ammonia; Nitrate of Silver, the Acetates of Lead, and the Soaps.</p>
<p>“ ZINC,</p>	<p>Salts whose bases form insoluble sulphates; Alkalies and their carbonates; Earths; Hydro-sulphurets; Astringent vegetable infusions and Milk.</p>
<p>“ QUININE,</p>	<p>Substances containing bases of insoluble sulphates, would, no doubt, decompose it; and if they precipitated its base, which is very insoluble, or formed with it an insoluble salt, they would destroy or greatly diminish its medicinal properties; as gallic acid is said to form an insoluble salt with Quinine, we may suppose that astringent vegetables are incompatible with its sulphate.</p>
<p>ARSENITE OF POTASH, (<i>Fowler's Solution.</i>)</p>	<p>Lime water; Nitrate of Silver; Salts of Copper; Hydrosulphuretted water, and infusions and decoctions of Bark.</p>
<p>ACETATE OF AMMONIA, (<i>Spirit of Mindererus.</i>)</p>	<p>Acids; Fixed Alkalies; Lime water; Magnesia; Alum; Sulphates of Magnesia, Iron, Zinc and Copper; Nitrate of Silver, and Deutochloride of Mercury.</p>
<p>“ POTASH,</p>	<p>Almost every acid; the soluble salts, except those having potash for their base; Tamarinds and most sub-acid fruits.</p>
<p>“ LEAD,</p>	<p>Alkalies, Alkaline Earths, and their Carbonates, most of the Acids; Borax; the Sulphates and Muriates; Soaps; all Sulphurets; Tartrate of Potash and Iron; Tartrate of Potash and Antimony, and undistilled water.</p>
<p>TARTRATE OF POTASH,</p>	<p>Magnesia; Barytes, and Lime; the Acetates of Lead; Nitrate of Silver; all the Acids, acidulous salts, Tamarinds, and other sub-acid vegetables convert it into bi-tartrate.</p>
<p>“ POTASH &amp; SODA, (<i>Rochelle Salt.</i>)</p>	<p>Lime water; Tartaric Acid, and Acetate of Lead.</p>
<p>“ POTASH &amp; ANTIMONY, (<i>Emetic Tartar.</i>)</p>	<p>Mineral Acids; Alkalies and their Carbonates; Alum; Bi-Sulphate of Potash; water im-</p>

## Incompatible Substances—Continued.

pregnated with sulphuretted hydrogen; many infusions and decoctions of bitter and astringent vegetables; hence Bark, Rhubarb, and common tea, are incompatible with it; infusions of Gentian, Wormwood, and Chamomile are not.

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<sup>66</sup> POTASH & ANTIMONY, The Alkalies and their Carbonate; Lime water; the Mineral Acids; Hydrosulphuretted water, and astringent vegetable infusions.

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BI-TARTRATE OF POTASH,  
(*Cream of Tartar.*) Alkalies and Alkaline Earths, and the Mineral Acids.

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TABLE IX.  
**SYNOPTIC VIEW**  
OF  
**MINERAL POISONS;**  
WITH THEIR APPROPRIATE  
**TESTS & ANTIDOTES;**  
*TRANSLATED WITH ADDITIONS,*  
**From the Tables of Dr. De Salle,**  
PUBLISHED IN PARIS, 1824.

---

*Arsenious Acid or White Arsenic.*  
*Yellow Sulphuret of Arsenic or Orpiment.*  
*Red Sulphuret of Arsenic or Realgar.*  
*Arsenite of Potash, Fowler's solution.*

SYMPTOMS.

An austere taste, offensive breath, salivation, sense of constriction in the throat; hiccup, nausea and vomiting of matter of a brown or bloody colour; anxiety in the epigastrium, with fainting; heat and acute pain of the stomach; black and foetid stools; pulse small, frequent and irregular, with palpitations of the heart; difficult respiration; urine scanty, high coloured and even bloody; delirium, convulsions of the epileptic kind, death.

TREATMENT.

Excite or favour vomiting by large doses of tepid water, or flax-seed tea. If the arsenic has been taken in solution, direct copious draughts of lime water, or prepared chalk suspended in gum water. Oils, either animal or vegetable, vinegar, powdered charcoal, the sulphuretted alkalies, and various vegetable decoctions, which have been recommended at different times, are entitled to little confidence.

Symptoms of inflammation, as soon as manifested, should be

combated by venesection, and the application of leeches to the epigastrium. Warm fomentations to the same part, and emollient injections should be used freely.

During the convalescence from poisoning by arsenic, the diet of the patient should be liquid, farinaceous, and in small quantities. No real antidote for arsenic is known.

#### TESTS.

The solution of ammoniacal copper produces, in a solution of arsenic, a fine grass-green coloured precipitate. If the arsenic was dissolved in wine, the precipitate will be of a blackish blue.

Sulphuretted hydrogen causes a precipitate of a bright yellow colour, if the arsenic was dissolved in an infusion of tea. When dissolved in common water, the same re-agent affords a yellow colour, but gives no precipitate.

When albumen, gelaten or bile holds the arsenic in solution, the nitrate of silver produces a white precipitate.

Ammoniacal nitrate of silver affords a yellow precipitate, soluble in nitric acid and in ammonia; but the experiment is inconclusive when the liquid which we examine contains, muriatic or phosphoric acid; or any salt formed from either of those acids. To arrive at a correct conclusion, dip into the solution, under examination, a slip of paper, and while it is yet moist, touch it in different places with a stick of the nitrate of silver; the spots thus touched will become yellow, if there be either arsenic or an alkaline phosphate present; nevertheless, if it be the former, the coloured spots will be rough, curdled and flaky, like the lines traced with a soft crayon; while the yellow spots from the latter will be homogenous and uniform. Besides, the colour of the last changes in the course of a few minutes, into a dull green, which becomes gradually darker, and ends in black; while the yellow produced by arsenic, remains for a much longer time, and becomes black without passing previously into any shade of green.

The most certain evidence of the presence of arsenic is its reduction to a metallic state by calcination or burning-coals, when it emits the odour of garlic.

#### ADDITIONAL OBSERVATIONS BY THE COMPILER,

In the examination of a fluid suspected to contain arsenic, I commence my experiments with lime water, as this enables me at once to distinguish arsenious acid from corrosive sublim-

ate; if the former be present, a white precipitate (the arsenite of lime) will be formed, if the latter an orange red precipitate (deutoxide of mercury) will be produced,—sulphuretted hydrogen also enables us to make a similar distinction. The most convenient method of applying this test is the following: Procure a piece of glass tube five or six inches in length, (an old thermometer tube answers the purpose) and by heating it, bend one end into the form of a crook; cement the short end with sealing-wax into a perforated cork which accurately fits a common ounce vial: this is all the apparatus necessary for the production of the gas. To use it—drop into the vial two or three small lumps of sulphuret of potash, add thereto a little dilute muriatic acid, and instantly force in the cork to which the tube is attached. The end of the tube is now to be plunged to the bottom of a portion of the suspected fluid previously poured into a wine-glass, or what is still better a test tube; the sulphuretted hydrogen gas will issue rapidly from the end of the tube, and if the suspected fluid contains arsenious acid it will be changed to a yellow colour, from the formation of bisulphuret of arsenic; whereas, if it contains corrosive sublimate a copious dirty black precipitate of sulphuret of mercury will be produced. It may be said in favour of the sulphuretted hydrogen, that its results are less influenced by the presence of those substances with which the contents of the stomach are most liable to be mixed, than any other re-agent.

