

A syllabus of a course of chemical lectures / by James Cumming.

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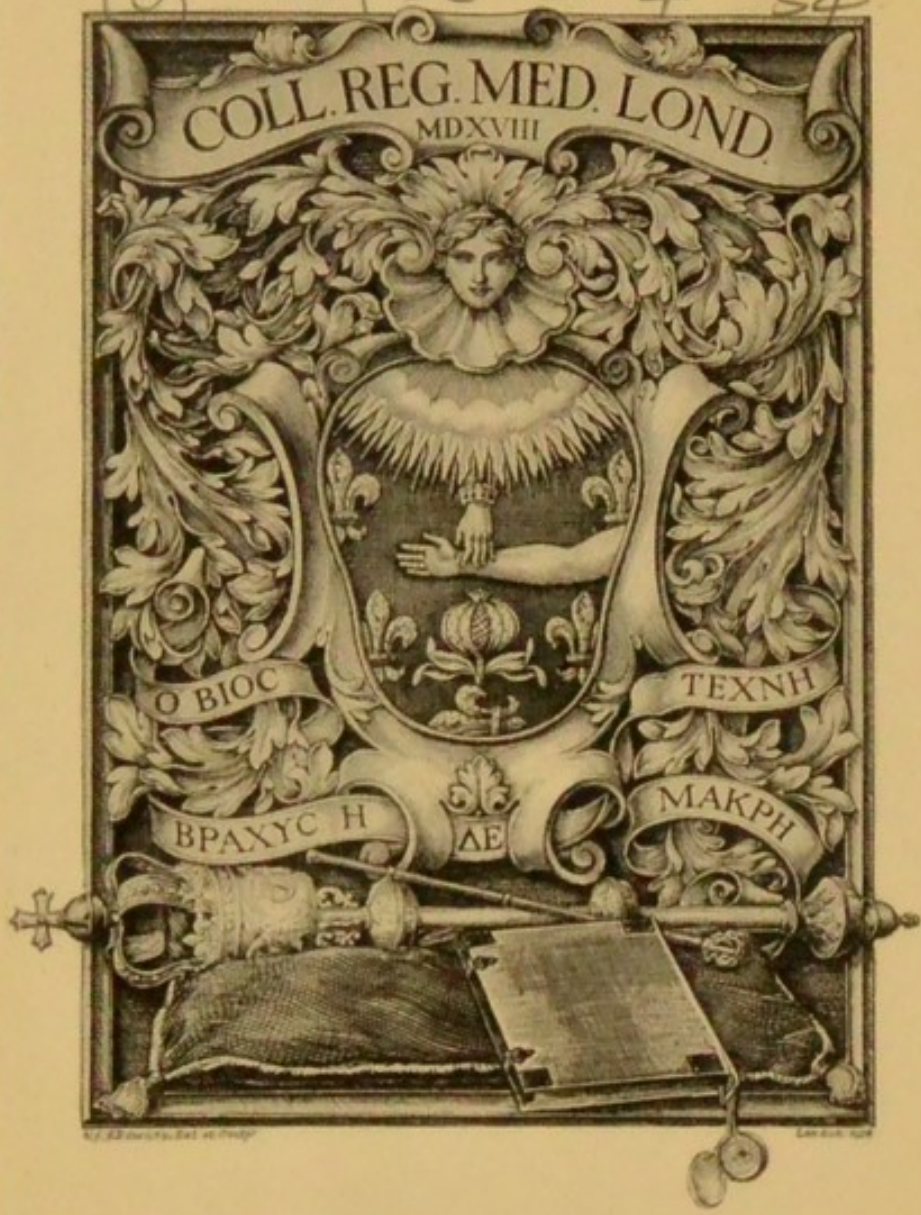
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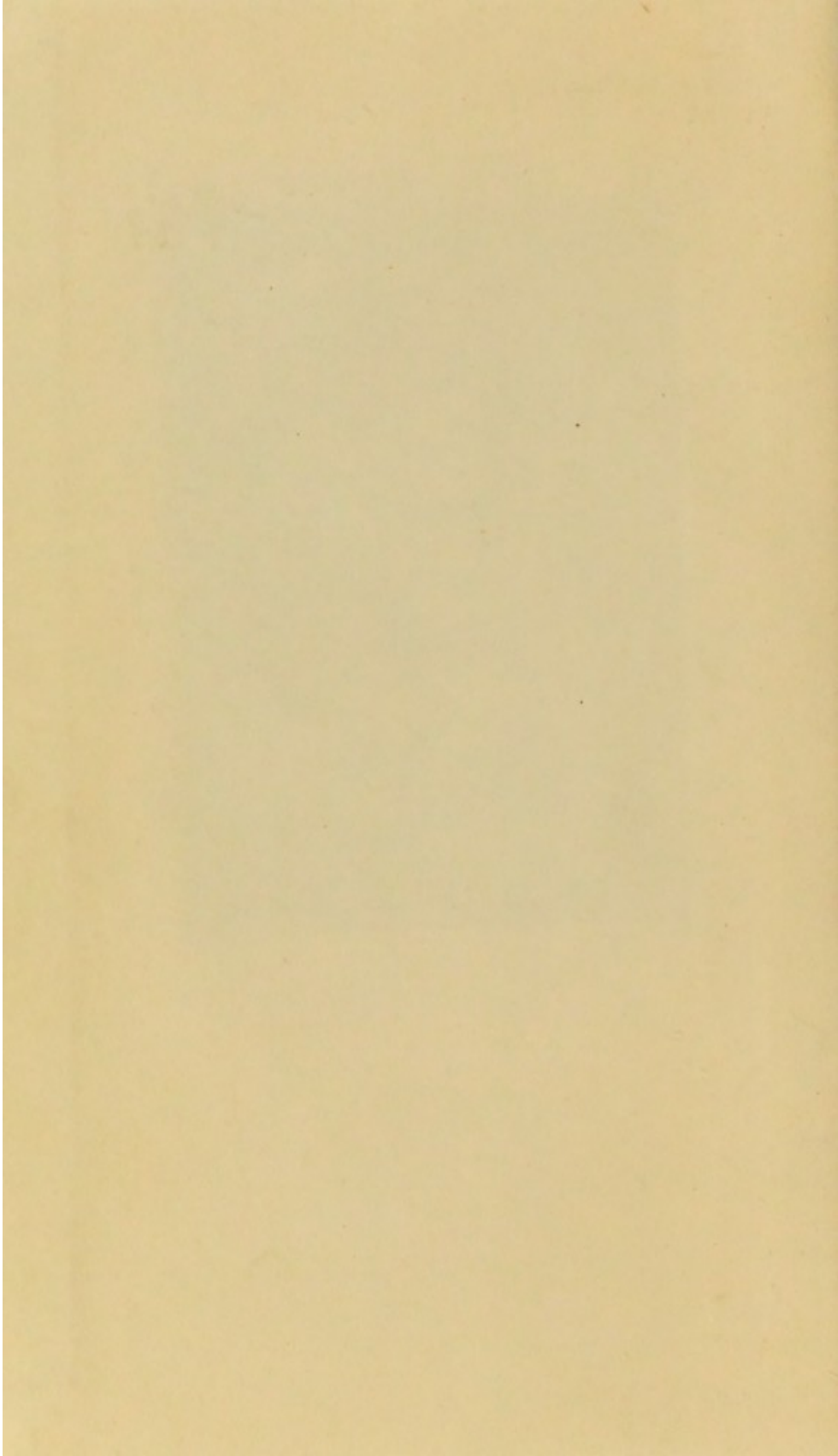
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67/37
B9

In nature lakes of Egypt
carbonate of soda is formed by the
limestone rocks decomposing the
of soda - effect of quantity -

Sulphate of P in soil - macerated
in water - & largely from gas work
to form minute of P from thin
muriate of soda - heat -
to obtain pure P or its C to add
caustic lime or C to of D -

fluorides and chlorides when
phosphorescence of fluor is
destroyed by heat - restored by
electricity

By heating of oil by
real gas & steam -
already to ...

Thompson's history of Chemistry.
 Griffin ~ Howpipe.

$$= 2c + d$$

Cymosa

$$\text{Hyd. 3}^{\circ} \text{ acid} = \text{Cym} + k = (2c + d) + k.$$

$$\text{Sulph. 5}^{\circ} \text{ acid} = g + 2p + k = \frac{2c + d}{2} + 2s + k$$

$$\text{Ferro Cy acid} = 8g + 2m + 2k = 9 \frac{2c + d}{2} + 5f + k$$

the ... of water be added ...
 Place

A
SYLLABUS
OF
A COURSE
OF
CHEMICAL LECTURES.

BY

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1825

OBJECTS OF CHEMISTRY

DIVIDED INTO

		Art.
Imponderable Agents.	Heat	11—20
	Light	21—25
	Electricity, Magnetism, Galvanism	359-392
Supporters of Combustion.	Oxygen	30
	Chlorine	91
	Iodine	101

FORMING A

Non-Metallic Combustible bases.	Nitrogen	
	Hydrogen	
	Sulphur	
	Selenium	
	Carbon	
	Phosphorus	
	Boron	

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FORMING ALKALIES.

Metallic Combustible bases.	Potassium	42
	Sodium	46
	Lithium	50

FORMING EARTHS.

Metallic Combustible bases.	Calcium, the base of Lime	115
	Barium..... Barytes	129
	Strontium Strontia	136
	_____ ? _____ Magnesia	123
	_____ ? _____ Alumina	143
	_____ ? _____ Glucina	147
	_____ ? _____ Yttria	148
	_____ ? _____ Zirconia	149
	_____ ? _____ Thorina	150
	_____ ? _____ Silica	152

FORMING OXIDES.

<i>Malleable Metals.</i>		Art.	
Metallic Combustible bases.	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	
	<i>Brittle and easily fused Metals.</i>		
	{	Bismuth	227
		Antimony	232
Tellurium		237	
Arsenic		241	
<i>Brittle and difficultly fused Metals.</i>			
{	Cobalt	247	
	Manganese	252	
	Chromium	257	
	Molybdenum	262	
	Uranium	265	
	Tungsten	269	
	Titanium	272	
	Columbium	275	
Cerium	278		

VEGETABLE SUBSTANCES.

Ternary
Com-
pounds
of

{	Carbon . .	}	in	{	Oxygen & Hydrogen,		Gums, &c. 286, &c.
{	Hydrogen	}	excess	{	Oxygen & Carbon,		Oils, &c. . . . 293, &c.
{	Oxygen . .	}	with	{	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, Almigration, Calcination, Rubification, Encorporation, Circination, Sementation, Albification, and Frementation. With as many termes impossible 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 affords
knowledge of the elementary particles
matter, and investigates the laws which
govern them in their state of separation or
union 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 which the original substances are
reproduced by the combination of
their elements.

Difficulties in analysis - energetic
combinations, minute quantities &

Synthesis, and analysis of some principles

Original division of substances into combustible and supporters of combustion.

Oxygen supporter of combustion and animal life

+ Principle compounds w^h oxygen are, alkalies, acids, earths, oxides

Distinction between ultimate composition of animal and veget^l substances containing nitrogen.

+ Oxygen - name incorrect - forms w^h different bases acids and alkalis - Phosphorus burned in oxygen gives rise to acid, Potassium in do, alkali - for both group of violet.

Oxides proper neither acid nor alkaline properties.

by the attraction of cohesion or adhesion.
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-
gate or mass.

The attraction of cohesion counteracted or
modified by heat and chemical affinity.
Cohesion is most strongly exerted in solids,
liquids it acts wth considerably less energy,
and in aeriform bodies we have no evidence
that it exists at all, for their particles are
mutually repulsive and if not held together
separate to a great distance. The force of
attraction differs not only in different bodies
but in different states of the same body. Thus
the cohesion of steel, important changes
are produced by the rate of cooling, by hammer-
ing and mercury will also illustrate this.

