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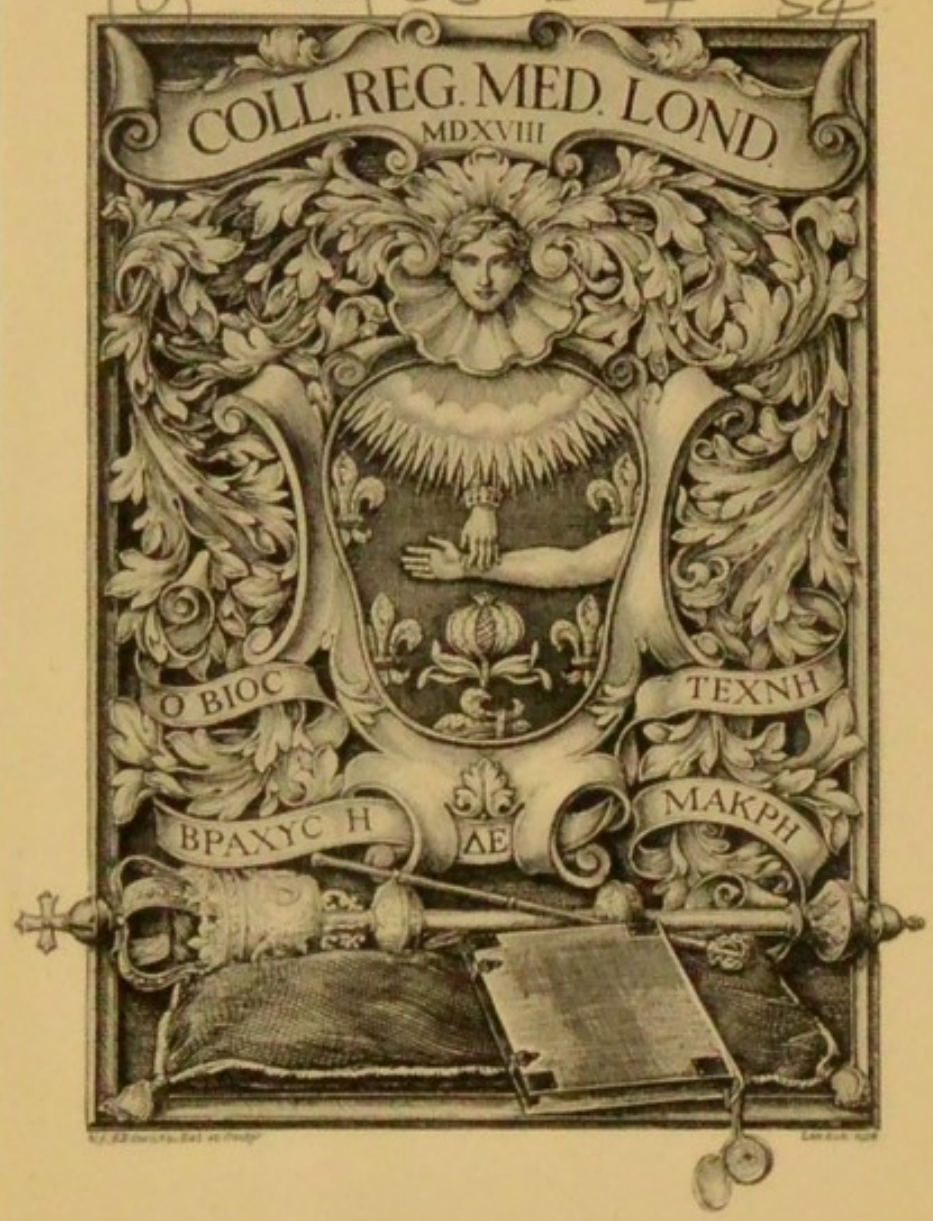

Cairns Coll

67/37
B9

In drainage lakes & soft
carbonate of soda is formed by the
limestone rocks decomposing the
of soda — effect of quantity —

Sulphate of N in soil — traces
in water — & largely from sulphuric
to form sulphate of N from the
muriate of soda — & heat —

to obtain pure N or its O to
caustic lime or O to of N —

fluorides and chlorides, more soluble

phosphorescence of flame when
destroyed by heat — destroyed by
electricity

by heat
cool

Thompsons history of Chemistry.
Griffin & Hodgkin.

A

SYLLABUS

OF

A COURSE

OF

CHEMICAL LECTURES.

BY

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1825

OBJECTS OF CHEMISTRY

DIVIDED INTO

Forming A

Forming Alkalies.

Forming Earths.

Forming Oxides.

Malleable Metals.

Metallic Combustible bases.

	Art.
Platina	159
Palladium	165
Rhodium	170
Iridium	173
Osmium	175
Gold	179
Silver	184
Mercury	189
Copper	194
Iron	199
Lead	204
Tin	209
Zinc	214
Cadmium	219
Nickel	223

Brittle and easily fused Metals.

Bismuth	227
Antimony	232
Tellurium	237
Arsenic	241

Brittle and difficultly fused Metals.

Cobalt	247
Manganese	252
Chromium	257
Molybdenum	262
Uranium	265
Tungsten	269
Titanium	272
Columbium	275
Cerium	278

Vegetable Substances.

Ternary Compounds of	Carbon .. Hydrogen Oxygen ..	in excess with	Oxygen & Hydrogen,	Gums, &c. 286, &c.
			Oxygen & Carbon,	Oils, &c....293, &c.
			Hydrogen & Carbon,	Acids, &c. 305, &c.

Animal Substances.

Quaternary Compounds of	Oxygen, Hydrogen, Carbon, Nitrogen	..... 332—352.

It is a very secret Science, for none almost can understand the language of it. Sublimation, Almigation, Calcination, Rubification, Encorporation, Circination, Sementation, Albification, and Frementation. With as many termes unpossible to be uttered, as the Arte to bee compassed.

John Lilly's Gallathea.

The new nomenclature of Chemistry seems to furnish a striking illustration, of the effect of appropriate and well defined expressions, in aiding the intellectual powers.

Dugald Stewart.

Complexity almost always belongs to the early epochs of every Science.——The more the phenomena of the Universe are studied, the more distinct their connection appears, the more simple their causes, the more magnificent their design, and the more wonderful the wisdom and power of their Author.

Sir H. Davy.

Chemistry - the Science which ...
knowledge of the elementary particles
matter, and investigates the laws which
govern them in their state of separation or
their and in combination, and their resulting
products.

Mechanical Philosophy differs from
Chemical - former considers masses
of matter acting at sensible distances.
latter - the action of integral particles.

Attraction acting at perceptible distances
Gravitation, electricity, magnetism -
Electro-magnetism

Analysis & Synthesis

Analysis the process by which bodies
are resolved into their constituent or
elementary Particles - Synthesis -
by w[hich] the original substances are
reproduced by the combination of
their elements.

Difficulties in analysis - energetic
combinations, minute quantities &

hypotheses, modified by some prin-
ciple

Original division of substances
into combustible and supporters
of combustion -

Oxygen supporter of combustion
and animal life

+ Principle compounds w' oxygen
en, alkalis, acids, earths, oxids

Distinction between ultimate com-
bination of animal and veget[e] subs
tances containing nitrogen.

+ Oxygen - name incorrect - forms w[h]
different bases acids and alkalies -
phosphorus burned in oxygen gives rise
to acid. Potassium in do, alkali - ter
for both sorts of violets.

Oxides possess neither acid nor alkalin
properties.

the attraction of cohesion [illegible]

It be understood that force or power
which particles or atoms of matter
the same kind attract each other, the
by effect of this attraction being an aggre
ate or mass

The attraction of cohesion counteracted or
odified by heat and chemical affinity or solution
cohesion is most strongly exerted in solids
liquids it acts in considerably less energy
d in aeriform bodies it have no evidence
that it exists at all, for their particles a
mutually repulsive and if not held toget
pressure to a great distance. the force of
s attraction differs not only in different bod
t in different states of the same body. Th
the cohesion of steel, important changes
e produced by the rate of cooling, by heat
ater and mercury will also illustrate this

* Solution is the result of an affinity b
tween the fluid and the solid acted upon
the affinity of the fluid overcoming the coh
of the solid. this force continues to act
tile overbalanced (?) by the cohesion of the
olid and the solution cannot be carried
further. this point is called saturation
if at this period heat be applied, the cohes
attraction is still further overcome in the solid

these instances upon cooling. The forces are
reversed and the balance again restored by
the action of cohesion. See 3. a

With respect to common salt, water
acquires no increase of its solvent power
by the application of heat. so to obtain crystals
in these cases it is necessary to expel a portion
of the fluid by heat. This constitutes the
process of evaporation. See 3. b.

The quantity of water of crystallization varies
in different salts, but exists in each in an
definite proportion. bearing in the same salt the
same ratio to the solid saline matter. in some
it is so abundant as to liquefy them on the
application of heat; producing watery fusion — also
3. c
* It is retained also in different salts with
different degrees of force. — some attract more from
the atmosphere see 3. d and e.

Crystals contain water hydrometrically. — except
owing to conversion of water contained between
their lamina into steam.

* Muriate of Lime and magnesia are deliquescent
salts. if muriate of soda deliquesce it contains
muriate of magnesia.

4 a. Vibrations caused by sudden contact
of atmosphere &c. Elevation of temperature
during sudden crystalization shewn. by immersing them

A

SYLLABUS,

&c.

INTRODUCTION.

1. **Distinction** between Mechanical and Chemical philosophy: definition and objects of Chemistry: analysis and synthesis. General view of elementary substances; different principles of classification; arrangement for Lectures, and reasons for adopting it.

ATTRACTION.

2. *Attraction of Cohesion:* counteracted by heat and solution.

3. *Crystallization:* a by reduction of temperature; b by evaporation: c water of crystallization; d effloresence; e deliquescence, &c.