Dr. De Salle justly remarks that the most certain evidence of the presence of arsenic, is its reduction to the metallic state; but the method by which he directs it to be effected, is by no means the most satisfactory one. The following method taken from 'Ure's *Chémical Dictionary*,' I have found by experience to give the most satisfactory results. Take any of the dry precipitates thrown down by reagents from the solution, or any dry substance suspected to contain arsenic, mix it with a pinch of black flux, or a mixture of lampblack and potash, put it into a narrow glass tube sealed at one end, and after cleaning its sides with a feather, urge its bottom with a blow-pipe till it be distinctly red hot, for a minute. The smell of garlick will be perceived at the open end of the tube and a steel-lustred coating of metallic arsenic will be seen about one fourth of an inch above its bottom. Cut the tube, across with a file at that point, detach a scale of arsenic with the point of a pen-knife; put a fragment of it into the bottom of a wine-glass along with a few drops of ammoniaco-acetate of copper and

triturate them well together for a few minutes with a round headed glass rod.\* The mazarine blue colour will be transmuted into a lively grass-green, while the metallic scale will vanish. Thus we distinguish perfectly between a particle of metallic arsenic and one of animalized charcoal. Another particle of the scale may be placed between two smooth and bright surfaces of copper, with a touch of oil; and, whilst they are firmly pressed together exposed to a red heat, the tombac alloy will appear as a white stain. A third particle may be placed on a piece of heated metal and held under the nostrils, when the garlick odour will be recognized.

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## ANTIMONY.

*Tartrate of Antimony and Potash, or Tartar Emetic.*

*Muriate of Antimony, or Butter of Antimony.*

*Vitrified Oxide of Antimony, or Glass of Antimony.*

### SYMPTOMS.

The same symptoms as in poisoning by the strong acids; but more copious and obstinate vomitings; copious stools, constriction of the throat, cramps; symptoms of drunkenness with great prostration of strength, frequently terminating in death.

### TREATMENT.

It is necessary to excite vomiting by tickling the throat with the finger or a feather, or by administering large draughts of mild liquids. Sometimes, according to the first effects produced by the poison, it is proper to add to the drinks a little tincture of opium. The best remedies are astringent vegetable decoctions—such as that of oak or willow bark, nut gall, or common tea. They will promote vomiting, and at the same time decompose the poison.

### TESTS.

Tartar emetic is precipitated of an orange or deep brown color by, sulphuretted hydrogen, and the hydrosulphurets

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\* A round ended glass rod, ground with emery into a thick test tube of corresponding shape and size, so as to leave the end of the rod and bottom of the tube a little rough, I have found to answer best for this experiment.

generally; of a white, by sulphuric acid, and the solution of the alkalies, of lime and of barytes. The neutral alkaline and earthy salts, do not produce this effect, but when they have an excess of acid it is otherwise. The infusion of nutgalls affords an abundant yellowish white precipitate.

The muriate or butter of antimony is a heavy brown fluid; which throws down a white precipitate by merely being diluted with water.

The vitreous oxide of antimony is soluble in muriatic acid, with which it forms a muriate, the substance just named.

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## BISMUTH.

*Nitrate of Bismuth.*  
*White Oxide of Bismuth.*

### SYMPTOMS.

The same as are produced by other corrosive poisons, with a feeling of great heat in the chest, and very difficult respiration.

### TREATMENT.

We are not acquainted with any agent capable of neutralizing these substances when taken into the stomach. Direct copious draughts of milk, and mucilaginous fluids, to facilitate vomiting; and administer injections of the same liquids. Inflammation and other consecutive effects, must be combatted by appropriate remedies.

### TESTS.

If boiled in distilled water, the nitrate of bismuth is decomposed: one part is deposited in the state of sub-nitrate; the other becoming a super-nitrate, remains in solution. This solution is colourless, changes curcuma to a red, and the hydro-sulphurets form with it a black and insoluble sulphuret of bismuth. The sub-nitrate dissolves in hot nitric acid, and from the solution the alkalies precipitate the white oxide of bismuth, which is easily rendered to a metallic state by calcination. The chromate of potash throws down from the solution a yellow precipitate.

## COPPER.

*Sulphate of Copper, or Blue Vitriol.**Sub-Acetate of Copper, or Verdigris.**Salts of Copper, impregnating food cooked in copper vessels.*

## SYMPTOMS.

Taste sharp and coppery; tongue excessively dry; tightness in the throat; eructations of a cupreous odour; violent vomiting or ineffectual retchings; pain in the stomach and bowels; stools, frequent, dark, and bloody, with tenesmus; abdomen distended; pulse frequent, hard and small; syncope, unquenchable thirst, anxiety, cold sweats, urine scanty, headache, vertigo, cramp, convulsions and death.

## TREATMENT.

Large draughts of warm water or milk, to promote vomiting; white of egg beaten with water. The inflammation should be treated with blood-letting and diluents: the morbid affections of the nervous system with anodynes and antispasmodics.

Sugar is not a specific antidote, as was formerly believed, but may be employed with advantage, dissolved in coffee.

## TESTS.

The salts of copper are generally of a fine blue or green colour; they are easily reduced to the metallic state by being heated with charcoal. The sulphate is in part decomposed by the alkalis, and the alkaline earths. Potash precipitates from it a sub-sulphate of a green colour.

If the salts of copper are dissolved in coffee, wine, or strong beer, they are in part decomposed: the tincture of guaiac added to either of these solutions causes a precipitate which varies in colour from a greenish blue to a pale green.\*

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\*It is stated in Chapman's Journal, No 1, page 210, that when the quantity of cupreous salt is too small to be detected by the tincture of Guaiac alone, the subsequent drops of Hydrocyanic (Prussic) acid, will instantly produce a blue colour, though the fluid should contain only  $\frac{1}{140000}$  part of its weight of Copper. I have ascertained by experiment, that it is far more delicate than the ammoniacal test. When the liquid acid is not at hand, Hydrocyanic acid gas may be extemporaneously prepared in the manner proposed in the observations on arsenious acid, for the preparation of sulphuretted hydrogen; by placing in the vial a few grains Bi-cyanuret (Prussiate) of mercury

Ammonia, or its carbonates, added to a solution containing a cupreous salt, forms a blue or green precipitate, according to the quantity of the re-agent employed. If we use a large quantity of the alkali, the precipitate is re-dissolved, and the solution, becoming transparent, assumes a fine deep blue color.

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## GOLD.

*Chloride, or Muriate of Gold.*

### SYMPTOMS.

It is probable that the symptoms of poisoning by this substance are nearly the same as those produced by the other corrosive salts, but they have not been accurately observed.

### TREATMENT.

We know of no specific antidote. Vomiting should be promoted, by warm mucilaginous drinks. The secondary symptoms must be corrected by their appropriate remedies.