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

These instances upon cooling. The forces are
overcome 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. ~~is~~ 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 a
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 - ^{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. - crystals
owing to conversion of water contained between
their laminae into steam.

Hydrate of lime and magnesia are deliquescent
salts. if hydrate of soda deliquesces it contains
hydrate of magnesia.

4. a. Vibrations caused by sudden contact
of atmospheres &c. Elevation of temperature
during ^{sudden} crystallization shown by immersing them

than at 212°

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*: ^aby reduction of temperature; ^bby evaporation: ^cwater of crystallization; ^defflorescence; ^edeliquescence, &c.
4. ^aCircumstances which affect the formation of crystals; ^bdifferent susceptibilities of crys-

A

When two salts are contained in the same solution varying in their degree of solubility and having no remarkable attraction for each other they can be obtained separately. It is not a...

and reverse of it in some combinations of
metals

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 of primary and secondary forms:
hypothesis of spheroidal particles: Gonio-
meters.

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: com-
pound: tables of affinity: modifications in
their practical use.

8. Limits of chemical attraction, as to the pro-
portions and number of combining sub-
stances: opinions of Berthollet on deter-
minate 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 che-
mistry.

and water mixed in proportion of 1/4 to 1/2 for
a list of Mercurials fr. 50 to 300.
solution is generally necessary for chemical act
instance tartaric acid and carb. of soda - except
instance, mixture of ammonia and lime. All the

formed during evaporation while forming
appears till after fluid has cooled. See l. b. c.

Many was led to his Theory of crystallization
Observing the accidental chipping of an
a sided prism of carbonate of lime. By
peeling he reduced the same to rhomb.

In the same manner the rhomboidal dodeca-
hedron may be reduced to the cube.

Crystals reducible to six primitive forms

in. Parallelepipedon including cube & rhomb,
tetrahedron, octahedron, regular hexahedral
prism, dodecahedron with equal and similar
rhomboidal planes, dodecahedron with triangular
planes. &c. Dr Woodston has suggested that if

the elementary particles be perfect spheres
they w^d give rise to the octahedron, tetrahedron
and acute rhomboid and cube - if of ob-
spheroids, to the regular rhomboid, and if ob-
to these or six-sided prisms.

Chemical attraction elective - Object of chem-
try to find the order of these. differs from
mere mixture in being permanent - instance
magnesia in water - chemical affinity ^{very} 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-
bined is greater than that of its elements
as a general rule increase of temperature a

precip^d by metals - instances of simple
affinity - decom^p of nitrate of potash by wa-
muriate of lime & potash, nitrate of copper
by iron. - method used largely in arts -
copper obtained fr. springs of mines by immor-
g old iron in them. Decom^p in dry
air - if cambric and iron filings be
heated together mercury distils over. -
this method largely used in arts.

Double affinity - sulphate of soda and
lead or lime - instance of decomposition
by a gas - sulphuretted hydrogen.

cohesive attraction, and as concurring with
an increasing elasticity.

Fire or unconsumed caloric / caloric 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-
citing the sensation of heat and of producing
expansion. — The degree of expansion produced
by caloric bears a sufficient proportion to its quan-
tity to afford a means of ascertaining the latter with
considerable accuracy. — Thermometer is otherwise a
measure of quantity ^{of caloric} than as ascertaining amount of
the power of its principal effects —

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

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

Experiments of Petit & Duboulay tend to show
that unequal degrees of expansion are produced
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
and some metals as cast iron, bismuth & antimony
and the various salts in the act of crystallizing.

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

Balance of surface ^{on} by radiation first accurately
diffused of heat by radiation first accurately
assumed by Leslie

Theory of Leslie that elastic fluids by their pulsations
and vibrations are the media of ~~communication~~ the
projection or radiation of heat - disproved
by experiments of Delong & Petit and Sir H. Davy
which show that effects of radiation are three
times greater in vacuum 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.

Atorifu says which have already passed thro'
a screen of glass experience in passing thro' a
second do: a much smaller dissipation of intensity.

L. P. Delandier.

CALORIC.

11. *Free Caloric*: the effects of caloric opposed to those of attraction: expansion: fluidity: evaporation.
- + 82 12. Equilibrium of heat: Thermometers of air, alcohol, mercury: Pyrometers: principles of graduation: nature and limits of the information derived from them. + 89 + 79 97
- of solids 13. Law of expansion in solids, fluids, airs; experiments of Dulong and Petit: exception in water; its beneficial effects and probable cause. 80 + 87. 106 +
14. Diffusion of heat by contact: different conducting power of solids; its application: 104. conducting power of fluids, of airs; effects in preserving equability of temperature. 106 + 7
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. + 91. 106 + 7
- + 126 16. *Specific Caloric*: specific heat of different bodies: distinguished from absolute heat: diff. in same 2 bodies at different temperatures.

+ 149

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

+ 125 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.

+ 132 18. Absorption of heat by liquefaction of salts :
transfer of heat by evaporation, of ether, of
water : discovery of Leslie : Cryophorus.

+ 112 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. + 135.

20. The nature and sources of heat : theory of
combined caloric ; of vibrations : heat by
friction and percussion, how explained : at-
tempts to ascertain the weight and absolute
zero of heat. See t. 86

LIGHT.

21. Solar light separated into heating, illumi-
nating and deoxidizing rays : experiment of
Morrichini. *magnetic effects of solar rays.*

22. Analogies of heat and light : Photometers :

*The French adopt the theory of the materiality of heat
but Cavendish & others considered it as depending on
vibrations. The reflexion & refraction of heat, seen to favour
the propagation of light & the phenomena observed during*

The latent heat of water increases as the temperature diminishes

see x 126

According to the experiments of Dr Black 800° 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, or 212 w^t 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 less - the sum of the two being constant quantities.

In general liquids boil in vacuo w^t about 1/2 of heat than are required under a great pressure of the atmosphere water therefore in a vacuum must boil at 58° and alcohol according to h^t heat water by conversion into steam has its bulk enlarged about 1800 times

The relative expansive forces of vapours may be measured in a barometrical tube filled w^t mercury - steam equal to 30 inches.

Water at 32 gives some evaporation in vacuo. 212 exactly counter balances weight of steam, the mixture of lime and new fallen snow has produced -50° freeze.

Upon the rapidity of the transfer of heat during the liquefaction of salts depends the efficacy of freezing mixtures - Ice, h^t, nitre & carbonate ammonia. S.C. & L.P. - Dilute L & S

The degree of cold produced will be found to be influenced by their water of crystallization. If glassy salts 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 in latter

striking illustration of heat evolved during combustion is afforded by the action of U on a mixture of water by Jotite & sugar.

292 - according to Herschell the greatest illuminating power is in the yellow rays. The greatest heat will be found in the red ray & to green? and in diminishing progression to violet. If the thermometer however removed out of the spectrum it will be found to rise considerably for half an inch beyond the red.

Considerable differences in the results of these experiments are produced by the nature of the medium by which the light is decomposed.

Beyond the violet the thermometer is not affected. The power of the deoxidizing rays diminishes gradually from violet rays to red. The greatest power is beyond violet -

Hence it appears that the solar beam consists of three distinct kinds of rays, viz those that excite heat & promote oxidation, illuminating rays, and deoxidizing or hydrogenating rays.

In the rays beyond the red extreme phosphorus is excited, smokes and emits white fumes; but the action is presently suppressed on exposing it to the deoxidizing rays. See + 159. & 158.

It has been asserted by Morichini (see 21) that the violet rays have a magnetising power, and are capable of preventing reversing the poles of a needle already magnetic.

fact has been demonstrated by Descrovaux in which
of point out a close connexion between heat & light.
The rays of invisible heat pass through glass & dif-
ficultly at below 212° but transmit it in fact
always increasing w' temperature, as it approaches
the point when bodies become luminous.

Bodies giving light w' out heat. Phosphorescence
glow worms &c & diamond exposed to sun by De
Lay became phosph. ut — See + 160 — fish-
bone with gun tragacanth made into scales & heated
in furnace — Canton's & Bolognian phosphoric
oyster shells & sulphur — obtain good ozone
— Light by attraction exhibited by a piece of
borax or quartz.

When phosphoric have lost their power in
they are restored by passing electricity through
them by increasing temperature.
Some bodies only flame at high temp. — a
class of lime — a variety called chlorophane —

Photometers — C. Ramsford's See + 161. —
Leslie.

Many of the gases have been reduced to
fluid state by pressure — as for instance carbonic
acid (36 atmospheres) and it is probable
that all might be so reduced if their tem-
perature could be sufficiently lowered or compressed
applied — Gases therefore cannot be dis-
tinguished from vapours. Gases enlarge about
 $\frac{1}{300}$ th part of their bulk for each degree Fahrenheit

essentially speaking substances I have at a low level
be separate or? must perfectly from atmosphere
the substances will burn in air in a? rather has you
then consumed oxygen entirely -

substance in filings - liquid substance of Jett
lost in 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.

At of 100 27. Atmospheric air, not elementary; composed + 827
to 92.30.92 of indivisible particles; its constitution and + 299
 general properties; Barometrical Thermometer. *water boils 10 times for every 520 ft.*

28. Analysis of the air by Eudiometers; separation of Carbonic acid; tests of aqueous + 56

+ 259 vapour by Hygrometers; theories of the formation of Rain and Dew. + 23

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. + 285
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 equal
evaporation give up the same quantity of water
- deliquescent salts. - This water has been a
hygroscopic water.

Sublimed bodies not as dry as those

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 (oxygene) of
potash - should be obtained in green glass
retort - red precipitate / peroxide of iron
used by Lavoisier to - oxide of mercury
- carbonate of potash at heat -
Oxygen from manganese sometimes comes
- from carbonate of lime in ore -
Oxygen enters largely into substances
used in the arts -

Oxygen not necessary to acidity - hydro-
cyanic acid & sulphuretted hydrogen
should be washed w' dilute NaOH or L and
then with distilled water.

100 cubic inches weigh 93 grs.

Refracts rays of light less than any
other gas

water composition & ...
200, atmosphere of water (test
in gms) -

Errors likely to arise from absorbability

(gases -

Water from fermentation then earth
dissolves many substances which
under its influence for other
out purposes - should be distilled

- Most common impurities -

Impurities - of soda

best nitrate of silver

Sulphuric acid - combined with

best & bright salts - lime oxide

hardness in water - depending upon

presence of sulphate of soda

is detected by solution of soda

in alcohol

Hydrates - their water cannot be

expelled by heat - hydrate of

lime - ^(glazed lime) - their

water may be separated by con-

fining their down & other substances

Hydrogen gas is soluble in water - is not altered
by intense heat or electric discharges - repels
light more powerfully than any other gas
is inflammable but extinguishes burning
bodies - is fatal to animals - is the light
of all elastic fluids - multiplies sound
Ascending force of Hydrogen balloons is as cube
of diameter - Descending force of balloons as the
square - in larger balloons former increases
much more rapidly than latter -
difficult to obtain hydrogen free from
water vapor - giving rise to various
vicious results in obtaining specific
- oxygen 16 to 1 hydrogen -

The flame of hydrogen in oxygen - when perfectly
pure - though giving intense heat affords
scarcely any light - quantity of
light depending on impurities in Hydrogen
alcohol contains great quantity of
hydrogen - flame of alcohol lamp is
jet of oxygen fine water spray -

Dr Clarke's blowpipe Test for composition
of air producing most rapid
therefore most intense ignition
& safety valve ~~is~~ besides
which bubbles through water - or or

stomach of hydrogen used for Klenck
book, prints etc -

volatile alkali - P - fixed pot. soda
lithia - reacts as inorganic, organic

Properties of alkalis - location last
rising from action on calve -
in w acids - Tests - paper of ^{containing} ~~containing~~
brown - cabbage, turmeric & beard -

Synthesis of ammonia in Volta
andrometer - if mixed in ^{hydrogen}
of 3 hyd. & 1 nitrogen - evolved
disappears on electrical spark
applies

is obtained from mixture of P.
lime - either dry or moist

Test III - mixture of

from animal ^{incubated}
old bones & ^{out of} ~~incubated~~
originally from ^{incubated}

in Egypt of boiled down to
get out grease for soap boilers
distilled in low ^{repeals}

purified by mixing w' quick lime & distilling
or to obtain IV - add gypsum which gives
liquida PL & insol calc C - liquid evaporates
gives an sublim

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.

decomposed at 58° f.
specific grav. 1.1
6 a - formed by adding *muratic acid* to the peroxide of barium - latter unites w' H_2O in shape of protox. (barytes) giving part of its oxygen to the water - being precipitated by **ALKALIES**, *leaves free to act on a fresh portion of peroxide of barium -*
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.