4. a Circumstances which affect the formation of crystals; b different susceptibilities of crys-

tallization in different salts; application to chemical analysis; pseudomorphous crystals.

5. *History of Crystallography*: analysis and synthesis of the structure of crystals: theory of Haüy: primary and secondary forms: hypothesis of spheroidal particles: Goniometers.

6. *Chemical Attraction*: distinguished from the attraction of cohesion: the results of its action, condensation, change of temperature: its application to the analysis and synthesis of substances.

7. Relative forces of Affinity: simple: compound: tables of affinity: modifications in their practical use.

8. Limits of chemical attraction, as to the proportions and number of combining substances: opinions of Berthollet on determinate proportions: Richter's law of the mutual decomposition of Salts.

9. *Theory of Atoms*: of volumes: equivalents: Wollaston's scale.

10. *Chemical Apparatus*: names and uses: modern improvements in experimental chemistry.

med during evaporation while fluid
pear till after fluid has cooled. See 4. b &c.

Haüy was led to his theory of crystalization
Assuming the accidental cleavings of an
ix sided prism of carbonate of lime. by
peeting he reduced the same to rhomb.
the same manner the rhomboidal dodeca
edron may be reduced to the cube.
Crystals reducible to six primitive forms
in. parallellopipedon including cube & rhomb
tetrahedron, octahedron, regular hexahedral
prism, dodecahedron with equal and simi
rhomboidal planes, dodecahedron with triangul
planes. &c. Dr Wollaston has suggested that of
the elementary particles are perfect spheres
they will give rise to the octahedron, tetrahedr
and acute rhomboid and cube - if if ob
spheroids, to the regular rhomboid, and globu
to these six sided prisms.

Chemical attraction elective - Object of chem
try to find the order of these. differs from
mere cohesion in being permanent - instance
magnesia in water - chemical affinity. Prod
by intervention of third body as acid. b. diff
from cohesion in being exerted between dissim
particles. c. condensation generally accompanies
chemical union i.e. specific gravity of com
pound is greater than that mean of its elem
ts. a general rule increase of temperature a

precipt^n by metals – instances of simple
affinity – decomp^n of nitrate of Silver by sea
muriate of lime by potash, nitrate of copper
by iron – method used largely in arts –
copper obtained fr. shavings of mines by soak
ing old iron in them. Decomp^n in dry
way – if cinnabar and iron filings be
heated together mercury distilles over –
this method largely used in arts.
Double affinity – sulphate of soda and nitr
of lead or lime – instance of decomposition
by a gas – sulphuretted hydrogen.

calorie may be increased
cohesive Attraction, and as concurring with
increasing elasticity.

Fire or uncombined calorie / calorie of temperature
capable of exciting the sensation of heat, and
producing expansion in other bodies.

By the term temperature we are to understand
the state of a body relatively to its power of ex
ting the sensation of heat and of producing
expansion. — The degree of expansion produced
calorie bears a sufficient proportion to its quan
affords a means of ascertaining the latter with
tolerable accuracy — Thermometer or otherwise a
measure of quantity of calorie as ascertaining amount of
one of its principal effects —

The expansion of bodies is an almost universal
effects of an increase of temperature.

By the equilibrium of heat is meant the
tendency which bodies of different temperature
have to assume a common temperature.

Experiments of Petit & Dulong find that when
that unequal degrees of expansion are produc
in a bar of metal by a succession of similar
increments of heat the rate of expansion
increasing with the temperature.

Exceptions to the law of expansion by heat
and contraction by cold are found in water
some metals as cast iron bismuth & antimon
and the terms salts in the act of crystalizing

Solid bodies convey heat in all directions — The
power differs however materially in different bod
Porous substances are very bad conductors of heat

[illegible] of propagation of Heat by radiation first accurately
Disproved by Leslie
assumed by Leslie

Theory of Leslie that elastic fluids by their pulsa-
tions are the media of ~~communication~~ the
projection or radiation of heat — disproved
by experiments of Dulong & Petit and Mr. Berg
which show that effects of radiation are three
times greater in vacuo than in air. See also +82

Invisible radiant heat, in some circumstances, passes
directly thro' glass, in a quantity so much greater
relative to the whole radiation as the temperature
of the source of heat is more elevated.

Calorific rays which have already passed thro'
a screen of glass experience in passing thro' a
second do. a much smaller diminution of intensity

Dr Delaroche.

CALORIC.

11. *Free Caloric:* the effects of caloric opposed to those of attraction: expansion: fluidity: evaporisation.

12. Equilibrium of heat: Thermometers of air, alcohol, mercury: Pyrometers: principles of graduation: nature and limits of the information derived from them.

13. Law of expansion in solids, fluids, airs; experiments of Dulong and Petit: exception in water; its beneficial effects and probable cause.

14. Diffusion of heat by contact: different conducting power of solids; its application: conducting power of fluids, of airs; effects in preserving equability of temperature.

15. Diffusion of heat by radiation: reflexion and refraction of heat: effect of different surfaces on radiation and absorption: practical application: differential Thermometer: apparent radiation of cold: Ethrioscope.

16. *Specific Caloric:* specific heat of different bodies: distinguished from absolute heat:

comparative: modes of ascertaining: affected by condensation and rarefaction.

17. Specific heat of the same body in different forms: discoveries of Dr. Black: latent heat of solids, fluids, airs: affected by pressure: estimate of the elastic force of vapours: application of Steam to mechanical purposes.

18. Absorption of heat by liquefaction of salts: transfer of heat by evaporation, of ether, of water: discovery of Leslie: Cryophorus.

19. Evolution of heat by the crystallization of salts; by chemical combination: application of the doctrine of latent heat to natural phenomena and artificial processes.

20. The nature and sources of heat: theory of combined caloric; of vibrations: heat by friction and percussion, how explained: attempts to ascertain the weight and absolute zero of heat.

LIGHT.

21. Solar light separated into heating, illuminating and deoxidizing rays: experiment of Morrichini.

22. Analogies of heat and light: Photometers:

The latent heat of bodies increases as their density diminishes — see × 186.

According to the experiments of Dr Black 810° was the latent heat of steam. It is now however estimated at about 1000°.

The latent heat of steam may be ascertained by mixing equal proportions of steam & water at 212 with equal quantities of water of a given temperature and ascertaining the resulting diff

The latent heat of steam will be found to be greater in proportion as the temp. of the water from which it is obtained is lower — the sum of the two being constant quantities.

In general liquids boil in vacuo with about 1 less of heat than are required under a mean pressure of the atmosphere water therefore in a vacuum must boil at 88° and alcohol at

According to Dr ~~hott~~ water by conversion into steam has its bulk enlarged about 1800 times

The relative expansive forces of vapours may be measured in a barometer tube filled with mercury — steam equal to 30 inches.

Water at 32 gives some evaporation in vacuo — at 212 exactly counter balances weight of atmosphere

Muriate of lime and new fallen snow will produce −50° Fahr.

Upon the rapidity of the transfer of heat during the liquefaction of salts depends the efficacy of freezing mixtures — Freg. mix. nitre & muriate ammonia. S Ca & L p — Dilute [illegible] L & S

The degree of cold produced will be found to be materially influenced by their water of crystal.n If glaubers salt have effloresced heat instead of cold will be produced during solution.

Water may be frozen in vacuo by the boiling of ether in consequence of rapid absorption of heat by latter

striking illustration of [illegible]
ion is afforded by the action of the on a mixture of
ride of Potash & sugar.

---

ys - according to Herschell the greatest illumin
ing power is in the yellow ray.
the greatest heat will be found in the red ray
xt to green: and in diminishing progression
ow to violet. If the Thermometer however
removed out of the spectrum it will be
und to rise considerably for half an inch beyon
e red.
Considerable differences in the results of these
experiments are produced by the nature of the
edium by which the light is decomposed -
Beyond the violet ray thermometer is not affected.
The power of the deoxidizing rays diminishes
radually from violet rays to red the greatest
ower is beyond violet -
Hence it appears that the solar beam consists o
three distinct kinds of rays, viz those that excit
eat & promote oxidation, illuminating rays,
nd deoxidizing or hydrogenating rays
In the rays beyond the red extreme phosphorus
ated, smokes and emits white fumes; but the
e presently suppressed on exposing it to the d
idizing rays. See + 159. & 158.
It has been asserted by Morichini (see 21) that
the violet rays have a magnetizing power, and
are capable of reversing the poles
e needle already magnetic

a fact has been ascertained by D Delaroche which se[ems]
to point out a close connex^n between heat & light.
The rays of invisible heat pass thro' glass w^h dif-
ficulty at below 212° but traverse it w^h facility
always increasing w^h temperature, as it approaches
the point when bodies become luminous.

Bodies giving light w^out heat. Phosphorus
glow worms &c &c by diamond exposed to sun by Du
Fay became phosph^ent — see + 160 — fish —
the teeth gum tragacanth made into tubes & heated
in furnace — Canton's & Bolognian phosphorus
oyster shells & sulphur — retain prop some
— Light by attrition exhibited by 2 pieces of
borax or quartz.

When phosphori have lost their power it
may be restored by passing electricity thro' them
others by increasing temperature.

Some bodies only shine at high temp — as
fluate of lime — a variety call'd chlorophane —

Photometers — C. Rumfords see + 161. —
Leslie.

Many of the gases have been reduced to a
fluid state by pressure — as for instance as
Carbonic acid (36 atmosph.) and it is probable
that all might be so reduced if their tem-
perature could be sufficiently lowered or compress[ion]
applied — Gases therefore cannot be distin-
guished from vapours. Gases enlarge about
1/480th part of their bulk for each degree Fahr.

-nerally speaking substances w^d burn at a low temp^r.
-ld separate ox^{n} most perfectly from atmosphere
-ine phosphorus wile burn i air in w^h latter has gon
-ther consumed oxygen entirely -

sulphur & iron filings - liquid sulphuret of potash
-bsorb [illegible] by water.