### TESTS.

The chloride of gold is decomposed by the nitrate of silver. A precipitate is formed of a reddish brown colour, which is a chloride, formerly called a muriate of silver. Its colour is perhaps owing to the presence of a portion of oxide of gold. Ammonia, or its carbonate added to the precipitate, dissolves the chloride of silver, and leaves the oxide of gold of a fine yellow colour, resembling that of the canary bird.

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## SILVER.

*Nitrate of Silver, or Lunar Caustic.*

### SYMPTOMS.

Those produced by the other corrosive poisons.

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moistened with strong muriatic acid, and applying a gentle heat to the vial, the gas will be formed and liberated: it may be passed through the suspected fluid (previously mixed with Tincture of Guaiac in a test tube or wine glass) precisely in the manner there directed for the application of sulphuretted hydrogen.

As by this process the hydrocyanic acid is produced in a highly concentrated state, the operator should be extremely cautious.

## TREATMENT.

Dissolve a spoonful of common salt in a pint of water, and give a wine glass full of the solution every five minutes. It will decompose the poison: afterwards employ mucilaginous drinks and purgatives.

## TESTS.

The nitrate of silver is decomposed by the muriate, the phosphate, and the chromate of soda, affording with the first a white, and the others a yellow precipitate. Placed upon burning charcoal, nitrate of silver increases the combustion, and a metallic residuum is left. Calcined with charcoal and potash, the silver is revived.

## LEAD.

*Acetate, or Sugar of Lead.*

*Carbonate of Lead, or White Lead.*

*Wines adulterated with Salts of Lead.*

## SYMPTOMS.

A sugary, metallic, and astringent taste; constriction of the throat; pain in the epigastric region, violent vomitings, the discharges often bloody; hiccups, convulsions, and death.

When taken in small doses for a long time, colic with palsy of some of the muscles of locomotion.

## TREATMENT.

A weak solution of the sulphate of soda or magnesia, will act as an antidote—forming an insoluble and inert sulphate of lead. If inflammatory symptoms supervene, venesection, purging &c. with the sulphates just named, aided by emollient injections, and the warm bath.

## TESTS.

All the preparations of lead are easily reduced to the metallic state, by calcination upon charcoal.

The solution of superacetate of lead yields from the sulphuric acid a white—from the chromic acid and chromate of potash a canary yellow precipitate. The salts thus formed may be reduced by calcination. The sulphuretted hydrogen gas

and the sulphuretted alkalies, afford with the solution of acetate of lead precipitates of a blackish colour.

## MERCURY.

*Deuto-Chloride of Mercury, or Corrosive Sublimate.*  
*Deutoxide of Mercury, or Red Precipitate.*  
*Deutosulphuret of Mercury, Cinnabar, or Vermillion.*

### SYMPTOMS.

An acrid and metallic taste; thirst, choaking, and burning heat in the throat; anxiety, rending pains in the stomach and bowels; nausea and vomiting of matters variously coloured—sometimes bloody; diarrhœa and dysuria; pulse frequent small and hard; faintings, extreme weakness, difficult respiration, cramps in the extremities, cold sweats, insensibility, convulsions and death.

### TREATMENT.

Give the white of one egg beat up with water every two or three minutes; it envelopes the poison and forms with it an insoluble and comparatively inert precipitate. The gluten of wheat flour may answer the same end, and therefore thin paste might be administered. Milk, gum water, flaxseed tea, sweetened water, or water alone, slightly warmed, may be administered in large quantities. No antidotes to the other mercurial preparations are known.

The usual means of preventing and curing inflammation should be employed.

### TESTS.

The mercurial preparations, mixed with potash and heated to redness in a glass tube, are decomposed; the mercury being volatilized. With the solution of the deutochloride, ammonia forms a white, lime water an orange coloured precipitate; the nitrate of tin a copious deep brown precipitate; and albumen or white of egg, a white and flaky precipitate.

The deutoxide of mercury may be dissolved in muriatic acid, and converted into the deutochloride.

Vermillion is insoluble in water or muriatic acid, but entirely volatilizable by heat.

## TIN.

*Muriate of Tin—employed in dying.*  
*The Oxide of Tin—used in Glazing Delft Ware.*

## SYMPTOMS.

An austere and metallic taste, a feeling of constriction in the throat; vomitings, with pain in the whole abdomen; copious stools; pulse small, hard and frequent; convulsive movements in the extremities and face. In a few cases subsequent paralysis; but more commonly death is the consequence.

## TREATMENT.

Milk in great quantities, to excite vomiting by distension; and to decompose the poison, as an antidote. Inflammation or nervous symptoms are to be combatted by bloodletting, the warm bath, opium and other appropriate means.

## TESTS.

The muriate of tin affords with a solution of muriate of gold a purple precipitate. Strong hyson tea or a tincture of galls gives a precipitate of a brilliant yellow colour. Albumen and gelatin produce an abundant and flaky precipitate.

The oxide of tin may be volatilized by heat; it is soluble in nitric acid, combines with the earths by fusion, and, mixed with the fixed alkalies, forms enamel. It is easily reduced by calcination.

## ZINC.

*Sulphate of Zinc, or White Vitriol.*  
*Oxide, or Flowers of Zinc.*

## SYMPTOMS.

A sharp and styptic taste, with a feeling of strangulation, nausea and vomiting; pains in the stomach, frequent alvine discharges, difficult respiration, pulse frequent, face pale, extremities cold. As the preparations of zinc, especially the sulphate, possess strong emetic properties, they are in general

speedily ejected from the stomach; and therefore rarely occasion death.

#### TREATMENT.

It is sufficient to promote vomiting with tepid water or some other analagous liquid. The symptoms are to be met by the various means pointed out in preceding articles.

#### TESTS.

The sulphate of zinc, when pure is decomposed by potash and ammonia, and the precipitate is white; by the hydrosulphuretted alkalies, which afford a yellowish white precipitate; and the chromate of lead, which gives one of an orange hue\*.

The oxide is promptly reduced to the metallic state by calcination with charcoal and nitrate of potash.†

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#### ACIDS.

*Sulphuric Acid or Oil of Vitriol.*

*Nitric Acid or Aqua Fortis.*

*Muriatic Acid or Spirit of Salt.*

*Oxalic Acid.*

*Phosphoric Acid.*

*Fluoric Acid.*

*Tartaric Acid.*

*Hydrocyanic or Prussic Acid.*

#### SYMPTOMS.

A sharp and burning taste, very lively pains in the throat, stomach and intestines; repeated vomitings of a bloody fluid which causes an effervescence with chalk or the carbonated alkalies, and changes turmeric paper to a red; hiccup; copious stools often tinged with blood; tenderness of the abdomen extreme; respiration difficult; pulse irregular; thirst intense and unextinguishable, increasing the pain if indulged to satiety; repeated but ineffectual efforts to discharge urine; cold.

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\*This is certainly a mistake, chromate of lead is insoluble in water, and the alkaline chromates do not form precipitates with the salts of zinc.

†The black flux would be preferable in this case.

sweats, altered expression of countenance; convulsions; death.

The prussic acid is the most subtle and active of all poisons; producing death almost instantly, even when applied in small quantities to the external surface of the body where the cuticle has been removed.