At a high temperature it decomposes all those metals that are reducible by hydrogen

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

decomp. of N. by passing sulphuric acid through it in voltaic circuit - resolved into a mixture of

N₂ - Zinc is the only metal which liquefies

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

*Mercury with ammonia exposed to galvanic action
was amalgam*

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).

*cannot be decomposed by the most intense heat alone
but if heated wth iron filings hydrogen is given off.*

- 44. Compounds of Potassium with Hydrogen.

*formation takes place in Egypt
From Niter (KNO₃) or rock salt*

SODA.

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

*Potash makes soft soap
soda wash*

- 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 decomposing Potash by a voltaic
action. - by French chemists
Potassium at high temperatures
volatile - decomp. of Pot in iron
barrel ^{in iron filings?} & converts a iron Potash
sublimed into cold part of barrel
decomposes water by potassium in mercury
trough & collect Hydrogen & mercury
previously with Potassium - thus
synthesis of Potash effected

Potash perfectly pure and free from
water absorbs oxygen when heated in
air and is converted into an orange color
peroxide. - when thrown into water oxygen
is evolved and it passes into the state
of Potash.

Properties of Potash - intensely acid taste
destroys animal texture & vegetable substance
changes by blue green - neutralizes acids with
effervescence - renders oils miscible
with water, & dissolves resin.

Where an alkali was found in an analysis
of a substance, it was always considered either
potash or soda. The discovery of lithia
however has rendered the accuracy of such
assessments doubtful.

Sodium when heated ~~is~~ fused
with dry soda not below of just of its oxygen
dark brown fluid results, becoming a
very solid on cooling of doubtful whether a
compound of soda wth oxygen or merely
a mixture of metal wth soda. This substance
is capable of abstracting oxygen from air &
water & forming soda.

Lithia discovered in Lepidolite Petalite.
Prop. of 5 percent, in Spodumene & per-
so is scarce as former / in crystallized
epidolite 4 per cent.

To obtain lithia fuse the mineral in
carbonate of potash. - dissolve in water
separate & dissolve in nitrate of lithia in alcohol
repeat the process to purify it & digest
in carbonate of silver - & decompose solution
in carbonate by lime or barytes. -

Ammonia, recognized by smell - form
white cloud w/ muriatic acid - turns
red. blue green of blue restored on boiling +
tartaric acid forms a soda soluble
salt - w/ Potash insoluble (precip.)
salt crystalline therefore other addition
of tartaric acid - conclude the Potash
is present if not soda
- nitromuriate of platinum - form
yellow ^{crystalline} precip. w/ Potash - ammonia
of platinum & Potash soluble w/
soda - corrosive sublimate w/
white precip. - w/ fixed alkali
brick red -

Acid - proof our tests - natural
alkalis - change color red -
- L pure nitrate of Potash - after
contains muriate of soda - if so
L will be impure from presence of
the test nitrate of other - if the
nitrate of. Duplicates - after which
tell over perfectly pure L
Wolston test - if suspect presence
of L boil w/ gold leaf & add HCl
- alcohol or Turpentine added to L
end of tub - if in reverse order

table of decomposition L - holds
very loosely - - instance where

The nitrates are ~~not~~ generally
leaking / decomposed by heat -
L difficult to detect because
it does not form insoluble
precipitates -

Test - paper dipped in solution
of nitrates deflagrates -
boil gold leaf in addition of ¹²

hydrate of Soda (41); peroxide of Sodium

(36).² orange coloured substance formed
by burning soda in oxygen - sodium 2 atoms

48. Compound of Sodium and Nitrogen.

= 40 ox 3 = 24 = 72.

LITHIA.

L. neutralises much greater quantity of acid than
P. or S. even more than magnesia - changes blue &

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

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

the difficult solubility of its carbonate in water, by
forming deliquescent salts with B. & L. & by high cap
of saturation. agrees wth Soda in not being precipitated

ACIDS

Lactic acid in Quercite Plethion - when mixed
with carbonate of Soda deposits carbonate of Lithia.

Their BASES and COMBINATIONS.

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

52. General properties of Acids; their composi-
tion, classification and nomenclature.

53. The nature and nomenclature of their com-
binations.

NITRIC ACID.

54. Process for procuring liquid Nitric acid;
purification and properties; tests; suscepti-
bility of decomposition.

soluble in water which has been boiled
and allowed to cool out of contact of air,
and test of purity - it is not diminished
in mixture with either oxygen or nitrous gas -

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.

Employed by Dr Dalton to ascertain purity of air -

nitrous oxide from "base of N by heat
(gentle)

nitric acid	5.6	{	6x 2	}	22 parts
			ox 1		22 parts
			ox 1		
			ox 1		
			nit. li		
71 =					
ammonia	17	{	sub. li	}	9 water
			hyd 1		9 water
			hyd 1		9 water
			hyd 1		9 water
71			71		71

bodies from increase brilliancy in
nitrous oxide -
nitric oxide obtained by decomⁿ of
L by metals as copper - used by
Driesth for endometry - great affn
for oxygen - absorption in water
with nitric oxide (of oxygen) - discol
lant results from different diameter
of tubes - (not all the oxygen is
added) - green sulphate of iron
absorbs nitrous gas but not nitrogen
his solution externally used for endometry
crystalline, deposit from applying for
nitrous gas to inside of jar inverted
in water - on adding water substance
decomposed & two very vaporous
- Synthesis by repeated shock of
nitrogen + oxygen - L decomposed

pernitrous acid obtained by destructive
distillation of lead -

(of selenium tetroxide by hydrogen)
his solution (see over leaf) precipitates all
metallic solutions when neutral. - Iron
as found to end of carbon & is color
acid.

countries - Sulphuric - by con-
suing & obtained - Sulphur when
becomes fluid first and again solid
by cooling heat condensed again, fluid
when by forming into water
may be kneaded & used for casts
combined wth alkalis

Sulphur is soluble in boiling oil of turpene
but therefore of purity -

Sulphuretted Hydrogen capable of
existing in fluid state under pressure
of ~~two~~ $2\frac{1}{2}$ atmospheres -
delicate test for many metals -

If hydrogen be mixed wth sulphur
or combination takes place but
if presented to each other in
massive state - as ~~hydrogen~~ action
and on sulphuric of iron - reads
white -

S. S. Precip^d almost all metals
above of precipitate difference
wth arsenic yellow - a precipitate by
Dro. of acetic acid -

Analysis of S. S. by potash in
closed vessel heated - sulphur

... of ... by electric spark
... S. H. be inflamed Sulphur is deposited

Sulphuric acid formed gradually, by
exposure of iron pyrites to atmosphere
green vitriol obtained - glacial
oil of vitriol (~~anhydrous acid~~)
obtained by distilling this white substance ^{over}

- In com' process for obtaining
this sphere supplies greatest quantity
oxygen - so, also formed -
discoloration of U by shading of str
- fraudulently clarified by
boiled in mixture of J. starch - Dec
mixture w' oxygen & flies of -
from sulphurous acid by burning
in - w' iron at bottom of vessel
- then introduce zinc - sulphur
deposited -

Sulphurous acid obtained by distilling
concentrated U w' metals -

Selenium differs fr metal in being
non conductor of electricity - since
of horse radish only pungent - discol
in powder remaining after manufactⁿ of U
combines w' hydrogen - forms acids
with oxygen (at Fahlun in Sweden)

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.

suspected by him to be Tellurium from
eye flamm. blue
By subliming this powder selenium is obtained
by fused of Potassium & addition of water

formed by...
by dissolving S. in L or Ltm & evaporating
distilling, remaining mass - acid crystals
in cool part of 12 vessel. - solution

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

e. lve - p. 715

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.
boiling of water carbon charred
antiseptic
iron
trig ink
destroys colour - filtering

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

bi C. of / See v. 12

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

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

precipitate lime water

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.

oxygen by conversion into carbonic acid under
no change in volume
prod. during respiration

... from by action of ...
... diamond dust this showing iden
... ^{of charcoal}
probable that gases when absorbed by
charcoal exist in ^{fluid} state - charcoal
should be previously heated to expel
moisture -

Prussian blue obtained from blood - heated
with caustic potash -

Zincogen obtained by exposing precipitate of
mercury to heat - burns with pale blue
flame - precipitate of mercury formed by
boiling together Prussian blue & red oxide
of mercury in water -

Hydrocyanic acid from decompt. of ferrocyanide
& mercury by sulphuretted hydrogen
or by ~~the~~ wood

Sulphuret of carbon most volatile
... fluids - evapⁿ rapid enough to
congeal mercury - obtained by fusing
sulphur in vapour over red hot ch
coal - fluid distils over -
propose to use for lens - high re
fracting power -

Bicarbonate hydrogen when pure does a
precipitate from water - after burning

Carbonic oxide may be obtained by heating
coke mixed wth the oxide of almost any
metal - Zinc, lead, manganese, iron &c
should always be washed wth lime water

Potash - Properties - Not offensive
itself - is lighter than common air -

inflammable wth blue flame
When mixed wth ^{more than} half its volume of oxy-
gen exposed to temp. 300° in contact wth
spongy platinum - converted into CO
is sparingly soluble in water, fatal
to animal life.

Carbonic acid - Prod from atthaline carb
by burning C in - - generated
during fermentation - analysis.

by impure
analysis of
Carbonic oxide obtained by heating stre
of over ignited charcoal - carbonic oxide
formed.

Carbonic oxide / mixed however with CO
which may be separated by lime water
or caustic potash / obtained
by distilling dimoxalate of potash

Carbonic oxide analysed by potash
carbon set free & potash formed

Phosphorus does not readily combine
with oxygen ^{under ordinary pressure} at common temperature
unless previously dissolved in /
Phosphorus first obtained from urine
by evaporating & distilling w charcoal
by Scheele from bones calcined
phosphate of lime remains w it
decomposed by H_2 & superphosphoric
acid - & evaporated & fused gives glass
phosphoric acid - from this phosphorus obtained
by distillation w powdered charcoal -
applicⁿ to endometry for proof of absorb

Phosphuret of lime - formation by
distilling phosph. thru tube containing powdered
marble - C is also decomposed & phosphoric
acid from a C deposited - obtained when
decompo - water - from phosphoretic

When phosphorus is heated in highly vac
in these substances are formed - phosphoric
acid - a volatile white substance w app^r
to be phosphoric acid & a red solid w
probably an oxide - w when thrown in
in flames

* purified by preping thru chamois cloth

phosphate of soda when fresh powder of
nitrate of silver red precip - when kept
a long time yellow - jaw -

phosphureted hyd - by distilling
lvs - in corrosive potash - or from phos
phuret of lime & ~~lime~~ - (if allowed
to stand over water proto ph. hyd. obtain
a p. of a zinc filings & dilute l
the red oxide of P inflames when thrown
into l.