In weighing gases they should be perfectly dry.

evolution of light by phosphorescence, attrition, chemical combination.

23. Polarisation of light by Refraction, through Iceland Spar, Tourmaline, Glass: law by Dr. Brewster.

24. Polarisation by Reflection: discovery by Malus: polarising plate: analysing plate: depolarising substances, natural and artificial: law of the polarising angle.

25. Application of polarised light to Crystallography.

ATMOSPHERIC AIR,

And its ELEMENTS.

26. Nature and general properties of aeriform substances: distinction of vapours and gases erroneous: apparatus and modes of manipulation for the gases.

27. *Atmospheric air,* not elementary; composed of indivisible particles; its constitution and general properties; Barometrical Thermometer.

28. Analysis of the air by Eudiometers; separation of Carbonic acid; tests of aqueous

vapour by Hygrometers; theories of the formation of Rain and Dew.

29. *Nitrogen* (14) obtained by the decomposition of atmospheric air; by other processes; its general and distinctive properties and combinations; opinions as to its composition.

30. *Oxygen* (8); the discovery of it; different modes of procuring; general properties; power in supporting animal life and combustion; tendency to combination; nomenclature of its compounds; not the sole cause of acidity; its electrical relations.

31. *Theories of Combustion*, by Stahl, Lavoisier, Davy; evolution of heat and light, how accounted for.

WATER AND ITS BASE.

32. Properties of Water; compressibility; crystallization; absorbability of gases; tests of its impurities; erroneous opinions of its nature; its chemical combinations, hydrates.

33. *Water* (9), decomposed by different processes; effects of the discovery on Chemical Science.

34. Synthesis of water by Priestley and Cavendish;

at the same temperature ...
erent gases give up the same quantity of water
to deliquescent salts. — This water has been c
hygrometric water.
Absorbent bodies act as dry ...

If two currents of air meet at different temperatures the resulting temperature will be below the mean, consequently if they contain moisture it will be deposited in the form of rain.

Purest oxygen from chlorate (oxymuri) of potash — should be obtained in greenglass retort — red precipitate (peroxide of mer) used by Lavoisier to ... — oxide of mercury — nitrate of potash w. heat —
Oxygen from manganese sometimes cont. C— from carbonate of lime in ore —
Oxygen enters largely into substances used in the arts —
Oxygen not necessary to acidity — hydro... organic acid & sulphuretted hydrogen
... should be washed w. dilute ... or ... and then with distilled water.
100 cubic inches weigh 33 grs.
Refracts rays of light less than any other gas

ydrogen from [illegible]

ith alcohol

t – remains permanent over water – is not alter
y intense heat or electric discharges – refrac
ight more powerfully than any other gas
is inflammable but extinguishes burning
bodies – is fatal to animals – is the light
of all elastic fluids – modifies sound
Ascending force of Hydn on balloons is as cube
of diameter – descending force of balloon as the
square – in larger balloons former increases
much more rapidly than latter –

Difficult to obtain hydrogen free from
watery vapour – giving rise to ana
rigorous results in obtaining specific g
– oxygen 16 to 1 hydrogen –

The flame of hydrogen in ox. – when perfe
pure – though giving intense heat af
scarcely any light – quantity of
light depending on impurities in hyd

Alcohol contains great quantity of
hydrogen – flame of spirit lamp w
jet of oxygen fuse watch spring &c

Dr Clarke's blowpipe heat from com
pression of air producing most rapid
therefore most intense ignition –
of safety valve besides
which bubbles through water or oi

experiments of the French Chemists; ambiguous results, how avoided.

35. *Hydrogen* (1); modes of obtaining it; impurities; general and distinctive properties; inflammability; tenuity; levity; balloons; effects in the production and propagation of sounds; chemical affinities; natural sources.

36. *Deutoxide of Hydrogen* (17); discovered by Thenard; its properties.

ALKALIES,

Their BASES *and* COMBINATIONS.

37. Classification and distinguishing properties of Alkalies; their affinities.

AMMONIA.

38. Preparation of Ammonia; its general and peculiar properties; aeriform, absorbable by Water; modes of examining; comparative affinity to acids.

39. *Ammonia* (17) analysed in part by Priestley and Scheele; analysis completed by Berthollet; effects of metals in promoting the decomposition.

40. Synthesis of Ammonia, by Milner and Higgins; natural causes of its formation; anomalous experiment of Berzelius.

POTASSA.

41. Practical preparation and purification of Potash; its properties and combinations; mineral sources.

42. *Potassium* (40), the base of Potassa; its discovery; process for obtaining it; its nature and properties; affinity for oxygen; utility in Chemical research.

43. Synthesis of Potassa; protoxide of Potassium (48); hydrate of Potassa (57); peroxide of Potassium (64).

44. Compounds of Potassium with Hydrogen.

SODA.

45. Preparation of Soda; its properties and combinations; how distinguished from Potash; native; mineral sources.

46. *Sodium* (24), the base of Soda; its formation and distinctive properties.

47. Synthesis of Soda; protoxide of Sodium (32);

ashes of herbs generally give more
potash than trees — charcoal
however will give considerable
quantity —

Sir H Davy obtained potassium
by decomp of potash by galvanic
action. — by French chemists
potassium at high temperature
volatile — decomp of pot in gun
barrel w iron filings — unites a iron potassium
sublimes into cold part of barrel
decompose water by potassium in mercury
trough & collect hydrogen & ...
previously weigh potassium — thus
synthesis of potassa

Potassa perfectly pure and free from
water — absorbs oxygen when heated in
air and is converted into an orange col
peroxide — when thrown into water oxygen
is evolved and it passes into the state
of protoxide —

Properties of potassa — intensely acrid taste
destroys animal texture & vegetable substance
changes veg blues green — neutralises acids w
out effervescence — renders oils miscible
with water, & dissolves resin —

[W]here an alkali was found in analysing [s]ubstances it was always considered either [p]otash or soda the discovery of lithia [h]owever has rendered the accuracy of such [ex]periments doubtful.—

Sodium when ~~heated wh fusee~~ fused [w]ith dry soda robs latter of part of its oxygen [a] dark brown fluid results, becoming a [gr]ey solid on cooling (doubtful whether a [c]ompound of soda w^t^ oxygen or merely [m]ixture of metal w^t^ soda) this substance [c]apable of abstracting oxygen from air & [w]ater & forming soda

Lithia discovered in ~~Lepidolite~~ Petalite. [i]n prop. of 5 per cent. in Spodumine 8 per [c]ent so scarce as former) in crystallized Lepidolite 4 per cent.

To obtain lithia fuse the mineral pulver[ised w^th^] carbonate of potash.— dissolve mass in [...] [e]vaporate & dissolve muriate of lithia in alcoh[ol] repeat the process to purify it & digest [with] carbonate of silver — & decomp. solution. [...] carbonate by lime or baryta.—

[illegible]
pable of decomposing & - holds
very loosely - instance alcohol

The nitrates are ~~not~~ /generally
speaking/ decomposed by heat -
& difficult to detect because
~~for~~ does not form insoluble
precip. -
test - paper dipped in solut
of nitrates deflagrates -
boil gold leaf & addition of [illegible]

hydrate of Soda (41); peroxide of Sodium (36).

48. Compound of Sodium and Nitrogen.

LITHIA.

49. Discovery of Lithia; its analogy with Potash and Soda; how distinguished; its sources.

50. *Lithium* (10); *Lithia* (18); *Analysis and Synthesis.*

ACIDS.

Their BASES *and* COMBINATIONS.

51. Enumeration of the simple acidifiable bases; their general and distinctive characters and combinations.

52. General properties of Acids: their composition, classification and nomenclature.

53. The nature and nomenclature of their combinations.

NITRIC ACID.

54. Process for procuring liquid Nitric acid; purification and properties; tests; susceptibility of decomposition.

55. *Nitrous oxide* (22); preparation; composition and decomposition; general properties; effects in combustion and on the animal system.

56. *Nitric oxide* (30); preparation; qualities; attraction for oxygen; decomposition.

57. *Hyponitrous acid* (38); formation; combination with Sulphuric acid.

58. *Nitrous acid* (46); formation and properties; combination with water.

59. *Nitric acid* (54); formation and properties; synthesis by Cavendish; analysis.