#### TREATMENT.

The alkalies and alkaline earths are antidotes to all the foregoing acids, except the prussic, uniting with them to form neutral salts. The carbonates of these substances are not so proper, as the great disengagement of carbonic acid sometimes oppresses the stomach of the patient. One ounce of magnesia may be mixed with a pint of water, and a wineglass of the mixture given every two minutes. If magnesia is not at hand, direct hard soap or chalk, or a lie of wood-ashes, or a solution of pearlsh. As the salts formed by many of these substances with some of the acids named are irritating to the stomach, vomiting should be provoked by tickling the fauces. After the poison has been destroyed or rejected, the patient should be kept for some time on a mild and liquid diet. Inflammation and other morbid states, must be met by appropriate remedies.

When undiluted sulphuric acid has been taken, water should not be given, as much heat is generated by its union with the acid.\* In this case the carbonate of magnesia is preferable to magnesia itself.

A mixture of chalk and water is better than magnesia when oxalic acid has been swallowed. When the prussic acid has been taken, vomiting should be excited as quick as possible; and after the stomach has been emptied, oil of turpentine, ammonia, brandy, and other stimulants should be administered; and their action may be seconded by the external application of heat, frictions and sinapisms.

#### TESTS.

Sulphuric acid may be known by its great weight, and the heat, without fumes, which is devolved by mixing it with water; with barytes it forms a salt insoluble in water and nitric acid.

The nitric acid disengages deep orange coloured fumes, when poured upon a plate of copper, and a moment after assumes a white colour. With potash it forms a salt which

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\* This depends on its state of dilution.

sparkles when thrown upon burning coals. Nitric acid stains the cuticle of a yellow colour.

Muriatic acid exhales, constantly, a sharp and penetrating vapour;\* with nitrate of silver it forms a very white precipitate, the chloride of silver, soluble in ammonia, but not in nitric acid.

Oxalic acid precipitates lime and all its salts from their solutions; the precipitates are soluble in nitric acid, but not in oxalic acid; exposed to heat this acid is volatilized and leaves scarcely any residuum. The sulphuric acid is changed by it to a brown, and at the same time both acids are decomposed. By heat it is dissolved in nitric acid, the solution becoming yellow. It dissolves in hot muriatic acid, and they undergo mutual decomposition.

Phosphoric acid precipitates barytes and lime from their solutions in water; and the new substances are soluble in nitric acid. At a high temperature it is decomposed by charcoal, carbonic acid escapes and phosphorus is sublimed.

Fluoric acid emits a white vapour, somewhat resembling that of muriatic acid; added to water its temperature is raised and a hissing noise is heard; it dissolves glass.

Tartaric acid forms in lime water, a precipitate soluble in excess of the same acid and in nitric acid. With potash it forms a neutral and a super-salt.

Tartaric acid forms no precipitates with the salts of silver, but the tartrates decompose them.

Prussic acid has a strong odour of bitter almonds or peach kernels. It is found in those seeds as well as in the leaves of the peach and cherry laurel. Alcohol dissolves it readily: water in a slight degree. The nitrate of silver precipitates it from these solutions.

\* This vapour results from the combination of the muriatic acid gas with the moisture of the atmosphere. If the stopper from a bottle of ammonia, wet with the fluid, be held over muriatic acid, a dense white fume of muriate of ammonia will be produced; but these effects take place only when the acid is strong or its temperature raised.

## ALKALIES.

*Potash and its Carbonates.**Soda and its Carbonates.**Ammonia and its Carbonates.*

## SYMPTOMS.

A sharp urinous and caustic taste; burning heat in the throat; vomiting of matters often bloody, capable of changing the vegetable blues to green, and if it be either of the carbonated alkalies, that was swallowed, of producing effervescence with the strong acids; copious stools, acute pain in the stomach, colic, convulsions, hippocratic countenance, and death.

## TREATMENT.

Vinegar or some other vegetable acid should be first given to neutralize the poison. Then warm water slightly acidulated, in large draughts. Symptoms of inflammation must be combated by appropriate remedies.

## TESTS.

The alkalies have many common properties: Their solutions are soapy to the touch; and they change the vegetable red colours to green and blue, and turn the yellow to a brown. Their solutions remain transparent when carbonic acid is passed through them; and by this they may be distinguished from the alkaline earths—barytes, strontian and lime. They precipitate the nitrate of silver in the form of a deep brown oxide soluble in nitric acid. Potash and soda may be distinguished from each other by evaporating their solutions to dryness. On exposure to the air the former will attract moisture and become humid; the latter will remain dry. Ammonia may be easily identified by its pungent odour.

## ALKALINE EARTHS.

*Lime.**Barytes.**Carbonate of Barytes.**Muriate of Barytes.*

## SYMPTOMS.

Violent vomitings; convulsions; palsy of the limbs; excruciating pains in the abdomen; hiccup; altered visage: these symptoms generally followed by speedy death.

## TREATMENT.

If the poisoning be by lime, give vinegar and the other vegetable acids, with demulcents; if by barytes or one of its salts, direct copious draughts of a weak solution of phosphate of magnesia or sulphate of soda. The poison will thus be at once evacuated by vomiting and decomposed—an insoluble, innocuous sulphate of barytes being formed. If the salts recommended are not at hand, the patient should drink freely of *well* water, which may be rendered slightly sour with sulphuric acid or elixir vitriol.

## TESTS.

The solution of lime changes the vegetable blues to a green; the carbonic and oxalic acids form with it white precipitates, which are not acted on by the sulphuric acid. Its salts, generally are decomposed by the fixed alkalis, which precipitate the lime: ammonia does not produce the same effect.

Barytes causes the same change in the vegetable blues as lime: the sulphuric acid and all the sulphates produce with it, a white precipitate—the sulphate of barytes, which is insoluble in water and nitric acid.

The carbonate of barytes is insoluble in water; but dissolves with effervescence in nitric and muriatic acids.

The muriate of barytes dissolved in water, is not altered by ammonia; but the carbonate of this alkali, as well as all the other alkaline carbonates, forms with it a white precipitate, which is the carbonate of barytes.

## NITRATE OF POTASH.

*Nitre or Salt Petre.*

### SYMPTOMS.

Cardialgia, nausea and most painful vomitings; excessive purging; convulsions; syncope, feeble pulse; coldness of the extremities with pain; rending pains in the stomach and bowels; difficult respiration; a sort of drunkenness; death.

### TREATMENT.

The means of cure are the same as when arsenic has been taken to excess, except that it is not necessary to employ lime.

It is only in large doses that nitrate of potash becomes poisonous.

### TESTS.

Nitre melts and sparkles when thrown upon burning coals, affording a beautiful white flame. When it is reduced to powder and thrown into sulphuric acid a white vapour is disengaged. These two circumstances distinguish it from sulphate of soda. At a high temperature nitrate is decomposed, and gives out a great quantity of oxygen gas.

## NITRATE OF AMMONIA.

*Sal Ammoniac.*

### SYMPTOMS.

Excessive vomitings, with convulsions and general rigidity of the muscles; acute pains in the intestines; speedy alteration of countenance, followed by death.

### TREATMENT.

Provoke vomiting by large draughts of warm sweetened water; and irritating the fauces. Nervous affections must be calmed with anodynes, and the subsequent inflammation combated by the usual remedies.