Insert

Phosphoric acid obtained by decomf. of l
by phosphorus* - this when exp. to
dryness & fused gives glacial phosph
in solid - substance remaining is phosphoric acid
both ^{from purer part of water} may be expelled by heat

Phosphorous acid by subliming phosph
in corrosive sublimate & mixing product
with water & evaporating to dryness & crys
on cooling - this when heated out of c
is into acid fonnell by decomf. 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. *See 78.*

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. *from phosphuret of lime*

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

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

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.

note -

*if an gives phosphureted hydrogen
acetate of lead - previously page - phosph*

both evolve heat & light on sudden condensation.

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.

destroys column of chlorine. This diff. from effects of sulphurous acid.

boracic acid from borax of soda -
- borax of shops borate of soda -
iron obtained for acid by combustion
of potash - synthetic iron
boron in oxygen - Best green color
of flame in alcohol -

it is project into red hot crucible with
chlorate or nitrate of potash -

Boric acid redens flames - effervesces
with alkaline carbonates & according to
ready boron boracic -

Borax used as a flux - also in glass
houses & in soldering -

Chlorine supposed by French to be
a substance supersaturated w oxygen
from oxide of mang - & ~~the~~ -

arsenic, antimony & bismuth influence
spontaneously in chlorine

- Chlorine - bleaching prop. + desinfectant
contagious matter - chloride of
lime or soda - to w add a
lime should be in excess to w
small - used in Cottedales -

Liveries & c
oxide of chlorine (anhydrous) for

Chloride of nitrogen from chlorine
the carbonate of ammonia in
solution - oil forms on surface
detaches in oil - not a ~~pure~~ ^{pure} ~~aliphatic~~

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

If the watery solution of chlorine be
see from ~~the~~ nitrate of mercury will
give no precipitate -

Chlorine expands at a gentle heat -
and presents this anomaly that the
explosion is accompanied by heat & light
it with an increase of volume
- parts becoming six -

Colour of gas yellow green smells of
chlorine & burnt sugar, gives orange
tint to water - first reddens & then
rests veget blue - antimony & copper
heated brown in it - do charcoal of
& a decomp -

oxide of Chlorine -
chloride of Potash in water bath -
immerse in water bath - proceeding
on attaining boiling by mixture w/ alcohol -
chloride of Potash & Phosph. (see end of
row) - ~~Prepar.~~ of Ch. may be collected
or more at common temperature
alone much brighter yellow than one
more rapidly absorbed by water - has
omnific smell not mixed w/ that of phos.
more explosive & gives greater expan-
sion - accord^g to Davy destroys blues
but 1st reddening -

Chloric acid may be obtained by decom-
position of chlorate of barites by
L. - Imp^y of solution free from colour
reddens blues - does not precipi-
tates of lead silver or mercury -
decom^d by ~~heat~~ ^{when in certain proport^{ns}} & chlorine & water formed
also by sulphureted hydrogen & by sul-
phurous acid - H₂ being formed

water in 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 minute
of iron - latter destroyed by muriatic
of tin - source of impurity -

Glazing of common earthenware by
Fuch salt - such salt does not de-
compose which do not contain water and
not decompose the minerals as
anhydrous U

Synthesis of mix equal vol. of chloro-
hydrogen - analysis - by potas-
sated P (muriatic acid gas)

decompt by electric spark in solution
in 2 vols of m.a. gas instantly absorb
water -

zinc & tin heated in Et gas from
chlorides - diff. vol. of hydrogen send
muriatic 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. - *precipitates from nitrate of silver soluble in caustic*
100. *Muriates of Ammonia* (53); Potash (76); Soda (60); Lithia (46); their formation and natural sources; uses; composition, considered as chlorides or as muriates.

† distinguished from ϵ by forming yellow precipitate of platinum muriate of lime very deliquescent

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.

The iodates / most of them / when
decompose water, and form hydriodic
acid. Similar manner to chloro-

lime grain. kept in water for some
half.

Iodine exists in state of hydriodate
& potash in nature.

lime - unites wth oxygen & hydrogen
soluble in alcohol - not in water

The salts in sea water probably exist
there in the order of their solubility
sulphate of soda & muriate of lime
have the solution - sulphate of lime
& muriate of soda when dry -

To obtain hydriodic acid
heat iodine wth potash & water
oxide & hydriodate of potash
formed - decomp. by sulphuretted
Hydrogen of excess of latter by heat
add to hydriodate of potash - U &
com. by sulphuretted Hydrogen?

NOTICE

The undersigned, having been appointed by the Court, do hereby certify that the within and foregoing are true copies of the original records and all the same.

In witness whereof, I have hereunto set my hand and the seal of the Court, at the City of New York, this 10th day of August, 1880.

John C. [Name], Clerk of the Court.

The People of the State of New York, County of [Name], Sheriff.

John C. [Name], Sheriff of the County of [Name].

John C. [Name], Sheriff of the County of [Name].

John C. [Name], Sheriff of the County of [Name].

John C. [Name], Sheriff of the County of [Name].

John C. [Name], Sheriff of the County of [Name].

mine discovered by Bernard of
Apelies found a bitter of
a water - - -

concentrated Bittern
precipitated by Chlorine - & add
aliphatic ether to dissolve Iron
and Lead

110. Hydrochloric acid (171) is a colorless gas
with a pungent odor, soluble in water.
111. Hydrochloric acid, ferrous and ferric salts
are soluble in water.

EARTH

The River and Compounds

112. The earthy part of the Earth, and the
relation between the Earth, the
air and the water.

113. The earthy part of the Earth, and the
relation between the Earth, the
air and the water.

114. The earthy part of the Earth, and the
relation between the Earth, the
air and the water.

115. The earthy part of the Earth, and the
relation between the Earth, the
air and the water.

fluoric acid from fluor spar
(fluorite of lime) & H₂O =

fluates most delicate test of
lime

By mixing fluoric acid & fluor spar
& distilling over ^{with} contains no
water - therefore has greater affinity
for it than any other substance

fluates of P⁺ most delicate test of lime

Fluates not so soluble as alkalis
decrease in alkaline prop. as they
descend in scale -

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

obtained by heating vapour of fluor
acid then solution of P

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.

acid: for procuring air in state of perfect
 pure.

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. *cannot be obtained*

119. *Phosphate and fluuate 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.

*Leaching of mineral sulphate
obtained*

lost from green
contains sulphate of barytes &
with a little acid of pot -

sulphate of lime precip.
in water by alcohol - analysed

ed as manure - magnesian
lime stone (buff) - mixture of C of
lime & C of magnesia - common

lime stone (C of lime) dissolves
readily in acids (dilute) forms
T for manure - latter good

lime water Test for C - if latter
except a supercarbonate of lime
mixed it is soluble -

lime water good Test of sensitivity
Potash - if pure no precip.

sulphate of magnesia & of lime com-
pounding plasters also - latter precip.
- Potash precip. magnesia
& lime - lime precipitated

carbonate of ammonia
Test for magnesia add supercar-
bonate of lime then phosphate of soda
triple salt white precip.
lime & also test with

The first of these is the...

The second of these is the...

The third of these is the...

The fourth of these is the...

The fifth of these is the...

The sixth of these is the...

APPENDIX

The seventh of these is the...

The eighth of these is the...

The ninth of these is the...

125. Chloride of Magnesia (115): preparation and uses.

126. Oxide of Magnesia (121): composition and natural sources.

127. Triple Salt of Magnesia: their nature and method of formation and uses.

128. Miscellaneous combinations of Magnesia.

BARYTE

129. Barytes (131): preparation from the mineral; physical properties; solubility in water; crystallization; uses; other combinations.

130. Strontian (131): process for its discovery; properties; methods of separation by flame.

131. Nitrate of Barytes (131): preparation and properties.

132. Sulphate of Barytes (131): properties and composition; natural sources; detection; analytical reactions.

133. Carbonate of Barytes (131): nature and physical properties; decomposition by heat and acids.

126 remains in bitterness of sea water
after obtaining soda - 125 obtained
from it by adding an alkaline pt -

Tendency of magnesium salts
to form triple compounds
& must be done hot

Best way of magnesium obtained
deposits of pure carbonate -

to form nitrate of Mg from the
delute L must be used -

most common form - from
obtain sulphate of barytes by
of charcoal -

salts of barytes - Poison for sea
has 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.

*The 1st consists of Sat. carb. of magnesia
the hydrate of magnesia in gas water*

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.
- X 139. *Sulphate of Strontia* (92); composition and decomposition; distinguished from Sulphate of Barytes; sources. *former slightly sol*
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 of Potassium - not so
soluble as ^{the} former earth - red
same w' alcohol + (Heuteau)
ammonia of Strontia -

oiling - water - a add. carb' of Potash
Strontia - Parrot -

1. The first part of the book is devoted to a general introduction to the subject of the history of the United States, and to a description of the various states and territories which have since been admitted into the Union.

2. The second part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

3. The third part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

4. The fourth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

5. The fifth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

6. The sixth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

7. The seventh part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

8. The eighth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

9. The ninth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

10. The tenth part of the book is devoted to a description of the various states and territories which have since been admitted into the Union, and to a description of the various states and territories which have since been admitted into the Union.

test of alumine caustic Potash
soluble in excess of Potash -

Powders Pyrophorus by heating
burn w some substance cap
of affording C minutely divided
sugar - C forms a Potash of
burn - Potassium - w inflam
in moist air - act 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 Alumina* with Earths and metallic oxides; their uses.
145. *Sulphate of Alumina* (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 and 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 vitæx as an
acid - combines wth alkalis -
lays in some form of alkali a
vitæx - if alkali is in excess
lays becomes fluid - liquor
vitæx - by adding alkali to
vitæx & . . . acid

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2. The general principles of the theory.

3. The application of the theory to the study of the history of the world.

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4. The application of the theory to the study of the history of the world.

5. The application of the theory to the study of the history of the world.

6. The application of the theory to the study of the history of the world.

METALS.

143. General character of the metals; their specific gravities; malleability of heat and malleability; ductility; tenacity; crystalline structure; specific heat; expansion; contraction; etc.
144. Distinctive properties of metals for various chemical relations; malleability; volatility; point of fusion; etc.
145. Action of acids; reduction; iron; hydrogen; reduction.
146. Combinations; general character of metallic oxides; acids; salts; compounds with chlorine and sulphuric acid; bases; etc.

MALLEABLE METALS.

IRON.

147. Properties of iron; action of acids; purification and composition.
148. Properties of iron and its alloys; specific gravity; etc.
149. Properties of iron; impurities and purification by Martin's process; composition.

metals most perfect conductors
of electricity when pure or
or oxides

iron more ductile than gold or
less malleable

Cadmium most volatile metal

active states of metals general
in that of sulphuret - 9000

some metals combine in different
to iron & zinc - others can be
lead & bismuth & tin

alloys often melt at temp. much
below fusible point of either
as alloy of iron with lead & tin
201° -

expansion of metals. Dimpled
no contraction (by heat) cast iron

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-

*Platina is precipitated by ammonia
 P - giving muriate of Platina
 which is precipitated by heat a stringy Platina
 is obtained*

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.

Do hydrochloric acid...
including a case of silver &
being the common...
... silver in L
spongy plat loses power by ex
posure to air. restore fresh by
recharging -

Amount of platinum used for
distinguishing... fresh Pt rods

found often vol^o of platinum in
L... ac

radiated grains among platinum are
only iridium & osmium -

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PALLADIUM.