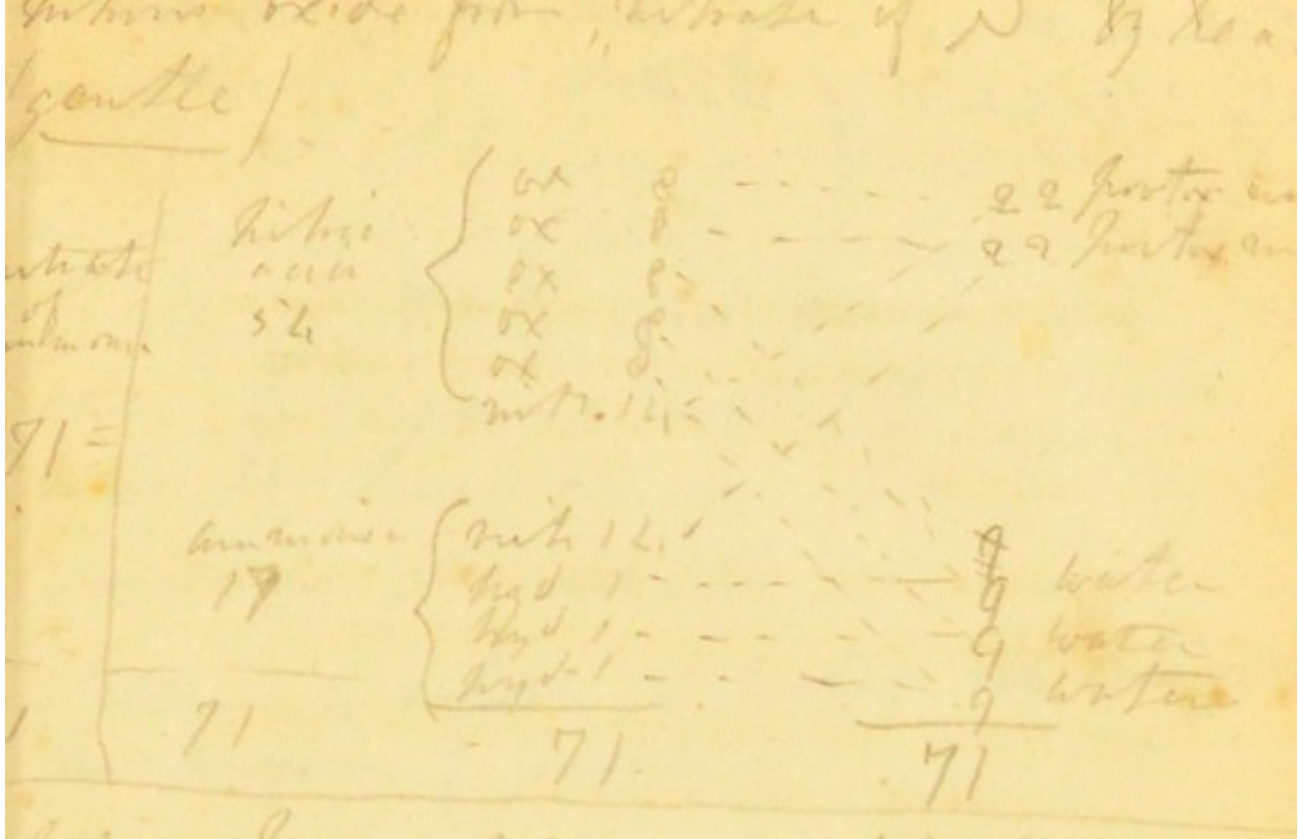
60. *Nitrate of Ammonia* (71); formation and properties.

61. *Nitrate of Potash* (102); composition; natural and artificial formation; properties and uses.

62. *Nitrates of Soda and Lithia* (86) and (72); their formation and composition.

SULPHURIC ACID.

63. *Sulphur* (16); properties and sources; compounds with alkaline bases.



ponitous acid obtained by destructive
stillation of Lead –

is solution (of seleniuretted hydrogen) (see overleaf) precipitates al
metallic solutions when neutral. – from
ap prods [illegible] and of catarrh &c its solu
acid.

64. *Sulphureted Hydrogen* (17); formation and general characters; tests; acid properties; combinations and uses in analysis; decomposition.

65. Compounds of sulphur and hydrogen, with alkaline bases.

66. *Sulphuric acid* (40); liquid (49); formation and properties; purifications; tests; decomposition.

67. *Sulphates* of Ammonia (57); Potash (88); Soda (72); Lithia (58); their composition, properties and uses.

68. *Sulphurous acid* (32); preparation; form and properties; compound with nitric oxide; tests and uses; decomposition.

69. Compounds of sulphurous acid with alkaline bases.

70. *Hyposulphurous and Hyposulphuric* acids (24) and (32); their composition.

SELENIC ACID.

71. *Selenium* (41)? discovery by Berzelius; peculiar properties and tests; opinions as to its nature.

72. *Selenic acid* (57); Selenic oxide; Seleniates; Selenurets; their composition and properties.

CARBONIC ACID.

73. *Carbon* (6); preparation and general properties, and uses; power in absorbing gases and moisture; conjecture by Newton and verification by Tennant, of the nature of the diamond.

74. *Cyanogen* (26); discovery by Gay Lussac; preparation and qualities.

75. *Hydro-cyanic acid* (27); formation; properties and combinations with alkalies; uses in analysis.

76. *Carbureted Hydrogen* (8); natural and artificial formation and properties.

77. *Bi-carbureted hydrogen* (7); preparation and decomposition.

78. *Sulphuret of Carbon* (38); formation and properties; power in producing cold; decomposition.

79. *Carbonic acid* (22); formation and peculiar properties; sources and natural decomposition; tests; analysis.

rbonic oxide may be obtained of heating
arcoal mixed w^d the oxide of almost any
etal – zinc, lead, manganese, iron &c
hould always be washed w^d lime water
. Properties – Properties – has offensiv
ell – is lighter than common air –
inflammable w^h blue flame
When mixed w^d ~~more than~~ half its volume of oxy
a exposed to temp 300° in contact w^t
spongy platinum – converted into C
is sparingly soluble in water, fatal
nimal life.
Carbonic acid – prod from alkaline carb
by burning C in – – generated
during fermentation – analysis.
~~by Simpsons~~
alysis of
Carbonic ~~oxide~~ ~~obtained~~ by passing stre
of over ignited charcoal – carbonic oxid
formed.
Carbonic oxide / mixed however with C
which may be seperated by lime water
or ~~carbon~~ caustic potash / obtained
by distilling binoxalate of potash
n C –
Carbonic oxide analyzed by potassi
carbon set free & potassa formed

Phosphorus does not readily combine w oxygen under ordinary pressure at common temperature
unless previous dissolved in / ,
Phosphorus first obtained from urine by evaporating & distilling w charcoal - by Scheele from bones calcined - phosphate of lime remains w is decomposed by " * super phosphoric a obtained - w evaporated & fused gives glacial phosphoric acid - from this phosphorus obt by distillation w powdered charcoal - *
applic to eudiometry from powr of absorb
— —
Phosphuret of lime - formation by distilling phos. thro tube containing powdered marble - C - is also decomposed & phos acid form & C deposited - obtained otherwise decompo - water - form d phosphuretted
When phosphorus is heated in highly rar air three substances are formed - phosp acid - a volatile white substance w app to be phosphorous acid & a red solid w probably an oxide - w when thrown i inflames

* purified by pressing thro chamois lea

hosphate of soda when fresh pros ca
itrate of silver red precip – when kep
r any time yellow – jaw –

e phosphuretted hyd – by distilling
hus – in caustic potash – or from phos
huret of lime & [illegible] – – (if allowe
stand over water proto ph. hyd – obtain
fr. ◠ & zinc filings & dilute [illegible]
the red oxide of ◠ inflames when thrown
into ⊥.

Insert

Phosphoric acid obtained by decomp of [illegible]
by phosphorus* – this when evap.d to
dryness & fused gives glacial phosph
in retort – substance remaining is phos.c ac
& ◠ [illegible] ⊥ both & may be expelled by heat
from 1 of ⊥ of water

Phosphorous acid by subliming phosph
thro' corrosive sublimate & mixing produ
& water & evaporating to syrup – cry
on cooling – this when heated out of c
... acid formed by decomp of w

80. *Carbonates and bi-carbonates* of Ammonia (39 and 61); Potash (70 and 92); Soda (54 and 76); Lithia (40); their composition, properties and uses.

81. *Carbonic oxide* (14); formation, properties and decomposition.

PHOSPHORIC ACID.

82. *Phosphorus* (12); discovery; preparation and purification; properties; application to Eudiometry.

83. *Phosphureted and bi-phosphureted* hydrogen (14) and (13); their preparations; properties and composition.

84. *Phosphurets* of sulphur, selenium and carbon.

85. *Phosphoric acid* (28); by combustion of phosphorus;* other processes; properties; ‡ tests; analysis and synthesis.

86. *Phosphates* of Ammonia (45); Potash (76); Soda (60); Lithia (46); their preparation, composition and uses.

87. *Phosphorous and hypo-phosphorous acids* (20) and (32); their formation; properties; composition and combinations.

BORACIC ACID.

88. *Boron* (6)? discovery by Davy; preparation and properties.

89. *Boracic acid* (22)? preparation; properties; tests; composition.

90. *Borate* of Ammonia (39)? Sub-borates of Potash and Soda (70 and 54)? their preparation and composition; natural sources of sub-borate of Soda; its uses.

CHLORIC ACID.

91. *Chlorine* (36); discovered by Scheele; preparation: form and general properties; tests; analogies with oxygen; opinions as to its constitution; practical application by Berthollet.

92. *Chloride of Nitrogen* (158)? discovery by Dulong; preparation; facility of decomposition.

93. *Protoxide of Chlorine* (44); formation and properties; tests; anomaly in its decomposition.

Boracic acid from solution of borax &
- borax of shops borate of soda -
Boron obtained fr acid by combustion
of potassium - synthesis boron
boron in oxygen + - ~~test~~ green colo
of flame of alcohol -
t or project into red hot crucible with
chlorate or nitrate of potassa -
Boracic acid reddens litmus - effervesc
of alkaline carbonates & (according to
Faraday) browns turmeric - -
Borate used as a flux - also in glass
borates & in soldering -
Chlorine supposed by French to be
a substance supersaturated w oxygen
from oxide of mang - & [illegible] -
Arsenic, antimony & bismuth inflame
spontaneously in chlorine
- Chlorine - bleaching prop - & des
contagious matter - chloride of
lime or soda - to w add [illegible]
lime should be in excess to a
smells - used in cathedrals -
lazarettos &c
Protoxide of chlorine (euchlorine) fr

Chlorine may be reduced to liquid
at temp of 40° but it perfectly
withstands the most intense cold
(by exposure to muriate of lime)

If the watery solution of chlorine be
free from [illegible] nitrate of mercury will
give no precipitate —

Chlorine applied at a gentle heat —
does not present this anomaly that the
of chlorine is accompanied by heat & light
but with an increase of volume
& parts becoming six —

Colour of gas yellow green smells like
chlorine & burnt sugar, gives orange
tint to water — first reddens & then
destroys vegetable blues — antim & oxide
heated burns in it — decomposed by
& & decomp —

Woulfes bottle should
be kept cool — cold water absorbs
more than hot — may be
collected over mercury —

Yellow colour of muriatic acid may
proceed either from chlorine or muriate
of iron — latter destroyed by muriate
of tin — source of impurity —

Glazing of common earthenware by
rock salt — rock salt does not
acids which do not contain water yet
not decompose the muriates as the
anhydrous —

Synthesis — mix equal vol. of chlo
& hydrogen — analysis — by detag
action of (muriatic acid gas)

decomp by electric spark on solution
give 2 vols of H. & Cl. gas instantly absorb
water —

Zinc & tin heated in Cl gas form
chlorides — half vol. of hydrogen remains
muriate of P anhydrous —

94. *Peroxide of Chlorine* (68); discovery by Davy; preparation and properties; decomposition by phosphorus.