### TESTS.

The muriate of ammonia is immediately volatilized when thrown upon hot coals. When rubbed with lime ammonia is

disengaged in the form of a pungent vapour. With nitrate of silver, a white precipitate is produced.

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## PHOSPHORUS.

### SYMPTOMS.

The same as in poisoning from the strong acids; with a strong taste of garlic, and a burning sensation in the mouth.

### TREATMENT.

No antidote for this poison has yet been discovered. Excite vomiting by large doses of sub-tepid water with magnesia. Avoid oil and all fat bodies.

### TESTS.

Phosphorus, boiled in a solution of potash in a vessel with a curved beak which is covered with water, produces phosphuretted hydrogen gas; which takes fire spontaneously when it comes to the atmosphere, and burns with a blue flame.

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## IODINE.

### *Tincture of Iodine.*

### *Hydriodates of Potash and Soda.*

### SYMPTOMS.

The same as in poisoning from acids; with a deep yellow colour of the tongue and throat.

### TREATMENT.

Vomiting is the best remedy to which we can resort, afterwards diluents, enemata, warm bath, and the treatment proper in high degrees of gastro-enteritis.

### TESTS.

As a great quantity of iodine is necessary to produce poisoning, it is easy, in general, to obtain enough to establish its presence. By pouring upon the hydriodates, an excess of concentrated sulphuric acid, iodine is liberated. By heating the apparatus the iodine is converted into violet coloured vapours; which may be passed into a receiver, where it crystalizes in laminae which have a metallic aspect—at first blue, and afterwards similar to that of carburet of iron, or black lead.

## ALCOHOL.

*Wines, Distilled Spirits—Spirit of Wine.*

## SYMPTOMS.

Drunkenness, and when great quantities have been taken, insensibility with apoplexy or hemiplegia. The face is swelled and of a deep red; respiration difficult and often stertorous; with a singular projection or puffing out of the lips; breath contaminated with the smell of the liquors which were drank.

## TREATMENT.

Administer as soon as possible an active emetic of sulphate of zinc or tartarized antimony. If the patient cannot swallow, convey the medicine into his stomach through a stomach tube. Copious draughts of warm water. Injections of salt and water. Place the patient in a sitting position. If these means do not succeed, open the jugular vein and apply ice or cold water to the head; which is especially required when the heat of the body is very great. If the extremities become cold, rub them with warm flannels.

## GLASS AND ENAMEL.

## SYMPTOMS.

Glass and enamel when taken in coarse powder irritate and inflame the primæ viæ.

## TREATMENT.

Cause the patient immediately to swallow a great quantity of crumb of bread; advising him to masticate it but little. The fragments will thus be enveloped; and the intestines protected from their action. Vomiting to be excited by the sulphate of zinc, and promoted by draughts of warm water, with demulcents.

## TESTS.

By rubbing on white paper the matters vomited by the patient, or found in his stomach after death, it is easy to perceive the fragments of glass or enamel.

# NOTE

ON THE

## Vegetable Poisons,

BY

DANIEL DRAKE, M. D.

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The following Catalogue comprises only such foreign deleterious vegetables as have been introduced into the Shops, or are connected with the history of Toxicology, Medical Jurisprudence or Physiology. The greater number are American plants; and in aiming to introduce to the notice of the Class, every vegetable which as a poison should engage their attention, several have no doubt been named, which future researches will reject from the Catalogue. Many of these are marked with a note of interrogation, to indicate the uncertainty which hangs over them.

The arrangement of them into *natural* orders was preferred; as it affords an opportunity of ascertaining how far external resemblances correctly indicate similarity of internal qualities. The orders are those of Jussieu, as they exist, modified and extended, in the *Essai sur les propriétés Médicales des Plantes*, of Professor Decandolle, Montpellier, 1816. The second or Therapeutic table exhibits the genera of the first, arranged into *acid*, *narcotico-acrid* and *narcotic* poisons on the plan of Dr. Foderé, in his *Médecine Légale* Paris, 1813. By transposing two of his classes, the student is here presented with a regular and natural series, beginning with the acid and terminating with the narcotic:—

The former excite inflammation without stupor; the latter insensibility and stupor, without inflammation; the intermediate articles produce both effects. In assigning a place, in this series, to each plant, I have consulted the authorities within my reach; but much remains to be ascertained concerning many of them; and not a few will, in all probability, suffer transposition when their qualities shall be better known.

The last table is limited to a few articles; as the deleterious principles of but a small number of plants have as yet been extracted. The whole of them are of recent acquisition; and, altho' not numerous, the short time in which they have been discovered, affords an earnest of what analytical chemistry, conducted on its present method is likely to accomplish for the profession. To estimate fully the importance of chemical researches in Vegetable Toxicology, we should refer to the fact, that until we acquire a knowledge of the deleterious ingredients of vegetables, we are not likely to become acquainted with antidotes for them.

In giving a summary of the symptoms and treatment, of the diseases produced by this class of poisons, I have consulted the best authors to which I had access and claim no other merit, than that of having brought into a condensed view, what is at present known on the subject.

**I.**  
**CATALOGUE**  
**OF**  
**POISONOUS PLANTS,**  
 ARRANGED ACCORDING TO THE  
**NATURAL ORDERS OF DECANDBLLE.**

*E. exotic, N. naturalized, I. indigenous.*

<i>Natural Orders.</i>	<i>Common Names.</i>	<i>Properties.</i>
<b>1. RANUNCULACÆ.</b>		
<i>Aconitum napellus</i>	Moonshood E.	} Narcotico-acrid.
———— <i>uncinatum</i> ?	I.	
<i>Actea americana</i>	Rattleweed I.	} Acrid.
<i>Cimicifuga racemosa</i>	Black snake root I.	
<i>Delphinium staphisagria</i>	Staphesacre E.	} Narcotico-acrid?
———— <i>consolida</i> ?	Garden Larkspur	
———— <i>tricorne</i> ?	} Wild Larkspurs I.	
———— <i>azureum</i> ?		
<i>Helleborus niger</i>	Black hellebore E.	Narcotico-acrid
<i>Ranunculus acris</i>	} Crow foot. I.	Acrid.
———— <i>flammula</i>		
———— <i>sceleratus</i>		
<b>2. MENISPERMA.</b>		
<i>Menispermum cocculus.</i>	Coculus indicus E.	Narcotico-acrid,
————	Canadense and other I. species?	
<b>3. GUTTIFERÆ.</b>		
<i>Stalagmitis cambogioides.</i>	Gamboge. E.	Acrid.
<b>4. ACERINEÆ.</b>		
<i>Æsculus pavia,</i>	Scarlet flowered buckeye	} I. Nar. acrid.
———— <i>flava,</i>	Sweet buckeye	
———— <i>ohioensis,</i>	Common or foetid buckeye	

*Natural Orders.*      *Common Names.*      *Properties.*

## 5. PAPAVERACEÆ.

<i>Chelidonium majus</i> , Celendine, N.	}	Acrid.
<i>Glaucium luteum</i> , Horned-poppy, N.		
<i>Papaver somniferum</i> , Poppy, Opium plant, N.	}	Narcotic.
<i>Podophyllum peltatum</i> , May-apple, I.		
<i>Sanguinaria canadensis</i> , Puccoon, I.		