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177. Properties of the reaction of hydrogen peroxide with ferrous sulphate

178. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate

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179. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate

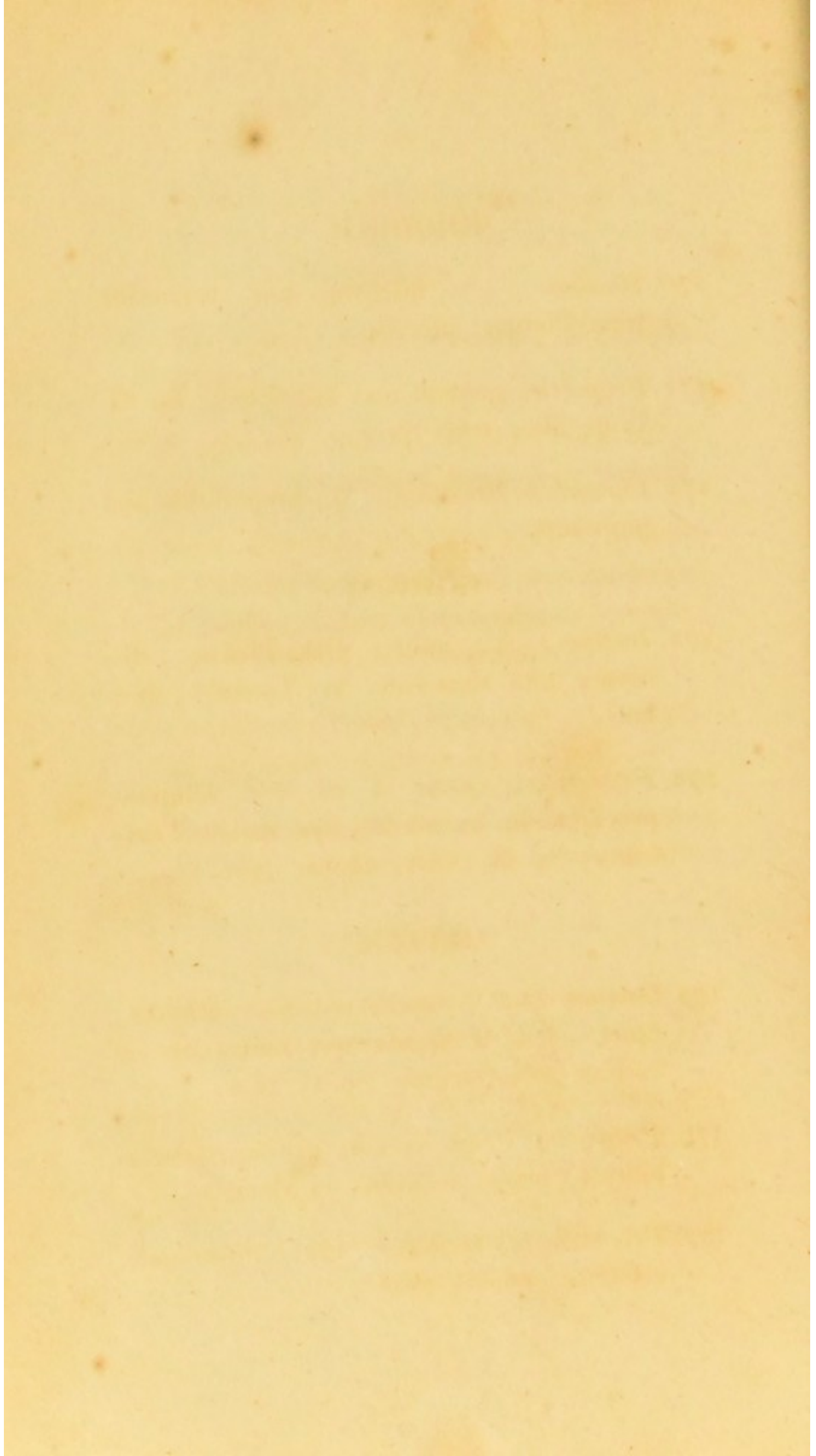
180. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate

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181. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate

182. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate

183. Kinetics of the reaction of hydrogen peroxide with ferrous sulphate



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.

ers for present
muriatic acid - slope of tin -
purple powder of copper precip
latter used for staining glass.

up^d by using a crucible & get rid
taken by heat -
Lead of oxide of lead forms kind
of glass in metals -

nitrate of silver in a retort & copper
& small quantity of potash w^h will
precip. latter first - on heat - copper
evapor. at red heat - red powder of
silver & crystalline pure nitrate of silver
silver enclosed in sheet of lead
enclosed in some concave,

obtained by mixing silver nitrate
soda & nitrate of silver -

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187 Compounds: Oxide (138); Sulphate (139);
combination with Arsenic and Oxalic acid;
alloys with Copper, Mercury, Silver, &c.,
their formation and properties.

188 Use in calico, cotton, paper, re-
covery of silver by Nitro-sulphuric acid,
medicine, &c.

MERCURY

189 Mercury (140); native compounds: cal-
cium and potassium.

190 Properties: Sp. G. (141); solution, heat,
solid, &c.; tests.

191 Salts: Nitrate (142 and 143); Sulphate
(144 and 145); Chloride (146 and 147);
their formation and properties; preparation,
&c.

192 Compounds: Oxide (148) ~~(149)~~; Sul-
phate (149 and 150); Cyanide (151);
amalgams, &c.; their formation and pro-
perties.

193 Use in extraction of gold and silver,
gold, &c.; medicine, &c.

Corrosive sublimate very soluble
with alkalies precipitates orange brown
to brick red - P white

Subsulfate of mercury
To obtain corrosive sub - digest
mercuric chloride with excess of
dry heat & distilled common sea
May be formed by action of chloro
on peroxide -

Colored formed from by rubbing
in corrosive sub - the globules do
appear & sublime -
best prepared by subliming in

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.

Purify from cor. sub. wash
 heated by hot water till no more
 comes. C^{tes} alkali
 used in moist way by heating the salt

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,

Handwritten notes:
 Sulphate of Iron is prepared by distilling
 the sulphuric acid over iron filings
 in a retort.

various metal alloys of which
copper & zinc

metallic copper obtained by
reduction of iron

Blue verditer

deutoxide of copper used in
analysis (organic) - oxygen unite
C & forms Cu

of iron insoluble in alcohol
see

liquor for absorbing oxygen - solution
ammoniate of iron thro' at stream
nitric oxide has been prepared
is decomposed by heat alone

for salts of iron ferrous sulphate of
sulphate of protoxide of iron be per
the base iron sesquioxide - double of sulphate gives

CHAPTER II

The first part of the book is devoted to a general introduction and to the history of the subject.

The second part is devoted to a detailed description of the various methods of investigation.

The third part is devoted to a discussion of the results of the various methods of investigation.

The fourth part is devoted to a discussion of the various methods of investigation.

The fifth part is devoted to a discussion of the various methods of investigation.

CHAPTER III

The first part of the book is devoted to a general introduction and to the history of the subject.

The second part is devoted to a detailed description of the various methods of investigation.

The third part is devoted to a discussion of the results of the various methods of investigation.

- 200. Ferrate (18), Chlorides (19 and 23); Ferro-cyanate; their formation and properties; precipitates, &c.
- 201. Compounds: Oxides (26 and 27); Sulphates (46); combinations with alkalies; alloys; their preparation and properties.
- 202. Uses; in steel, as formative and properties; history; miscellaneous uses of Iron.

LEAD

- 203. Lead (194); native combinations; separation and reduction.
- 204. Properties; sp. gr., m.p., solubility &c. &c.
- 205. Salts; Nitrate (206); Sulphate (100); Carbonate (104); Phosphate (140); Chloride (207) &c. &c.; their preparation, properties and precipitates.
- 206. Compounds: Oxides (112, 113, 114); Sulphate (100); Phosphate (140); &c. &c.; their formation and properties.
- 207. Uses; in soldering; in printing; in medicine; &c. &c.

By exposing coils of lead to
fumes of vinegar placed in pits
in dung beds.

+ cannot be crystalline artificially
chloride of lead yellow used for
saddles, obtained from carbonic
& carbonate of soda -

acetate of alumine used largely as
an antidote obtained from sulphate
of alumine & acetate of lead

- 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.

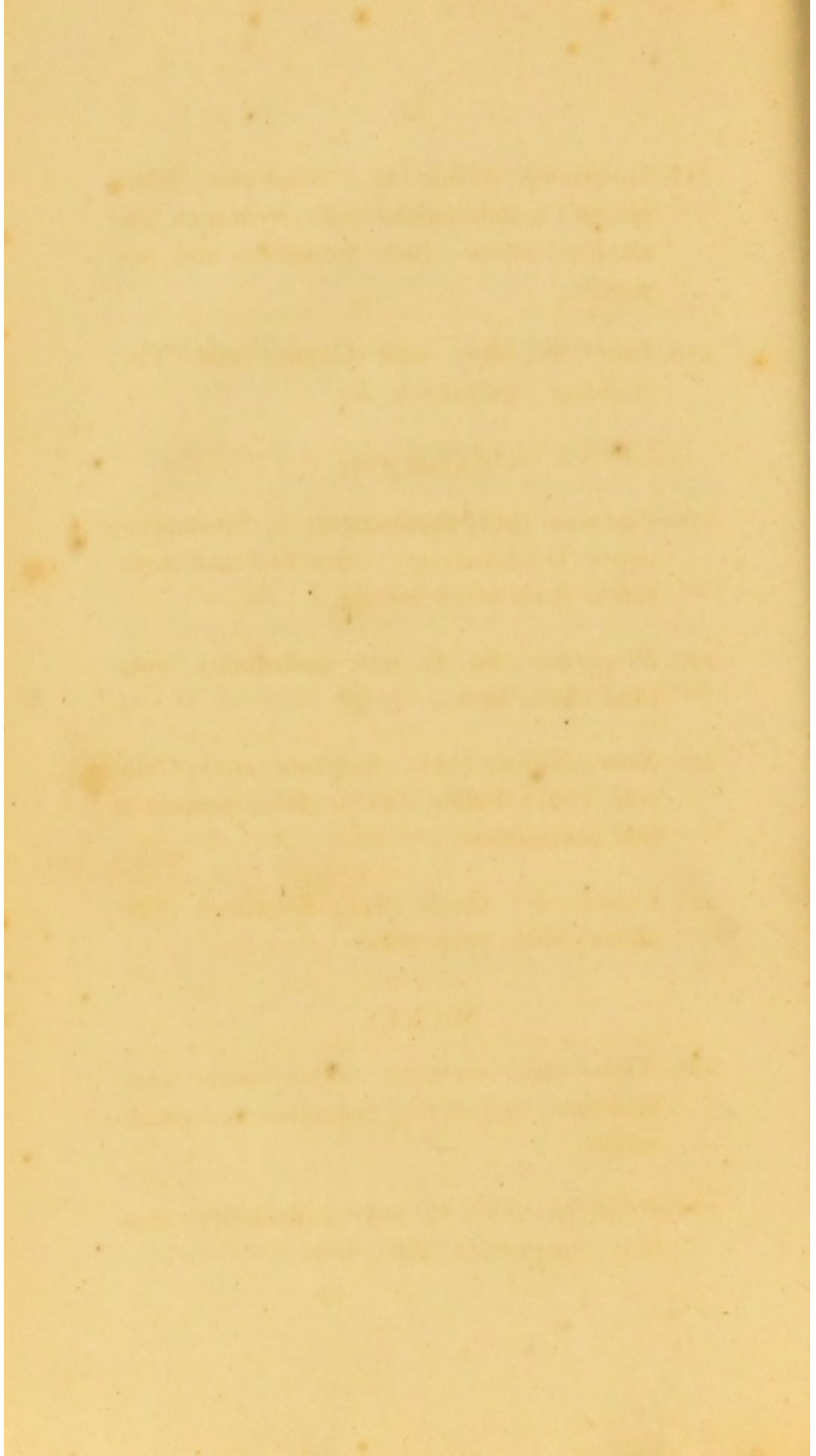
hydrochloride of tin by digestion to
except \square - used largely
deoxygense substances as
indigo, indigo, etc. - (may
be obtained indirectly from tin
corrosive sublimate ^{displacement} but has
deoxygenising prop.)