95. *Chloric and perchloric acids* (76), (100); their preparation; properties and combinations.

96. *Chlorates and perchlorates* of Ammonia ( ); Potash (124 and 131); Soda (108); preparation and general properties; action with inflammables.

97. *Compounds of Chlorine* with sulphur (52)? Carbon (120, 42, 48); Phosphorus (48, 84).

HYDROCHLORIC ACID.

98. *Hydrochloric (muriatic) acid gas* (37); preparation; general and distinctive characters; analysis and synthesis; statement and supposed proofs, of the theories as to its composition.

99. *Liquid muriatic acid;* preparation; properties; tests.

100. *Muriates* of Ammonia (53); Potash (76); Soda (60); Lithia (46); their formation and natural sources; uses; composition, considered as chlorides or as muriates.

IODIC ACID.

101. *Iodine* (125); discovery by Courtois; preparation and properties; tests; sources; analogies with oxygen, chlorine and sulphur.

102. *Iodide of Nitrogen;* preparation.

103. *Iodic acid* (165); formation; properties; decomposition.

104. *Iodates* of Ammonia (182), Potash (213), Soda (197); their formation and properties.

105. *Hydriodic acid* (126); composition and decomposition; properties; tests.

106. *Hydriodates* of Ammonia (143), Potash (174), Soda (158); their formation and properties.

107. *Iodides* of Potassium (165), Sodium (169), Lithium (135), Sulphur (141).

108. *Chloriodic acid;* its preparation and combinations.

Fluoric acid from fluor spar
(fluate of lime) & L =

fluates most delicate test of
lime

By mixing boracic acid & fluor spar
& distilling over with L contains no
water - therefore has greater affinity
for it than any other substance

fluate of [illegible] most delicate test of lime

Earths not so soluble as alka
decrease in alkaline props. as they
descend in scale -

plaster of Paris - calcined sulphate
lime made caustic in lime kiln

obtained by passing vapour of fluor
acid thro soln of [illegible]

FLUORIC ACID.

109. *Fluorine* (16)? attempts to ascertain its nature; probable analogies with Chlorine and Iodine.

110. *Hydrofluoric acid* (17)? preparation and peculiar properties; combinations and uses.

111. *Fluoboric acid;* formation and peculiar properties; combinations.

EARTHS,

Their BASES *and* COMBINATIONS.

112. General properties of the Earths; analogies and distinctions between the Earths, Alkalies and Metallic Oxides.

LIME.

113. *Lime* (28); preparation and general properties; hydrate (37); tests; sources and uses.

114. *Combinations* of Lime with Sulphur and Phosphorus.

115. *Calcium* (20); discovery and preparation; protoxide; peroxide.

116. *Nitrate of Lime* (82); formation, properties and uses.

117. *Sulphate of Lime* (68); composition and natural sources; properties; uses.

118. *Carbonate of Lime* (50); sources; composition and decomposition; solubility in Carbonic acid; crystallization by heat; uses.

119. *Phosphate and fluate of Lime* (56) and (61)? their mineral and animal sources; properties.

120. *Muriate of Lime* (65); composition and properties; application of Chloride of Calcium to bleaching; assay.

121. *Compounds* of Lime with Boracic, Iodic and other acids.

MAGNESIA.

122. *Magnesia* (20); preparation and properties; sources; tests; tendency to form triple combinations; uses.

123. *Magnesium* (12); discovery incomplete.

124. *Sulphate of Magnesia* (60); natural and artificial formation; properties and uses.

126 remains in bittern of sea w
after obtaining soda — 125 obta
from it by adding an alkaline pt —
Tendency of magnesian salts
to form triple compounds —
e must be done hot.

Bi carb of magnesia obtained
adding pt their carbonate —

to form nitrate of b. from the
dilute must be used —

most common form — from w
obtain sulphuret of barytes by b
w charcoal —
salts of barytes - poison for w
his no taste or smell — therefore

125. *Carbonate of Magnesia* (42); preparation and uses.

126. *Muriate of Magnesia* (57); composition and natural sources.

127. *Triple Salts of Magnesia*; their natural and artificial formation and uses.

128. Miscellaneous combinations of Magnesia.

BARYTES.

129. *Barytes* (78); preparation from its Nitrate; general properties; strong affinity for water; crystallization; tests; native combinations.

130. *Barium* (70); process for its discovery; protoxide; peroxide (86); its application by Thenard.

131. *Nitrate of Barytes* (132); preparation and composition.

132. *Sulphate of Barytes* (118); properties and composition; natural sources; decomposition; phosphorescence.

133. *Carbonate of Barytes* (100); native and artificial; properties; decomposition by heat and acids.

134. *Muriate and Chlorate of Barytes* (78) and (154); preparation and chemical uses.

135. Miscellaneous Barytic compounds.

STRONTIA.

136. *Strontia* (52); preparation and distinctive properties; crystallization; tests; native combinations.

137. *Strontium* (44); process for obtaining it from the native carbonate; properties.

138. *Nitrate of Strontia* (106); formation; peculiar properties; decomposition.

139. *Sulphate of Strontia* (92); composition and decomposition; distinguished from Sulphate of Barytes; sources.

140. *Carbonate of Strontia* (74); natural and artificial formation; composition and properties.

141. *Muriate of Strontia* (80); preparation; crystallization; properties and uses.

142. Miscellaneous combinations of Strontia.

are more soluble in alcohol than
any salt (perhaps)
alts not poisonous - not so
luble as ^those^ former earths - red
lame w^t alcohol × (Strontia)
muriate of strontia -

oiling water & add carb^t of potash
Strontia - precip^h -

[illegible] of alumina caustic potash
soluble in excess of potash —

[illegible] Homberg's pyrophorus by heating
alum w. some substance capable
of affording C [illegible] divided
as sugar — C forms w. potash &
alum - potassium - w. inflam
in moist air — not in dry —

ALUMINA.

143. *Alumina* (18); preparation from Alum; sources and native forms; general properties; solubility in alkalies; affinity for water and colouring matter; contraction by heat; tests; presumptive proof of its decomposition.

144. *Combinations of Alumnia* with Earths and metallic oxides; their uses.

145. *Sulphate of Alumnia* (58); preparation and test.

146. *Sulphate of Alumina and Potash* (*Alum*); formation and composition; uses; decomposition by Charcoal, Pyrophorus.

GLUCINA.

147. *Glucina* (26)? native combinations and discovery by Vauquelin; process; analogies with Alumina; distinctive properties.

YTTRIA.

148. *Yttria* (40)? sources and discovery by Gadolin; general aud distinctive characters.

ZIRCONIA.

149. *Zirconia* (45); native combinations and discovery by Klaproth; general properties; analogy with oxide of Titanium.

THORINA.

150. *Thorina* ( ); natural source and discovery by Berzelius; general and distinctive properties.

151. Presumptive proofs of metallic bases in Glucina, Yttria, Zirconia and Thorina.

SILICA.

152. *Silica* (16)? natural sources and preparation; precaution in analysis; general and distinctive characters; tests; opinions as to its composition.

153. *Combinations of Silica* with Alkalies, Earths and metallic oxides; their preparation and uses.

154. *Silicated fluoric acid* (24)? formation and general properties; decomposition by water; combinations with Ammonia and Potassium.

Berzelius considers silex as an
acid — combines w[ith] alkalies —
days in composition a alkali a
silex — if alkali is in excess
days becomes fluid — liquor
silicum — by adding alkali to
silex + = acid

METALS.

155. *General characters* of the metals; lustre; opacity; conductors of heat and electricity; high specific gravity, exceptions; fusibility.

156. *Distinctive characters*; affinities for oxygen; electrical relations; malleability; volatility; power of acidification, &c.

157. *Native state*; separation from impurities; reduction.

158. *Combinations*; general character of metallic oxides and salts; compounds with alkalies and inflammable bases; alloys.

MALLEABLE METALS,

Platina.

159. *Platina* (96); natural history; purification and preparation.

160. *Properties* general and distinctive; specific gravity 22.0; tests.

161. *Perchloride* (142); formation and precipitation by Muriate of Ammonia; ammonio-

muriate (196) and triple salts; action of precipitated Platina on Hydrogen; application to Eudiometry.

162. *Sulphuret and Sulphate*; their preparation; precipitation of Sulphuret by Alcohol and Ammonia; properties of the precipitates.

163. *Alloys*; their general properties; fusibility; action of acids.

164. *Uses*; general; chemical, its limitation; formation of fine Platina wires.

PALLADIUM.

165. *Palladium* (56); native; united with Platina; discovery and separation by Wollaston; process.

166. *Properties* general and distinctive; Sp. G. 11.2; tests.

167. *Combinations with acids*; precipitation by alkalies, by metals.

168. *Combinations* with alkalies; with Sulphur (72); their properties.

169. *Alloy* with Gold; its properties and practical application.

RHODIUM.

170. *Rhodium* ( ); discovery and separation from Platina; process.

171. *Properties* general and distinctive; Sp. G. 11.0; alloy with Steel.

172. *Chloride* of Rhodium ( ); preparation and properties.

IRIDIUM.

173. *Iridium* ( ); united with Platina; discovery and separation by Tennant; process.

174. *Properties*; colour of its acid solution; precipitation by alkalies and metals; fusibility; Sp. G. 18.68; alloys.

OSMIUM.

175. *Osmium* (120)? discovered with Iridium; process for its separation; native ore of Iridium and Osmium, Sp. G. 19.5.