## 6. TEREBINTHACEÆ.

<i>Brucea antidysenterica</i> , False angustura, E.	}	Narcotico-acrid.
<i>Rhus radicans</i> , Poison vine,		
— <i>vernix</i> , Poison sumach,	}	I.      Acrid.
— <i>toxicodendron</i> , Poison oak,		
— <i>pumilum</i> , Dwarf sumach,		
<i>Zanthoxylon clava herculis</i> , Toothache tree, I.		Acrid.

## 7. ROSACEÆ.

<i>Amygdalus communis</i> , Bitter almond, E.	}	Narcotic.
<i>Prunus lauro-cerasus</i> , Cherry laurel, E.		
— <i>virginiana</i> , Wild cherry tree, I.		
Most of the species of these two genera, yield Prussic acid.		

## 8. UMBELLIFERÆ.

<i>Ænanthe</i> ? several species, I.		Narcotico-acrid?
<i>Cicuta virosa</i> , Water hemlock, E.	}	Narcotico-acrid.
— <i>maculata</i> , American hemlock, I.		
<i>Conium maculatum</i> , Hemlock, N.		
<i>Ferula virosa</i> , I.		Narcotico-acrid?
<i>Pistinaea sativa</i> , Parsnip, N.		In wet places Acrid.
<i>Sium lineare</i> ,	}	Narcotico-acrid.
— <i>longifolium</i> ,		
— <i>rigidus</i> ,		
Water parsnip, I.		

## 9. RUBIACEÆ.

<i>Cinchona</i> ,	Peruvian bark, E.	Cinchonia & quinia.
<i>Cephealis ipecacuanha</i> , E.	}	Ipecacuanha plants,      Emetin.
<i>Psycotria emetica</i> , E.		
<i>Viola emetica</i> , I.		

## 10. LOBELIACEÆ.

<i>Lobelia inflata</i> , I	}	Acrid.
— <i>syphilitica</i> , I.		

<i>Natural Orders.</i>	<i>Common Names.</i>	<i>Properties.</i>
11. CUCURBITACEÆ.		
<i>Bryonia dioica,</i>	White briony, E.	} Acrid.
<i>Cucumis colocynthis,</i>	Bitter apple, E.	
<i>Momordica elaterium,</i>	Wild cucumber, E.	
12. ERICINEÆ.		
<i>Azalea?</i>	Swamp honey suckle, several species, I.	Acrid?
<i>Kalmia latifolia?</i>	} Calico bush. Am. laurel, I.	} Acrid?
——— <i>angustifolia?</i>		
——— <i>other species,</i>		
<i>Rhododendron crysanthum?</i>	E	} Acrid.
——— <i>maximum?</i>	Mountain laurel, I.	
13. STRICHNEÆ.		
<i>Strichnos nuxvomica,</i>	Nux vomica, E.	} Narcotico-acrid.
——— <i>upas tieute,</i>	Upas tieute, E.	
<i>Ignatia amara,</i>	St. Ignatius bean, E.	
14. APOCINEÆ.		
<i>Apocynum androsatifolium?</i>	} Indian hemp, I.	} Acrid?
——— <i>canabium?</i>		
——— <i>other species,</i>		
<i>Asclepias gigantea?</i>	} Swallow wort, I.	} Acrid?
——— <i>vincetoxicum?</i>		
——— <i>other species,</i>		
<i>Cynanchum?</i>	two or three species, I.	Acrid?
<i>Gelsemium nitidum,</i>	Carolina jessamine, I.	Narcotico-acrid?
15. GENTIANÆ.		
<i>Spigelia marylandica,</i>	Carolina pink, I.	Narcotic.
16. CONVULVULACEÆ.		
<i>Convolvulus scammonia,</i>	Scammony, E.	Acrid.
17. SOLONACEÆ.		
<i>Atropa belladonna,</i>	Deadly nightshade, E.	Narcotico-acrid.
<i>Capsicum annuum,</i>	Red pepper, N.	Acrid.
<i>Datura stamonium,</i>	Jamestown weed, N.	} N. Nar. acrid.
——— <i>tatula,</i>	with blue flowers, other white	
<i>Hyosciamus niger,</i>	Black henbane, N	Narcotic.
<i>Nicotiana tabacum,</i>	Tobacco, I.	Narcotico-acrid.
<i>Solanum nigrum,</i>	and other, I. species, Nightshade,	Narcotic.
——— <i>dulcamara,</i>	Bittersweet, N?	Narcotic.

<i>Natural Orders.</i>	<i>Common Names.</i>	<i>Properties.</i>
18. PERSONATÆ.		
<i>Digitalis purpurea</i> ,	Fox glove, N.	Narcotico-acrid.
19. CHENOPODEÆ.		
<i>Chenopodium anthelminticum</i> ,	Worm seed, I.	Acrid.
<i>Phytolacca decandra</i> ,	Poke, I.	Narcotico-acrid?
20. LAURI.		
<i>Laurus camphora</i> ,	Camphor tree, E.	Narcotico-acrid.
21. THYMELEÆ.		
<i>Daphne mezereum</i> ,	Mezereon,	} E. Acrid.
— <i>gnidium</i> ,	Spurge flex,	
— <i>laureola</i> ,	Spurge laurel,	
22. EUPHORBIÆ.		
<i>Croton tiglium</i> ,		} E. Acrid.
<i>Euphorbia officinarum</i> ,		
— several American species ?		Acrid?
<i>Jatropha manihot</i> ,	Manioc, E.	Acrid.
— <i>stimulosa</i> , I.		Acrid?
<i>Ricinus communis</i> ,	Castor oil plant, N.	Acrid.
23. URTICÆ.		
<i>Antiaris toxicaria</i> ,	Upas antiar, E.	Narcotico-acrid.
<i>Piper nigrum</i> ,	Black pepper, E.	Acrid.
24. AROIDEÆ.		
<i>Arum maculatum</i> ,	Wake robin, E.	} Acrid.
— <i>triphillum</i> ,	Indian turnip, I.	
— <i>dracontium</i> , I.		
25. LILIACEÆ.		
<i>Scilla maritima</i> ,	Squill, E.	Narcotico-acrid.
26. COLCHICACEÆ.		
<i>Colchicum autumnale</i> ,	Meadow safron, E.	} Narcotico-acrid.
<i>Veratrum album</i> ,	White hellebore, E.	
— <i>viride</i> , I.		
27. GRAMINEÆ.		
<i>Lolium temulentum</i> ,	Darnel, E.	Narcotico-acrid.
28. FUNGI.		
<i>Agaricus</i> , several species,	Mushrooms, I.	} Narcotico-acrid.
<i>Secale cornutum</i> ?	Ergot, I.	

# Therapeutic Classification.

OF THE

## GENERA

OF THE PRECEDING TABLE.