Phosphate of zinc iron sulphates
sulphate of magnesia

Ironies - iron - expose to
atmosphere iron peroxide form of
iron & go on balling
out by hydrate of zinc -

- 100. The
- 101. Properties of
- 102.
- 103.
- 104.
- 105.

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- 107. Properties of
- 108.
- 109.



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.

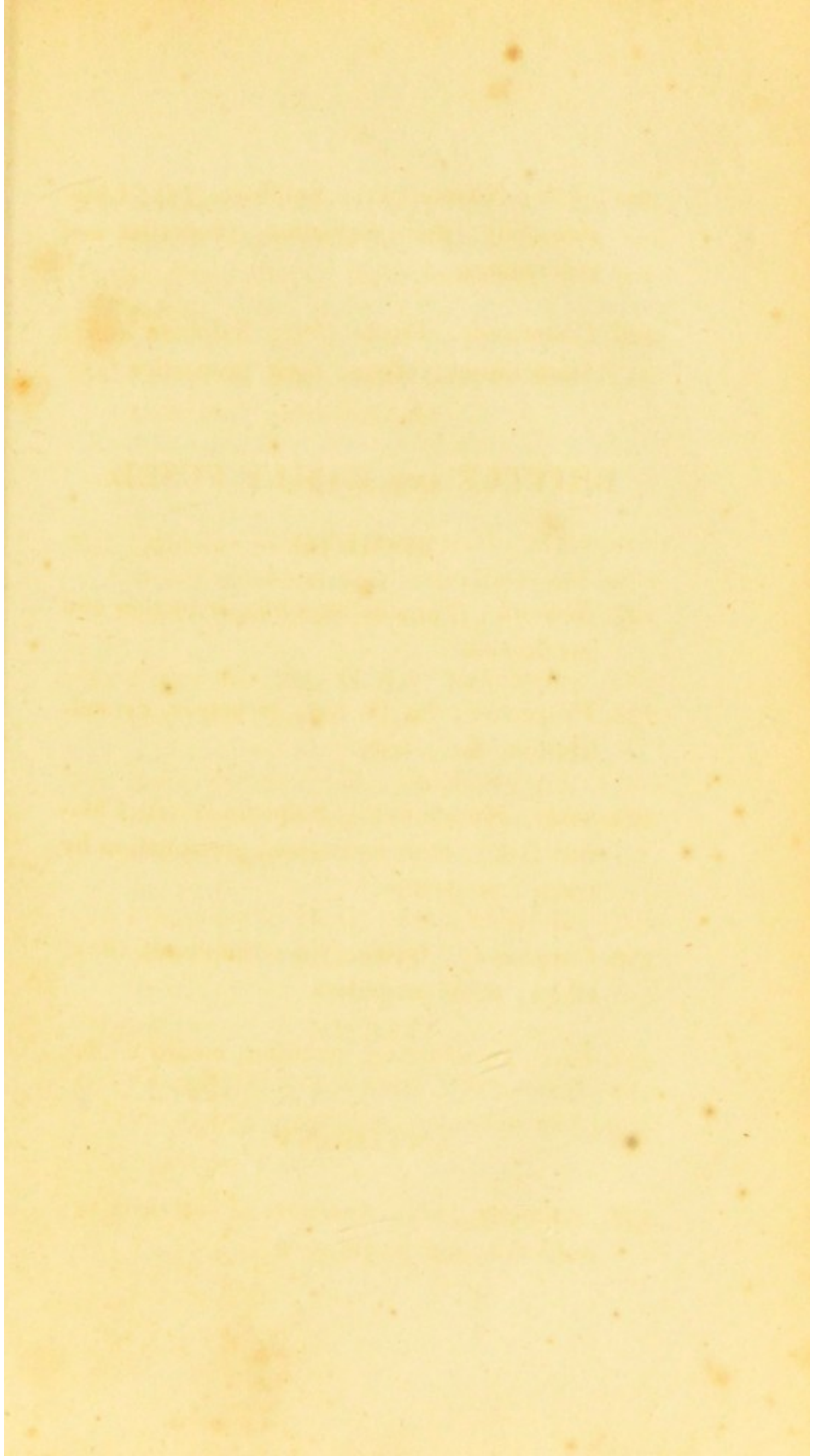
229. *Salts*; Nitrate (133); Sulphate (119); Chloride (107); their formation; precipitation by water; properties.

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.



1870-1871. [Faint text]

1872-1873. [Faint text]

BRITISH AND FAMILY FUNDS

BRITISH

1874-1875. [Faint text]

1876-1877. [Faint text]

1878-1879. [Faint text]

1880-1881. [Faint text]

1882-1883. [Faint text]

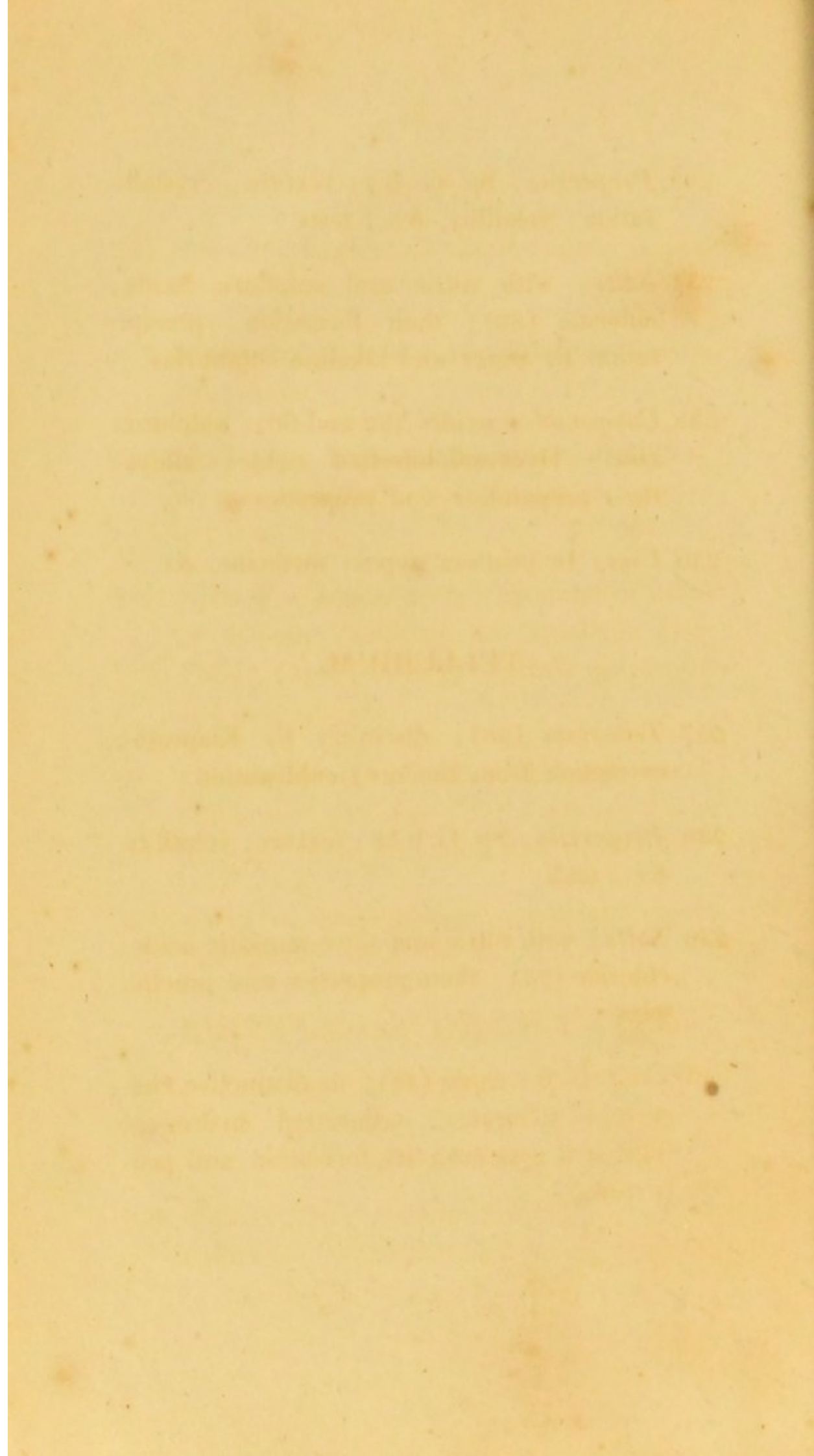
BRITISH

1884-1885. [Faint text]

- 233. Properties, Sp. Gr. 0.5, texture; crystallization; volatility, &c.; tests.
- 234. Solts; with sulfuric and sulphuric acids; chlorides (237); their formation, precipitation by water and alkaline sulphates.
- 235. Compounds, oxides (232 and 237); sulphuret (237); Hydro-sulphurated water; alloys; their preparation and properties.
- 236. Uses: in printers' types; medicine, &c.

TELLURIUM.

- 237. Tellurium (23); discovery by Klaproth; extraction from the ore; sublimation.
- 238. Properties, Sp. Gr. 6.14; texture; volatility, &c.; tests.
- 239. Solts; with nitric and nitro-muriatic acids; chlorides (241); their properties and preparation.
- 240. Compounds, acids (241); Oxidantive the-oxides; chlorides; sulphurated hydrogen; sulphur and arsenic; its formation and preparation.



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.

arseniate of potash formed by heating
white arsenic & caustic potash.
arseniate with nitrate of potash
The arseniates are isomorphous
with the phosphates.

To obtain salts of metals dissolve
a metal in that acid which
acts readily upon it & precipitate
by an alkaline carbonate from which
the salt may be obtained -
acetate of silver from carbonate

ARTICLE

241. [Faint text]

242. [Faint text]

243. [Faint text]

244. [Faint text]

245. [Faint text]

246. [Faint text]

247. [Faint text]

248. [Faint text]

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249. [Faint text]

250. [Faint text]

The change of colour in various
of cobalt does not depend on
change of Temp. - but its tract
of moisture - (changes under
air damp - if good blue, if
green - ^{another} synthetic ink -
acetate of lead & sulphuric
hyd - another nitrate of
a galls - Write on paper w/
starch & wash over w/ hydroiodic
acid

Chameleon mineral - changes
colour by addition of water -
Manganous acid by excess of
oxygen w/ metal -
Other instances - Chromates
arsenates -

248. *Properties*; Sp. G. 7.7; Magnetic; tests, &c.
249. *Salts*; Nitrate (92); Phosphate (66); nitromuriate, &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; manganesates.
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.

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THE UNIVERSITY OF CHICAGO
DEPARTMENT OF CHEMISTRY
RESEARCH REPORT NO. 100

BY
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AND
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MAY 15 1954

CHICAGO, ILLINOIS
1954

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.

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275. *Columbium* (144); discovery by Hatchet; native sources; reduction by Berzelius.
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277. *Compounds*; oxide, by fusion with potash and solution in acids; process, &c.

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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.

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2. Chapter I. The first part of the work

3. Chapter II. The second part of the work

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VEGETABLE SUBSTANCES

The vegetable kingdom is distinguished from the animal by the absence of organized animal life, and the presence of green plants which are capable of producing their own food by the process of photosynthesis.

The vegetable kingdom is the source of all the organic matter which enters into the composition of the animal body, and it is the only source of the oxygen which is necessary for the life of the animal.

The vegetable kingdom is the source of all the food which we eat, and it is the only source of the oxygen which we breathe.

The vegetable kingdom is the source of all the raw materials which we use in the manufacture of our clothing, and it is the only source of the oxygen which we breathe.

hydrogen & water - results from
distillation of vegetable matter

C & water - gums starch &c.

C water & - acids.