176. *Properties*; high specific gravity; insolubility in acids; solubility in alkalies.

177. *Protoxide of Osmium* (128)? formation; volatility; odour; tests.

178. *Alloys* with Gold, Silver, Mercury.

GOLD.

179. *Gold* (200); ores; separation and purification.

180. *Properties*; Sp. G. 19.3; malleability; colour by transmitted light, &c.; tests.

181. *Salts*; Chlorides (236 and 272), by solution in Chlorine and aqua regia; preparation and properties; action of precipitants; results; revival of Gold by inflammables.

182. *Compounds*; Oxide (224); Sulphuret (248); alloys; their formation and properties.

183. *Uses*; in coinage, assay; gilding; painting on glass and porcelain, &c.; test of nitric acid.

SILVER.

184. *Silver* (110); native combinations; extraction, reduction and purification.

185. *Properties*; Sp. G. 10.51; malleability &c.; tests.

186. *Salts*; Nitrate (172); Sulphate (158); Carbonate (140); Phosphate (146); Chloride (146); their preparation and properties.

187. *Compounds.* Oxide (118); Sulphuret (126); combination with Ammonia and Oxalic acid; alloys with Copper, Mercury, Steel, &c.; their formation and properties.

188. *Uses;* in coinage, cupellation; plate, recovery of Silver by Nitro-sulphuric acid; medicine, &c.

MERCURY.

189. *Mercury* (200); native combinations; separation and purification.

190. *Properties;* Sp. G. 13.56; aeriform, fluid, solid, &c.; tests.

191. *Salts;* Nitrates (262 and 324); Sulphates (248 and 296); Chlorides (236 and 272); their formation and properties; precipitates, &c.

192. *Compounds;* Oxides (208 and 216); Sulphurets (216 and 232); Bicyanuret (252); amalgams, &c.; their formation and properties.

193. *Uses;* in extraction of Gold and Silver; gilding; medicine, &c.

COPPER.

194. *Copper* (64); native forms; extraction and purification.

195. *Properties;* Sp. G. 8.8; malleability; ductility, &c.; tests.

196. *Salts;* Pernitrate (188); Persulphate (160); Carbonate; Chlorides (100 and 136); their formation and properties; precipitants.

197. *Compounds;* Oxides (72 and 80); Sulphurets (80 and 96); Ammoniuret, &c.; alloys with Lead, Tin, Zinc; their formation and properties.

198. *Uses;* in coin; brass, bronze; sheathing of ships, its preservation, &c. &c.

IRON.

199. *Iron* (28); Ores; extraction, reduction and purification; Meteoric Iron, its history and composition.

200. *Properties;* Sp. G. 7.8; welding; ductility; magnetism, &c.; tests and modes of separating from other metals.

201. *Salts;* Nitrates ( ); Sulphates (76, 100,

200); Carbonate (58); Chlorides (64 and 82); Ferro-cyanate; their formation and properties; precipitates, &c.

202. *Compounds;* Oxides (36 and 40); Sulphuret (44); combinations with alkalies; alloys; their preparation and properties.

203. *Uses;* in Steel, its formation and properties; tinning; miscellaneous uses of Iron.

LEAD.

204. *Lead* (104); native combinations; separation and reduction.

205. *Properties;* Sp. G. 11.36; malleability &c.; tests.

206. *Salts;* Nitrate (166); Sulphate (152); Carbonate (134); Phosphate (140); Chloride (140), &c. &c.; their preparation, properties and precipitates.

207. *Compounds;* Oxides (112, 116, 120); Sulphuret (120); Phosphuret (116), &c.; alloys; their formation and properties.

208. *Uses;* in cupellation; glass making; medicine, &c. &c.

TIN.

209. *Tin* (59); native state; reduction.

210. *Properties*; Sp. G. 7.3; malleability; imperfect elasticity, &c.; tests.

211. *Salts*; Nitrate; Sulphate; Muriates (104 and 171); Nitromuriate; Chlorides (195 and 131); their preparation and properties.

212. *Compounds*; Oxides (67 and 75); Sulphurets (75 and 91); combinations with alkalies; alloys; their formation and properties.

213. *Uses*; in dyeing; enamelling; silvering mirrors; bell-metal, &c.

ZINC.

214. *Zinc* (33); native combinations; reduction and purification.

215. *Properties*; Sp. G. 7.0; malleable and ductile at 300°; volatility &c.; tests.

216. *Salts*; Nitrate (95); Sulphate (81); Carbonate (63); Chloride (69); their preparation, properties and precipitates.

protochloride of tin by digestin tin
except [Sn] — used largely
deoxygenize substances as
oxides, indigo &c — (may
be obtained indirectly from tin
corrosive sublimate displaces but has
deoxigenizing prop:s)

Sulphate of zinc isomorphous
sulphate of magnesia
Impurities — iron — expose to
atmosphere iron peroxidized Some of
... & recrystallize.
... by hydrate of zinc

217. *Compounds*; Oxide (41); Sulphuret; Phosphuret; combinations with hydrogen and alkalies; alloys; their formation and properties.

218. *Uses*; in alloy with Copper and Tin; medicine; galvanism, &c.

CADMIUM.

219. *Cadmium* (56); its discovery by Stromeyer; native combinations; extraction and separation from other metals.

220. *Properties*; Sp. G. 9.0; malleability, volatility, &c.; tests.

221. *Salts*; Nitrate (118); Sulphate (104); Chloride (92); Iodide (181); their properties and precipitates.

222. *Compounds*; Oxide (64); Sulphuret (72); alloys; their properties.

NICKEL.

223. *Nickel* (30); meteoric; other native combinations; separation, reduction and purification.

224. *Properties*; Sp. G. 8.9; malleability; ductility; magnetism, &c.; tests.

225. *Salts;* Nitrate (92); Sulphate (78); Chloride (66); their formation, properties and precipitates.

226. *Compounds;* Oxide (38); Sulphate (46); Ammoniuret; alloys; their properties.

BRITTLE AND EASILY FUSED.

BISMUTH.

227. *Bismuth*; (71); native state; reduction and purification.

228. *Properties;* Sp. G. 9.8; structure, crystallization, &c.; tests.

229. *Salts;* Nitrate (133); Sulphate (119); Chloride (107); their formation; precipitation by water; properties.

230. *Compounds;* Oxide (79); Sulphuret (87); alloys; their properties.

231. *Uses;* In soldering, painting, medicine, &c.

ANTIMONY.

232. *Antimony* (44); discovery; native state; reduction and purification.

233. *Properties*; Sp. G. 6.7; texture; crystallization; volatility, &c.; tests.

234. *Salts*; with nitric and sulphuric acids; chloride (80); their formation; precipitation by water and alkaline sulphurets.

235. *Compounds*; oxides (52 and 60); sulphuret (60); Hydrosulphuretted oxide; alloys; their preparation and properties.

236. *Uses*; In printers' types; medicine, &c.

TELLURIUM.

237. *Tellurium* (58); discovery by Klaproth; extraction from the ore; sublimation.

238. *Properties*; Sp. G. 6.18; texture; volatility, &c.; tests.

239. *Salts*; with nitric and nitro-muriatic acids; chloride (74); their properties and precipitates.

240. *Compounds*; oxide (46); its distinctive character; tellurates; telluretted hydrogen, solid and gaseous; its formation and properties.

ARSENIC.

241. *Arsenic* (38); native combinations; reduction.

242. *Properties*; Sp. G. 8.31; volatility; odour, &c.; tests.

243. *Acids of Arsenic*; arsenious acid (54); arsenic acid (62); their formation and properties.

244. *Salts of arsenical acids*; arsenites of Silver, of Copper; arsenites of Ammonia (79); Potash (110); Soda (74); their preparation and properties.

245. *Compounds of Arsenic*; Chloride (100); Sulphurets (54 and 62); arsenuretted hydrogen; their formation and properties.

246. *Uses*; in glass-making; painting; speculum metal; medicine, &c.

BRITTLE AND DIFFICULTLY FUSED.

COBALT.

247. *Cobalt* (30); meteoric; other native combinations; separation and reduction.

arsenicate of potash formed by heating
white arsenic & caustic potash.
Chloroarseniate with nitrate of potash

The arseniates are isomorphous
with the phosphates.

To obtain salts of metals dissolve
the metal in that acid which acts
most readily upon it & precipitate
by an alkaline Carbonate from which any
of the salts may be obtained —
as acetate of silver from Carbonate from Ag

The change of colour in muriate of cobalt does not depend on change of temp. but attraction of moisture — changes under air pump — if good blue of ... green — another sympathetic ink — acetate of lead & sulphuret hyd — another nitrate of ... & galls — write on paper with starch & wash over w hydriodic vert

Chameleon mineral — changes colour by addition of water — manganesic acid by excess of oxygen w metal —

other instances — chromates arseniates —

248. *Properties;* Sp. G. 7.7; Magnetic; tests, &c.

249. *Salts;* Nitrate (92); Phosphate (66); nitro-muriate, &c.; their preparation and properties.

250. *Compounds;* chloride (66); Sulphuret (46); alloys.

251. *Uses;* in glass, porcelain, &c.

MANGANESE.

252. *Manganese* (28); native state; separation of impurities; reduction.

253. *Properties;* Sp. G. 8.0; texture; strong affinity for oxygen; tests.

254. *Salts;* Sulphate (76); Carbonate (58); Chloride (64); their formation and properties; manganesiates.

255. *Compounds;* oxides (36, 40, 44); black oxide, with borax and nitre, with unctuous substances; properties.

256. *Uses;* in bleaching; glass-making, &c.

CHROMIUM.

257. *Chromium* (28); discovery by Vauquelin; meteoric; mineral forms; reduction.

258. *Properties*; Sp. G. 5.9; Colour, &c.; tests.

259. *Chromic acid* (52); chromates of potash (100 and 152); chromates of mercury, lead, &c.; their formation and properties.