*N. B. The Numbers refer to the Natural Orders in that Table.*

### I. ACRID OR IRRITATING POISONS.

1 Aconitum	1 Cimicifuga	12 Kalmia
1 Actea	15 Convolvulus	10 Lobelia
28 Agaricus	22 Croton	11 Momordica
14 Apocynum	11 Cucumis	23 Piper
24 Arum	14 Cynanchum	1 Ranunculus
14 Asclepias	21 Daphne	12 Rhododendron
12 Azalea	28 Ergot	6 Rhus
11 Bryonia	22 Euphorbia	22 Ricinus
17 Capsicum	5 Glaucium	3 Stalagmitis
5 Chelidonium	22 Jatropha	6 Zanthoxylon
19 Chenopodium		

### II. NARCOTICO-ACRID.

4 Æsculus	1 Delphinium	19 Phytolacca
6 Amyris	18 Digitalis	8 Pistinacea
23 Antiaris	8 Ferula	5 Podophyllum
17 Atropa	14 Gelseminum	9 Pscotria
6 Brucea	1 Helleborus	5 Sanguinaria
9 Cephealis	13 Ignatia	25 Scilla
8 Cicuta	20 Laurus	8 Sium
9 Cinchona	27 Lolium	13 Strichnos
26 Colehicum	2 Menispermum	26 Veratrum
8 Conium	17 Nicotiana	9 Viola *
17 Datura	8 Œnanthe	

### III. NARCOTIC.

7 Amygdalus	5 Papaver	17 Solanum
17 Hyosciamus	7 Prunus	15 Sigelia

\* The Plants from which the Indian poisons, Woorara, Ticunas and Curare are manufactured, are not known.

CHEMICAL ARRANGEMENT

OF SUCH

**POISONOUS PLANTS,**

AS HAVE AFFORDED

DELETERIOUS PRINCIPLES BY ANALYSIS.

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1 ACIDS.

Hydrocyanic  
or  
Prussic

} Various species of *Amygdalus* and *Prunus*.

2. ALKALIES.

*Atropia*,  
*Brucia*,  
*Cinchonia*,  
*Daturia*,  
*Delphia*,  
*Emetin*,

*Atropa belladonna*.  
*Brucea antidysenterica*.  
*Cinchona*, several species.\*  
*Datura stramonium*.  
*Delphinium stavisagria*.  
*Cephealis ipecacuanha*, *Psycotria eme-*  
*tica*, *Viola emetica*,

*Hyosciana*,  
*Morphia*,  
*Picrotoxia*,  
*Piperia*,  
*Quinia*,  
*Solania*,  
*Strichnea*,  
*Veratria*,

*Hyosciamus niger*.  
*Papaver somniferum*.  
*Menispermum cocculus*.  
*Piper nigrum*, *Capsicum annum*?  
*Cinchona cordifolia*.  
*Solanum nigrum*.  
*Strichnos nux vomica*.  
*Veratrum album*, *V. viride*, *Colchicum*  
*autumnale*.

3. ACTIVE PRINCIPLES  
of an

*Uncertain Character.*

*Elatin*,  
*Fungin*,  
*Nicotin*,

*Momordica elaterium*.  
*Agaricus*, various species.  
*Nicotiana tabacum*.

\*It is proper to say, that neither *Cinchonia* nor *Quinia* appear to be equally deleterious as the other new alkalies and their Salts.—Magendie has given them in large doses with impunity; and at the same time they are active and efficient medicines in small portions.

## SYMPTOMS

### PRODUCED BY THE VEGETABLE POISONS.

The *Acrid or Irritating* vegetable poisons, like the mineral, excite *Gastritis* with various morbid states of vascular and nervous action.

The prominent symptoms are violent and obstinate vomiting—seldom absent;—in many cases drastic purging, great thirst, dryness and constriction of the throat; pain, anxiety, cramp and oppression in the epigastrium; pulse in some instances full, frequent and hard—in others accelerated, librating, small, and wirelike; great prostration of muscular strength; extreme restlessness; heat of the surface increased, sometimes diminished, especially in the lower extremities; hiccup; swelling of the abdomen; coma, convulsions and death.

When a student of Medicine it unfortunately happened to me, to be the only medical attendant of a family poisoned by eating mushrooms. The patients were a father and three children. The prominent symptoms were gastrodynia, colic and cholera. One child, a boy 6 years old, having eaten a double portion was lost. Four hours after its ingestion I found him labouring under excessive vomiting and purging; with great pain in the stomach and bowels; unquenchable thirst; extreme prostration of strength; cold extremities; imperceptible pulse; slight stupor, from which he was easily aroused and answered vehemently, but without delirium; swelling of the abdomen at length supervened; and, within twelve hours after the accident, death preceded by convulsions and insensibility, put an end to the sufferings of the little patient.

The morbid appearances observed after death from acrid poisoning, are those which attend and succeed to inflammation; such as congestion, gangrene and ulceration, chiefly in the alimentary canal.

The *Narcotico-acrid* poisons excite symptoms indicative of inflammation, complicated with great derangements of the nervous functions. The former are in general less severe than in acrid poisoning; as the presence of a narcotic principle does not permit the developement of an intense phlogistic action. The symptoms in the animal functions are various; but consist chiefly in an epileptic, tetanic or paralytic state of few or many muscles of the body; vertigo, intoxication, delirium, mania, idiotism, dilated pupils, squinting, and disordered or extinct vision; profound stupor and death.

In the poisoning of children by eating the seeds or flowers of stramonium, not an uncommon accident in the Western country, I have several times seen hemiplegia, with spasmodic affections of the opposite side.

Doctor Beardsley of Ohio, was called in 1822 to a family of five persons, who by mistake had drunk a decoction of the seeds of stramonium, mixed with coffee. Eight hours after the accident he found the mother with a soft and slow pulse, moist skin, relaxed and enervated muscular system; dilated pupils, fantastical visual deceptions, and mild insanity. The children had a reeling gait, expanded pupils, disordered vision, and manifested slight mental alienation. They all recovered.

Cattle poisoned by eating the nuts of the *Æsculus ohioensis*, which destroy them by inducing gastritis, are effected with extreme vertigo, accompanied with muscular debility and tremors.

The lesions found after death from the narcotico-acrid poisons, are analogous to those produced by the acrid, but generally less in degree and extent.

All the *Narcotic* poisons do not produce the same symptoms; but a general notion concerning them may be formed from the following summary:—Listlessness, subdued locomotion, blunted sensibility, coma-vigil, frequently profound sleep; spasmodic twitchings; paralysis of the limbs; slow and apoplectic respiration; yawning; full and soft pulse, in most cases preternaturally slow; mild and sometimes furious delirium with signs of great obstruction in the Brainular circulation; dilated pupils, often immoveable; if from opi-

um, itching about the nostrils and upper lip—sometimes over the whole surface of the body; torpor of the alimentary canal, nausea and, occasionally, vomiting; ultimately general convulsions and death.

The parts to which the poison was applied are not found inflamed in those who die. The brain and lungs are generally engorged.

—:o:o:o:o:o:—

## TREATMENT.

No antidotes for the vegetable poisons have yet been discovered. The indications of cure which the diseases excited by them present, are two fold;—1. To cause the expulsion of the poison;—2. To correct its effects.