C water &) oils resins.

In inorganic compounds one
of the radicals exists as a single
atom - in organic - many
example C

Like In the process of malting
oxygen is consumed & C given
out a 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 nitrogen
from the atmosphere, when
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 Hatched.

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

When indigo is dissolved in water
it may be diluted - common
indigo is not soluble till deoxidized
with green sulphate of iron & f

analysis of vegetable matters by ...
The chlorate of potash - subliming
weighing papers - or paper with
artificial potash - note quantity of
absorbed - mix 1 w - 2
tomato 1/9 - f.

Present mode - heat cap
hammer of scales - or decom-
hydrate of copper by red heat
mix this substance ^{both} perfectly
by heating to 212 - or by

oxide of copper in excess
basis 300 to 1 - heat in tube
a sublimate. Iron fused mixture
of time. - f. absorbs water &
into mercury - weigh tube before
& after - gain of weight owing to

gain & sugar give the same result
in their ultimate analysis. D - a
tic & succinic - difference may
depend on mode of arrangement
alcohol is not formed during distillation
& ...

from atmosphere & become
insoluble in water - are sol
in alcohol & alkalis - affini
for alumine - used in dyes
not definite compound -

- Gum - Test - L forms
Saccharic acid - ^{or malic or tartaric} alcohol
precip from water - U gives
citric acid - chlorine water -
To form such acid we must
begin w an organic substance
dissolve by alkalis & precip.
acetate of lead -

Sugar - juice of some contain
oxalic acid - boil down with

Starch not dissolved by hot
infusion of galls - Boiling -

Starch is soluble in alkalis &
afterwards in alcohol - Test
acetate of lead - iodine

During malting - quantity of
gluten diminished - and starch

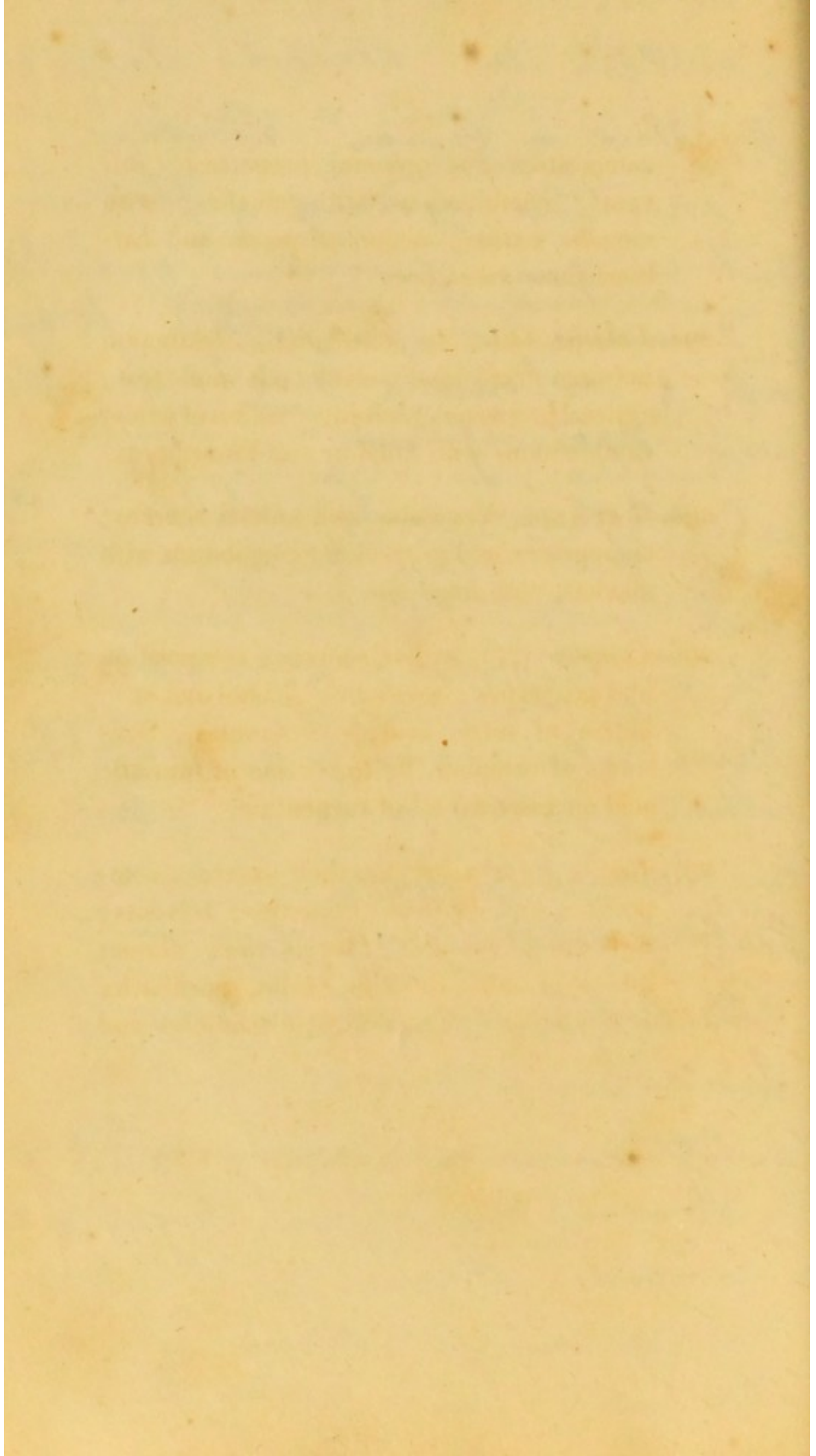
sugar / between two / increased -
Gluten - Alcohol takes up
Pyridine & leaves Limonene
to ascertain goodness of flowers
put in gum guaiacum quantity
zincous in proportion to inten-
sity of colour (said to be blue
intensity green) -

Carotene only soluble in ether
only that has been washed
with water / to free from alcohol
now dissolved in sulphur -

Black colour may be given by tannin
without gallic acid - Best for
tan, isinglass is 10 - for every 100
parts of solution 26 tan.

Bancroft on Philosophy of
Germanium colour

Most common mordant used
of alumine - from sugar of lead
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.

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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.

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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.

vali poison — apoc. strychni

Digitalis Purpurea, &c. their properties
and uses.

NATIVE VEGETABLE ACIDS.

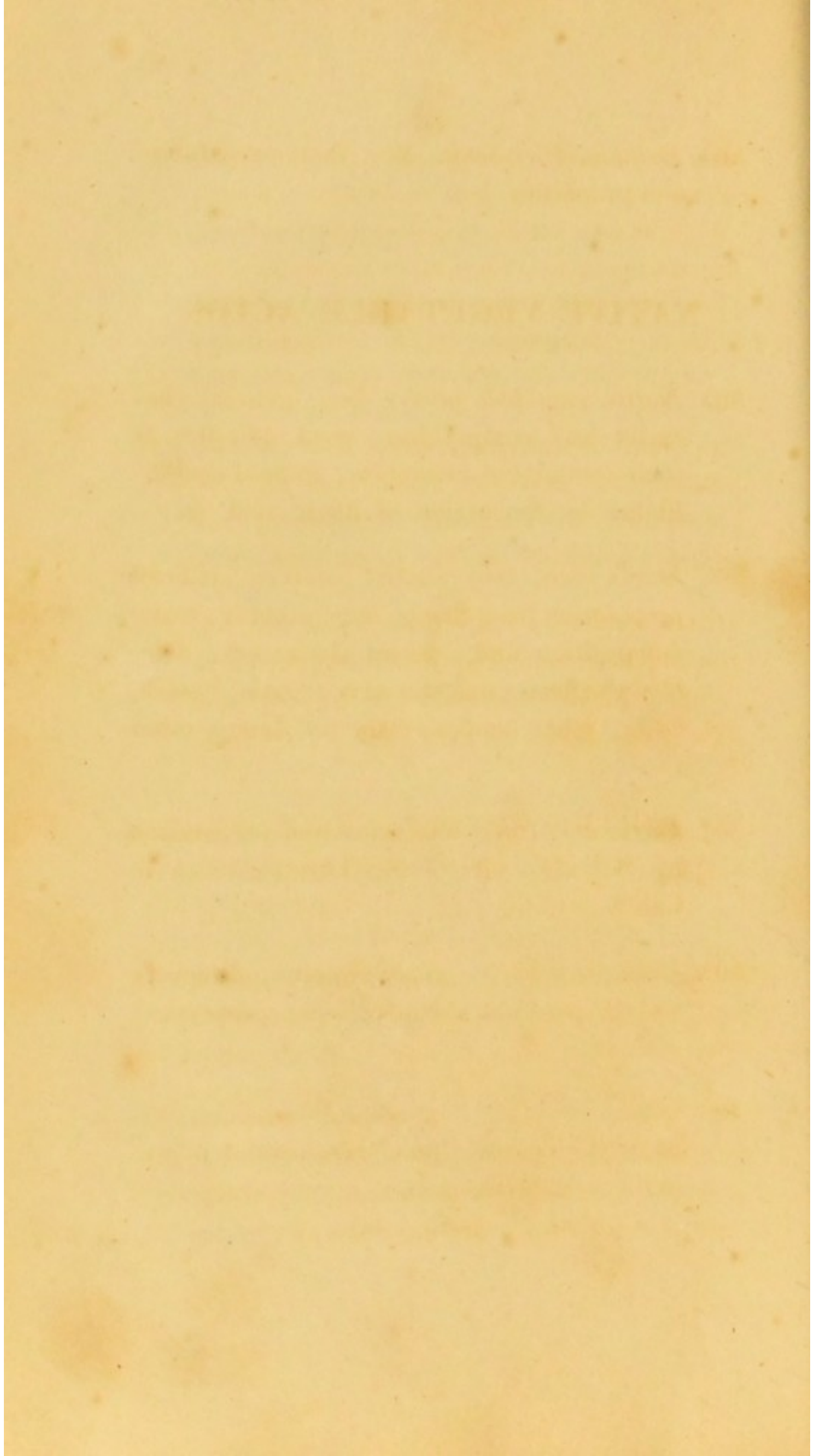
103. Native vegetable acids, their general char-
acters and properties, weak addition of
alkali, neutralization, mutual combi-
nations, &c.

104. Oxalic acid (10), native acids, official
preparations from Sugar, &c.; potash, lime,
ammonia and general characters, their
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105. Malic acid (11), official and pharmaceutical
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106. Tartaric acid (12), medicinal uses, &c.

107. Citric acid (13), medicinal uses, &c.



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.

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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.
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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-

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313. 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 Platinum, result; decomposition; constituents compared with those of Alcohol.