260. *Compounds*; oxide (36), &c.

261. *Uses*; in painting, calico-printing, &c.

MOLYBDENUM.

262. *Molybdenum* (47); native state; reduction.

263. *Properties*; Sp. G. 8.6; soluble in nitric and nitromuriatic acids, and chlorine; tests.

264. *Molybdic acid* (71); molybdous acid (63); oxide of molybdenum (55); their formation and properties.

URANIUM.

265. *Uranium* (125)? discovery by Klaproth; native combination; reduction.

266. *Properties*; Sp. G. 9.0; tests, &c.

267. *Salts*; nitrate; sulphate; their formation and precipitates.

268. *Compounds*, protoxide (133)? peroxide (137)?

TUNGSTEN.

269. *Tungsten* (96); united with lime; with iron and manganese; separation and reduction.

270. *Properties*; Sp. G. 17.4; colour, &c.; tests.

271. *Compounds*; protoxide (112); peroxide or tungstic acid (120); bisulphuret (128); their formation and properties.

TITANIUM.

272. *Titanium* ( ); discovery in menachanite, by Gregor; in iron slag, by Wollaston; other sources; separation and reduction.

273. *Properties*; Sp. G. 5.3; crystallization; colour; insolubility in acids; magnetism? tests.

274. *Compounds*. Oxide by heat with nitre; process; solution in acids; precipitation.

COLUMBIUM.

275. *Columbium* (144); discovery by Hatchet; native sources; reduction by Berzelius.

276. *Properties*; Sp. G. 5.61? porosity, insolubility in acids; tests.

277. *Compounds*; oxide, by fusion with potash and solution in acids; process, &c.

CERIUM.

278. *Cerium* (92); discovery by Berzelius and Hisinger; sources; preparation and reduction by Vauquelin.

279. *Properties*; Sp. G.? soluble in nitromuriatic acid; volatile? tests.

280. *Salts*; Nitrate, Sulphate, Muriate; their formation, properties and precipitates.

281. *Compounds;* protoxide (108); peroxide (116); their formation.

hydrogen & water — results from
decomposition of vegetable matter

C & water — gums starch &c.

C water & — acids.

C water &) oils resins.

In inorganic compounds one
of the radicles exists as a sing
atom — in organic — many
example C

In the process of malting
oxygen is consumed & C given
out & fecula is converted into
sugar — less C in sugar than
fecula — germinating seeds
consume oxygen & give out carbon

Green parts of plants only give
out oxygen under the influence of
light of the sun

Plants do not absorb nitrog
from the atmosphere, whether
it exists it must be derived
from the soil

VEGETABLE SUBSTANCES.

282. Formation of vegetable substances; distinction between organic and inorganic compounds; chemical physiology of vegetables; their proximate and ultimate principles.

ULTIMATE ANALYSIS.

283. Imperfection of ancient methods; modern, by peroxide of Copper; process; mode of collecting and estimating the results; general conclusions; peculiarity in the atomic constitution of vegetables.

PROXIMATE ANALYSIS.

284. Natural and artificial proximate analysis; agents; character and classification of the results.

NEUTRAL VEGETABLE COMPOUNDS.

285. *Extract*; its preparation and general properties; solvents; affinity for alumina and metallic oxides.

286. *Gum* (90); composition and properties; solvents; action of acids; products.

287. *Sugar* (81); natural sources and preparation of saccharine juices; composition and properties of sugar; its effects on metallic salts; action of solvents and acids.

288. *Starch* (101)? preparation and properties; composition; action of solvents and acids; conversion of Starch into Sugar, theory of the process; test of Iodine.

289. *Gluten;* its preparation and peculiar properties.

290. *Caoutchouc* (20); native sources; properties; solvents.

291. *Tannin;* sources and native combinations; preparation and properties; solution in alcohol and precipitation by acids; compounds with metallic oxides; test of gelatine. Synthesis of tannin by Hatchet.

292. *Colouring matter;* distinction of substantive and adjective colours; mordants, their use and mode of action; preparation and properties of Indigo, &c.; affinity of colouring matter for alumina, lakes.

293. *Fixed Oils;* obtained by pressure; their

from atmosphere & become
insoluble in water - are dis
in alcohol & alkalies - affin
for alumine - used in dye
not definite compound -

Gum - test - by nitric in oxalic -
saccholactic acid - alcohol
precips from water - by gum
acetic acid - alumine citric -
to form such acid we must
begin w an organic substance
dissolve by alkalies & precip. by
acetate of lead -

Sugar - juice of cane contains
oxalic acid - boil down with

Starch not dissolved by cold
infusion of galls - Boiling -
Starch is soluble in alkalies &
afterwards in alcohol - test
acetate of lead - iodine -
Brewing - malting - growth of
gluten - germinated - and star

sugar / between two / increased —
gluten — Alcohol takes up
Glycerine & leaves tincture
to ascertain goodness of flowers
put in given quantity
tincture in proportion to inte
nsity of colour said to be blue
with green) —
Carmichael soluble in alco
only that has been washed
with water / to free from alcohol
now dissolved in water —
Black colour may be given by tann
without gallic acid — Take for
tan, 1 grain to 1 oz — for every 100
parts of solution 4 tan —
Bancroft on Fixed Colours /
Permanent colours
Best common mordant acet
of alumine — From 1 part of clea
common alum —

composition and general properties; solvents; combinations with alkalies, with metallic oxides; action of acids and carbonaceous substances.

294. *Volatile Oils;* by distillation; distinction between fixed and volatile oils and test; general properties; solvents; action of acids; combinations with Sulphur and Phosphorus.

295. *Wax* (97); Vegetable and animal sources; composition and properties; compounds with alkalies, with fixed oils.

296. *Camphor* (77); native sources; composition and properties; solution in alcohol and oils; action of nitric acid; camphorates. Synthesis of camphor, by the action of muriatic acid on essential oil of turpentine.

297. *Resins, gum resins,* &c. their sources; composition and general properties; solvents; distinction between Resins and Gums; action of nitric acid on resins, peculiarity in the result. Their uses in medicine and in the arts.

NATIVE
VEGETABLE ALKALIES.

298. *Native vegetable alkalies;* powerful medical action of their natural combinations; recent discovery of their preparation; their relative power in neutralizing acids; other general properties.

299. *Morphia;* prepared from Opium by Derosne; different processes; crystallization; general properties; solvents; medical effects.

300. *Strychnia;* native sources; preparation; crystallization; general properties; medical effects.

301. *Atropia;* from the Atropa belladonna; preparation; general properties; solvents; characters of its Salts; medical effects.

302. *Veratria;* united with Gallic acid in the Colchicum autumnale, &c.; preparation; general properties; solubility in Alcohol; medical effects.

303. *Cinchonia* and *Quinia;* from Peruvian bark; their preparation; Salts of Cinchonia, of Quinia; their characteristic properties; uses in medicine.

304. *Delphia, Picrotoxia,* &c.; their preparation and properties.

NATIVE VEGETABLE ACIDS.

305. *Native vegetable acids;* their general character and composition; weak affinities of their component principles; mutual convertibility by the action of nitric acid, &c.

306. *Oxalic acid* (36); native source; artificial preparation from Sugar, &c.; process; form, composition and general characters; deleterious effects; oxalates of Ammonia, Potash, Soda; other oxalates; test of Lime; other uses.

307. *Citric acid* (58); discovery and preparation by Scheele; properties; citrates; uses in Calico printing, &c.

308. *Malic acid* (60); native sources; discovery and preparation; composition; properties; malates.

309. *Gallic acid* (63); native combinations; separation; purification; composition; properties; solvents; uses in chemistry as a precipitant, in dyeing, inks, &c.

310. *Tartaric acid* (66); native combination with potash; separation and purification; composition; properties; tartrate and supertartrate of potash (114 and 130), of potash and soda (212)? of potash and Antimony (284)? pyrotartrates; their preparation; medical and other uses.

311. *Benzoic acid* (120); preparation from Gum benzoin and other sources; composition and properties; Benzoate of Ammonia; other benzoates; uses in chemical analysis.

312. *Succinic acid* (50); not strictly a native acid; preparation from Amber; composition and properties; Succinate of Ammonia; other Succinates; uses in chemical analysis.

SPONTANEOUS DECOMPOSITION OF VEGETABLE SUBSTANCES, AND RESULTS.

313. *Vinous fermentation*; from the reaction of vegetable constituents on each other; precedes the acetous and putrefactive fermentations; nature of the process; results.

314. *Alcohol* (46); a constituent of fermented liquors; separation by distillation and other modes; preparation and purification; gene-

ral properties; chemical combination with water; solvent powers; decomposition; proximate and ultimate constituents, compared with those of Sugar.

315. *Ether*; preparation of Sulphuric Ether (37); other Ethers; purification and general properties of sulphuric Ether; volatility, &c.; solvent powers; detonated with oxygen and chlorine; slow combustion by Platina, result; decomposition; constituents compared with those of Alcohol.

316. *Acetous fermentation*; distinguished from vinous; process; results.

317. *Acetous and acetic* (50) *acids*; by fermentation, by distillation of wood; other processes; general properties; decomposition and constituents of acetic acid.

318. *Acetates*; of Ammonia ( ); potash (98); soda (82); lime (78); other acetates; their preparation, composition and properties; uses in medicine, calico printing, &c.

BITUMINOUS SUBSTANCES.

319. *Bituminous substances*; their mineral sources; probability of their vegetable origin;

chemical composition and general properties.

320. *Naphtha* (41)? sources, natural and artificial; properties; analysis; chemical uses.

321. *Naphthaline* (13); from the decomposition of coal; its purification, crystallization, &c.

322. *Petrolium; mineral tar*, &c.; their nature and properties.

323. *Asphaltum;* discovery in Trinidad; other sources; composition and properties; solvents; uses, in varnishes, Greek fire? &c.