I. If spontaneous vomiting come on, it should be promoted by mucilaginous diluents; to which saline cathartics or a slight infusion of senna may at length be added, to determine an effect upon the bowels. Should vomiting not take place, which is most likely to be the case from narcotics, administer an emetic of sulphate of zinc, tartarized antimony; or, if it be an acrid poison, ipecacuanha. To promote the operation copious blood letting, even to fainting might be employed: or the sensibilities of the stomach to the medicine increased by the administration of an alkali as practised, by Dr. Brown in 1801: or, a resort might be had to the stomach tube and syringe, as suggested a century ago by Boerhaave of Leyden; proposed *de novo*, by Doctor Monro of Edinburg; employed by M. Renault of Paris; used and publickly recommended by our able countryman Professor Physic, of Philadelphia; and lately re-invented by Mr. Jukes of London. The insensibility attendant on those cases, in which vomiting is with difficulty excited, must render the introduction of the tube an easy operation. Finally, when solid substances have been swallowed which cannot be pumped out; or insurmountable obstacles oppose themselves to the use of the catheter, a grain of tartarized antimony dissolved in two ounces of warm water should be slowly injected into a vein, and could scarcely fail to excite speedy vomiting.

It is best always to evacuate the contents of the stomach before the administration of purgatives. Of these, for acrid poisoning, calomel with small doses of opium, alternated with oleum ricini, should be preferred. In narcotic poisoning the stimulating and drastic cathartics are most efficient.

Injections under all circumstances requiring purgatives, will be proper.

II. As the effects of the vegetable poisons are various, the means of correcting them must differ.

### BLOOD LETTING.

The gastritis produced by the irritating and narcotico-acrid, requires copious blood letting from the arm; and from the epigastrium by means of cups or leeches.

The narcotic poisons render venesection necessary, to relieve the brain, spinal marrow, heart and lungs from fatal congestions. In 1801 Professor Rush published several cases of its efficacy in promptly removing all the symptoms produced by opium; and many others have employed it with equal success. It is best adapted to cases attended with full and slow pulse.

### COLD AFFUSION.

This application seems not to have been tried in acrid poisoning, and is perhaps contra-indicated: in narcotico-acrid, it might undoubtedly be useful; in narcotic it has unquestionably done much good; examples of which have been published by Porta of Rome, Mr. Wray of England, and Doctors Jackson, Cross and others in the United States—in the chronological order in which they are here named. Very cold water should be suddenly and repeatedly aspersed upon the patient; and, in imitation of the Italian practitioner, injected into the rectum.

### HOT WATER.

What would be the effect, in acrid poisoning, of large draughts of water as hot as it could be safely swallowed, before gastric inflammation had supervened? At the same time would not a general hot bath contribute to allay the fatal irritation excited by the poison in the vascular, ner-

vous and muscular systems? In poisoning attended with great stupor, the alternate aspersion of hot with cold water might give additional efficacy to the latter, in awakening the sensibilities of the system. To the warm bath alone Professor Chapman has lately directed the attention of the Faculty, by refering to a case of narcotic poisoning in which it was beneficial.

#### EXTERNAL IRRITATION.—LOCOMOTIVE EXERTION.

In acrid poisoning, sinapisms, blisters and hot diluted nitric acid, applied to the epigastrium, might do much good, by lessening irritation and inflammation within. In narcotico-acrid, and especially narcotic poisoning, extensive cutaneous irritation may accomplish much. Rough frictions, switching, and urtication, or whipping with nettles, have long been practised; and authentic reports of their efficacy are scattered through the records of the profession.

Placing the patient on his feet, and compelling him to locomotion, a variety of the same treatment, has been found beneficial. A part of the advantage in this case doubtless comes from the erect position, which lessens the volume of blood in the vessels of the head.

#### GALVANISM AND ELECTRICITY.

When the functions of the nervous system are deeply impaired from the narcotic poisons, after proper depletion it can scarcely be doubted that Galvanism, which has been recommended, would do good. The currents should be passed from the occiput to the epigastric centre, in the direction of the pneumogastric nerves. Gentle shocks through the same parts, from an electrical machine, might perhaps answer equally well.

#### THE ALKALIES.

Nearly a century since Dr. Mead recommended spirit of hartshorne for poisoning by distilled laurel water; and at the present time it is regarded as the most valuable means of counteracting the morbid effects of prussic acid. It may do good in other narcotic poisoning. As a prompt and diffusible stimulant, it must in many cases be useful.

But it would appear that both the fixed and volatile alkalies have in some degree the power of reviving the sensibilities of the stomach when scathed by the presence of deleterious substances. Moreover, it appears that potash, soda and ammonia, have the power of displacing all the newly discovered poisonous alkalies from their union with acids; and as those new bodies appear to be in general less soluble than the salts which they contribute to form, they may likewise be less deleterious than those salts. In this way in part, we may perhaps explain the alledged efficacy of the carbonated alkalies, in diminishing the active properties of opium. The influence of ammonia, in counteracting the effects of prussic acid, must, however, be referred to some other *modus operandi*.

#### ACIDS.

Vinegar and the acids generally are injurious in the diseases produced by the acrid poisons, from irritating the stomach still further; and, in both the acrid and narcotic, they may act upon the poisonous alkaline principles, and form with them more soluble and virulent salts, than those already existing, in the vegetables taken. In narcotic poisoning, *after* full evacuation of the contents of the stomach, diluted vinegar, according to Dr. Orfila, is of unquestionable utility; but before such evacuation it should be prohibited.

#### COFFEE.

Strong coffee has much reputation in the treatment of narcotic and narcotico-acrid poisoning. It may be given, both before, and after the expulsion of the poison. It appears to act on the system of the *patient* rather than on the *poison*. It will probably be beneficial in proportion to the absence of gastritis; and the presence of a severe lesion of the nervous functions.

#### OIL OF TURPENTINE.—SULPHURIC ETHER.

These medicines, especially the former, have been strongly recommended in poisoning from prussic acid. They might be useful in all cases of narcotic poisoning where active stimulants are required. It is worthy of remark, that one of the popular remedies in the Western Country,

for the poisoning of cattle by *buckeyes*, is the application of turpentine to the head of the animal.

### CALOMEL AND OPIUM.

From the known efficacy of this combination in cholera and certain stages of gastritis, would not large doses be serviceable in acrid and narcotico-acrid poisoning? A compound pre-eminent in allaying irritation, and lessening sub-acute mucous inflammation of the stomach and bowels, from ordinary causes, would seem well adapted to the states which follow the ingestion of irritating poisons.

### FEWILLEA CORDIFOLIA.

This plant, a native of the West-Indies and Colombia, where it is denominated *habilla*, has long been regarded as an antidote to the poison of venomous reptiles. Recently, M. Drapiez, of the continent of Europe, has made with it a series of experiments on dogs, to which he had given large doses of *rhus toxicodendron*, hemlock and *nux vomica*: they all recovered in a short time; while others to whom equal portions of poison were administered, without the *habilla*, all died. He concludes, therefore, that it is a real antidote; but further experiments are evidently required.

—:o:o:—

I cannot conclude this hasty Note to the Toxicological Table of Dr. De Salle, translated in equal haste, without recommending to the class the new *ELEMENTS OF MEDICAL JURISPRUDENCE*, of our countrymen Dr. Beck; of which the least I can in justice say, is, that it should be in the hands of every medical gentleman.

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### ERRATA.

Page 28, line 8 from bottom—Read 'action of' before 'ammonia.'  
 47, in the 3d line of the note—Read 'addition of a few' after 'subsequent.'