324. *Elastic bitumen;* in Derbyshire; history; peculiar properties; solution in petroleum.

325. *Retinasphaltum;* in Bovey Coal; distinctive characters.

326. *Coal;* distinctions of Brown, Black and Glance Coals; their composition; peculiar characters and properties.

327. *Coal gas;* history of its discovery and practical application; present process of its preparation and distribution; gaseous products; purification; solid and liquid results; their purification and uses.

328. *Oil gas;* its preparation and purification; gas-meters; portable gas; comparison of light and heat from coal and oil gases; their relative advantages; analysis of the gases by Chlorine.

329. *Nature of flame;* its high temperature; distinction between light and heat of flame; difference of combustibility of carburetted hydrogen, hydrogen, sulphur, phosphorus; its cause; extinction of flame by rarefaction, by incombustible gases, by metallic surfaces.

330. *Safety lamp.* History of fire-damp, its nature and destructive effects; attempts to prevent them; invention of the Safety lamp and experiments which led to its discovery; improvements and practical application; theory of its action.

331. *Invisible combustion;* of vapour of Ether and Alcohol, of oxygen and hydrogen, by platina at low temperatures; experiments of Davy and Dobereiner; application to safety lamp, to Eudiometry. Probable causes of these phenomena.

ANIMAL SUBSTANCES.

332. *Animal compounds;* their general composition and chemical properties; distinguished from vegetable compounds; products of their spontaneous decomposition; modes of proximate and ultimate analysis. Results from proximate analysis of animal compounds.

333. *Gelatine* (180); Its preparation and general properties; action of acids; of alkalies; precipitation by tannin; analysis. Analogy of gelatine and mucus.

334. *Albumen* (180); its composition; coagulation by heat, by alcohol, by acids and metallic salts; cause of its coagulation; precipitation by prussiate of potash; decomposition by tannin.

335. *Fibrin* (204); its preparation and properties; action of alcohol, of acids; solution in alkalies; composition.

336. *Blood.* Effects of respiration on the animal system; animal heat; experiments of Brodie; venous and arterial blood; serum, crassamentum, their proximate constituents; colouring matter; form of globules; ultimate constituents of blood; its uses in the animal system. Preparation of Prussian blue.

Alcohol — Tannin also precipitates
albumen — test for albumen —
corrosive sublimate or acetate
of lead — dilute acetic acid
and prussiate of potash

Acetic & oxalic acids are produced
from the action of [illegible] on fibrin

Galvanic test for albumen

337. *Milk*; its proximate constituents; coagulation, &c.; caseic, lactic and Saccholactic acids (105); ultimate analysis.

338. *Animal Oils*; distinction between vegetable and animal oils: Whale oil (105); Spermaceti oil (77), their history and composition; Adipocire, produced from animal muscle; natural and artificial process, properties; separation of fat into Stearin and Elain; Sebacic acid; artificial production of fat from gaseous substances.

339. *Animal resins*; from Bile; Cerumen; Ambergris; Castor, &c.; their general and peculiar properties.

340. *Gastric juice*; its peculiar coagulating and solvent properties, &c.; existence of free muriatic acid in the human stomach.

341. *Bile and biliary calculi*; general properties and composition of Bile; Picromel, its preparation and properties. Composition of biliary calculi; solution in alcohol, crystallization; Cholesterine, its distinguishing properties.

342. *Urine*; its composition in different classes of animals; modifications by disease; detection and separation of its constituents.

343. *Urinary calculi*; their chemical history, constituents and classification.

344. *Calculi of uric acid, and urate of ammonia*; their general form, colour and internal structure; composition; *tests*, by the blow-pipe, by the action of acids and alkalies, by colour with nitric acid. Preparation of purpuric acid and urea by Prout, their properties.

345. *Calculi of ammoniaco-magnesian phosphate*; external characters; crystallization; action of water, of acids; analysis by Wollaston; tests.

346. *Calculi of phosphate of lime*; external characters; action of acids; of the blow-pipe; tests.

347. *Calculi of phosphate of lime and magnesia with ammonia*, (*fusible calculi*); their characters; analysis; test by the blow-pipe.

348. *Calculi of carbonate of lime*; characters and tests.

349. *Calculi of oxalate of lime* (mulberry calculi); external characters; action of acids and alkaline carbonates; analysis; tests.

350. *Calculi of Cystic oxide*; discovery by Wol-

laston; their peculiar external characters; solvents and precipitants; test by the blow-pipe.

351. *Calculi of xanthic oxide;* discovery by Marcet; distinguished from uric and cystic calculi.

352. *Bone, horn, shells,* &c. &c.; constituents of bone; their separation by heat, by dilute acids; results, their uses; analysis of teeth, fluoric acid; composition of horn; distinction between pearl and porcellaneous shells, &c.

353. *Putrefactive fermentation;* common both to vegetable and animal substances; processes by which it is retarded, their practical application; progress of putrefaction; results, gaseous and solid; its utility in the economy of nature.

DETECTION OF POISONS.

354. *Organic poisons*; *Vegetable;* opium, essential oil of bitter almonds, &c.; their detection by external characters; chemical tests; experiments of Brodie; *Animal;* difficulty in their discrimination; defect in their chemical analysis.

355. *Inorganic poisons; soluble;* arsenic, corrosive sublimate, salts of Copper, nitrates of

Silver and Lead, nitrate and muriate of Barytes: *insoluble;* oxides of Mercury, carbonates of Lead and Barytes: their distinctive characters and tests.

356. *Mixed poisons;* emetic Tartar, acetates of Lead and Copper; oxalic and tartaric acids; their distinctive characters and tests.

ANALYSIS OF MINERALS AND MINERAL WATERS.

357. *Minerals;* comparative accuracy of modern analysis; causes; advantages of small analysis; apparatus; *preparatory examination;* distinction of mineral, vegetable, and animal substances; external characters of minerals, specific gravity, &c. &c.; the blow-pipe, its different forms and application; fluxes; supports; tests. — Fusion of the mineral with alkalies, &c.; separation of the constituents; examples.

358. *Mineral waters;* preliminary observations; sources, temperature, &c.; trial tests; collection and examination of gaseous products; examination of solid contents, by precipitation from a concentrated solution, by evaporation to dryness and redissolution. Pre-

cautions in filtration, in drying precipitates, &c.; probable errors from concentration; formula by Dr. Murray; application.

ELECTRO-CHEMISTRY.

359. *Etherial or imponderable substances applicable to Chemistry;* enumeration; mutual analogies; connection with chemical phenomena.

ELECTRICITY.

360. History of the principal Electrical discoveries; electrical phenomena in nature; animal electricity.

361. *Electrical excitation;* by friction, change of temperature, contact of dissimilar substances; distinction of Electricities, positive and negative, resinous and vitreous; electrical attraction and repulsion.

362. *Electrics and non electrics;* distinction between them; enumeration of the principal; electrical properties independent on chemical.

363. *Electrical apparatus;* Electrometers; Elec-

trical machines; Leyden Jar, &c.; their construction and properties; Electrophorus; Condenser; theory of their action; inductive electricity.

364. *Chemical agency of Electricity;* analysis and synthesis of water and gaseous substances; transfer of chemical affinities; fusion and oxidation of metals.

365. Theories of Electrical excitation.

ELECTRO-MAGNETISM.

366. Supposed analogies between Electricity and Magnetism; experiments of Ritter and others; conjecture of Œrsted and his consequent discovery. Magnetism developed by chemical or electrical action, Electro-magnetism; by Heat, Thermo-electricity; discovery of Seebeck.

367. Action of a fixed horizontal or vertical conductor, on a magnetized bar in different positions.

368. Action of the bar on a conductor moveable round a horizontal axis.

369. Mutual action of two parallel conductors; comparison with that of parallel magnets.

370. Mutual action of a conductor and a transverse magnet.

371. Mutual action of two conductors moveable round a common vertical axis; compared with the action of a conductor and a magnet, and with that of two magnets similarly situated.

372. Action of terrestrial magnetism on moveable conductors; their position compared with the direction and dip of the compass needle.

373. Electro-magnetic rotation; experiments of Ampère, Faraday, Barlow, &c.; rotation of fluid conductors.

374. Rotation by Thermo-electricity; of a conductor round an interior magnet; of thermo-electric parallelograms, by external magnets.

375. Electro-magnetic Helices; their construction and modifications; analogies with the common magnet.

376. Magnetic polarity induced by Helices, in soft Iron, in Steel; by Galvanic action, by Electricity.

377. Construction of the Galvanoscope; its practical application; Galvanoscope of Gold leaf, its analogy with Bennet's Electrometer.

378. Comparison of Electric, Galvanic, Thermo-electric, and Ferruginous Magnetism.

379. Laws of Electro-magnetic action; Electro-dynamics.

380. Theories of Electro-magnetic action; application to terrestrial magnetism.

GALVANISM.

381. Discovery of Galvanism; *tests;* animal, chemical, magnetic.

382. Different Galvanic circles; Thermo-electric series.

383. Discovery and structure of the Voltaic column and the Couronne des Tasses; the Voltaic battery; the Calorimotor; different constructions of each and their respective advantages; distinction between quantity and intensity of Galvanism.

384. Structure of the Electric Column; its properties, compared with those of the Leyden Jar, the Voltaic pile, and the Thermo-electric battery.

385. Chemical agency of Galvanism, in the analysis of water and decomposition of Salts.

386. Decomposition of Alkaline and earthy oxides by the Voltaic battery; discoveries of Davy.

387. Ignition and fusion of metals, &c., by the Voltaic battery, in vacuo; in different gases.

388. Magnetic and chemical properties of the Voltaic arc of light.

389. Analogies of Heat, Light, Chemical Affinity, Electricity, Magnetism, and Galvanism.

390. Theories of Galvanic agency; electro-motive, chemical, &c.

391. Theories of the action of the Voltaic pile.

392. Effects of Voltaic action on the animal system.

CONCLUSION.