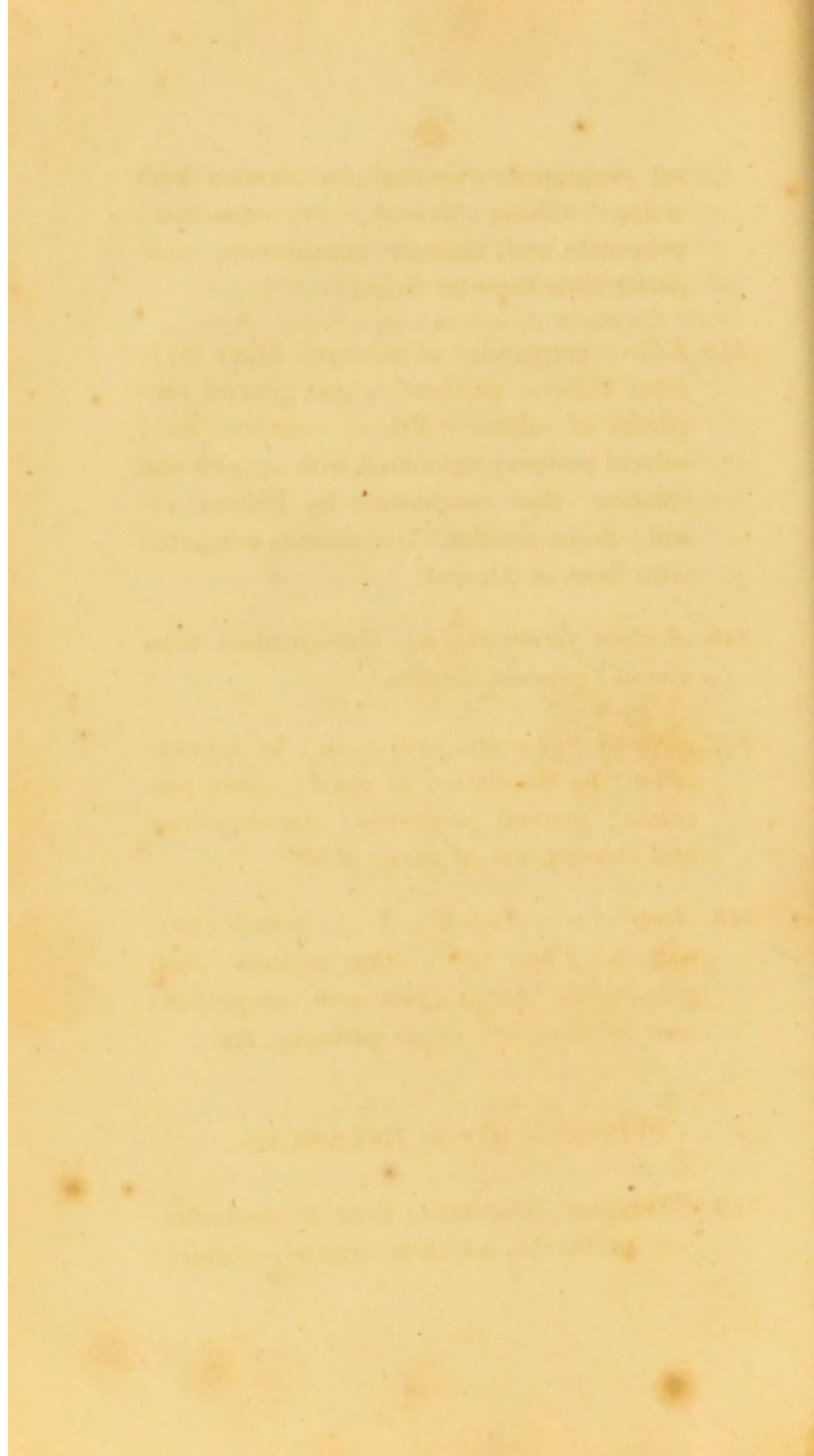
314. *Acetum Fermentatum*; distinguished from vinegar; process; results.

315. *Acetic and acetic (20) acids*; by fermentation, by distillation of wood; other processes; general properties; decomposition and constituents of acetic acid.

316. *Acids*; of Ammonia (); of Lead (38); of Zinc (39); of Iron (40); other articles; their preparation, composition and properties; use in medicine, color printing, &c.

ESSENTIAL SUBSTANCES.

317. *Essential Oils*; their general character; volatility; specific vegetable odors;

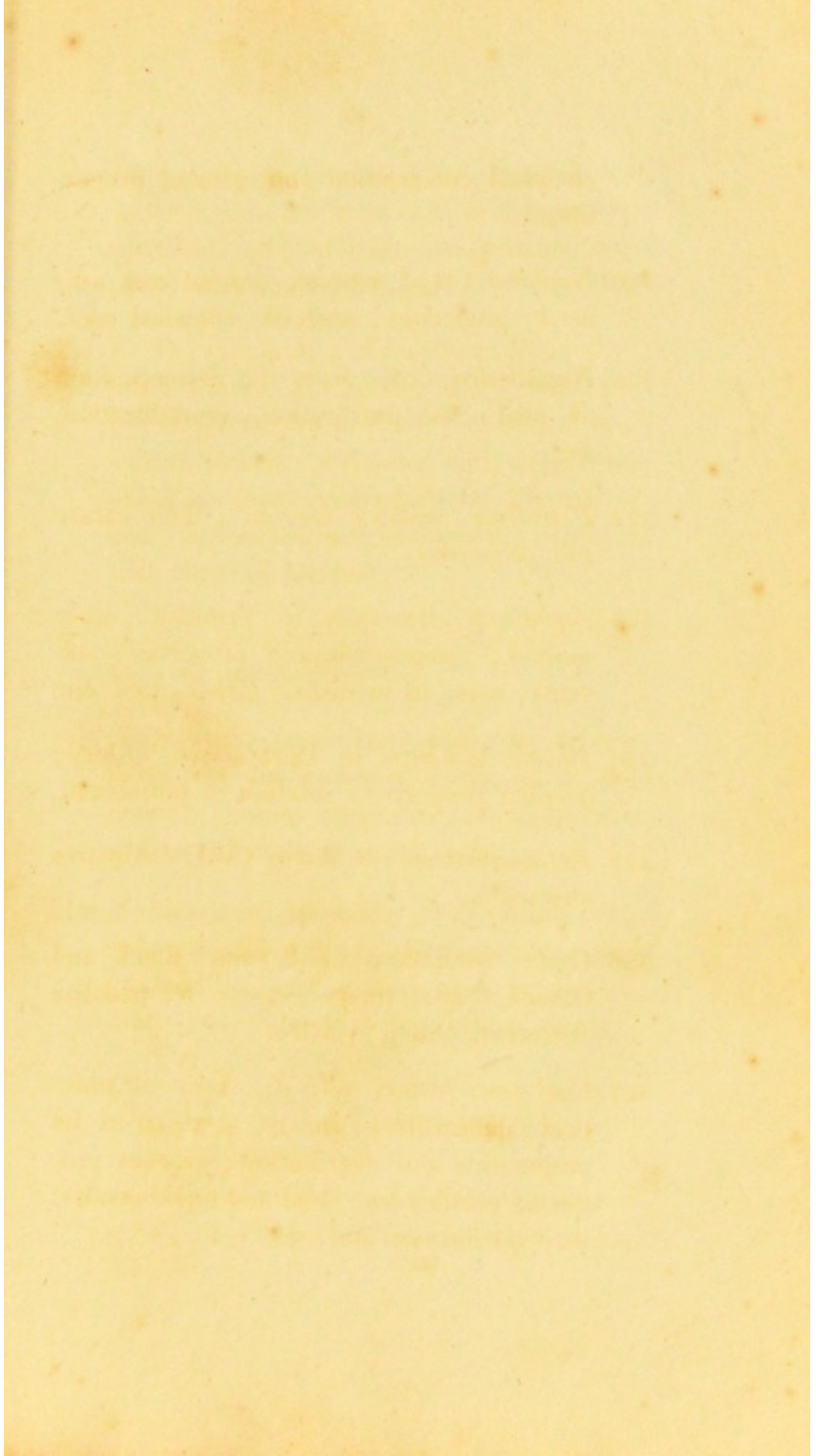


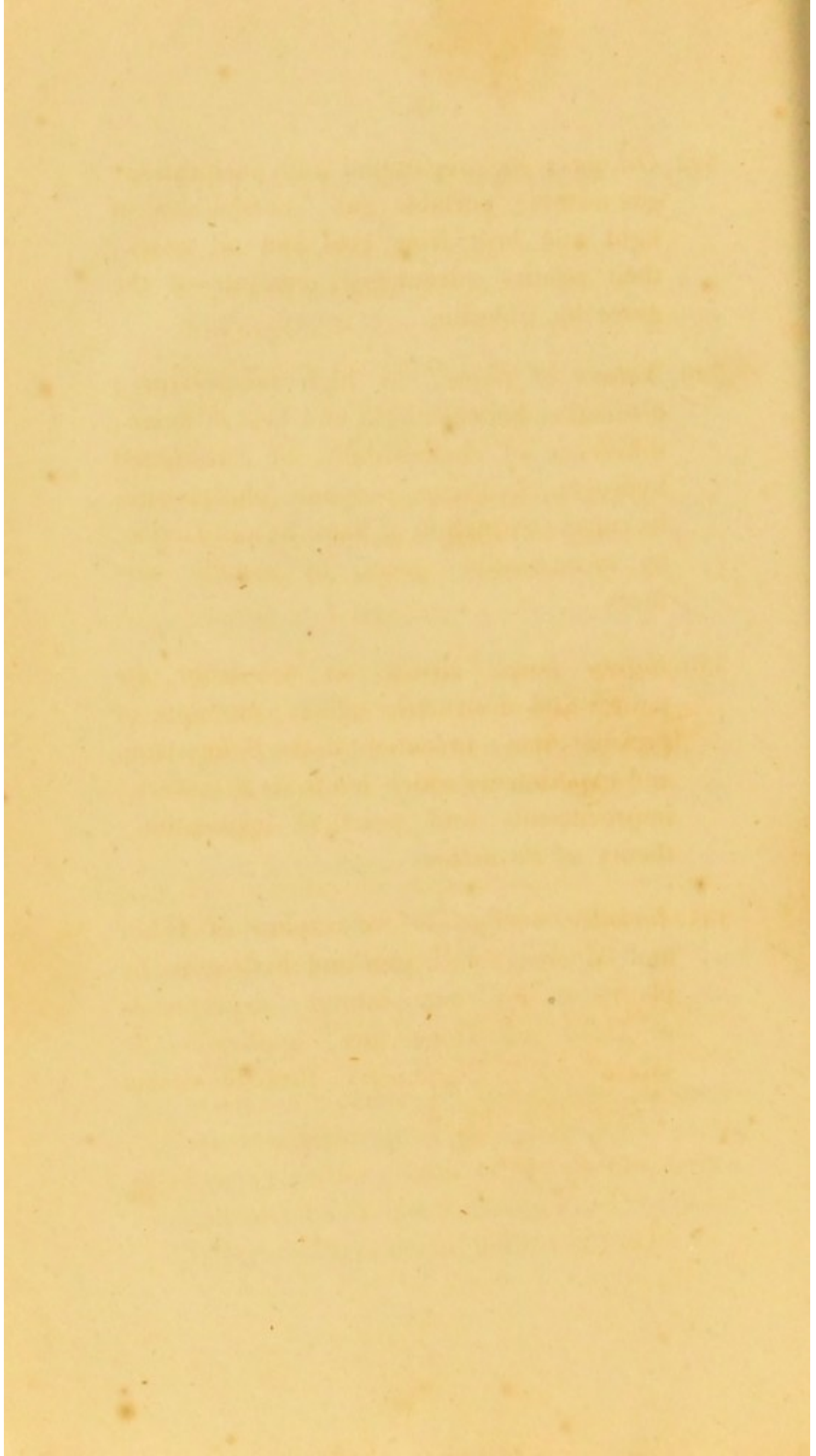
- ral properties ; chemical combination with water ; solvent powers ; decomposition ; proximate and ultimate constituents, compared with those of Sugar.
315. *Ether* ; preparation of Sulphuric Ether (37) ; other Ethers ; purification and general properties of sulphuric Ether ; volatility, &c. ; solvent 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.

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320. *Naphtha* (41)? sources, natural and artificial; properties; analysis; chemical uses.
321. *Naphthaline* (13); from the decomposition of coal; its purification, crystallization, &c.
322. *Petroleum*; *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.

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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.

Leetrol = - Ferric also precipitates
albumen — test for albumen —
massive sublimate or acetate
of lead — dilute acetic acid
and phosphate of Potash

acetic & malic acids are produced
from the action of L on fibrin
Galvanic test for albumen.

ANIMAL SUBSTANCES.

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

312. *Gelatin* (120): its preparation and general properties: action of acids: of alkalies: precipitation by acids: analysis. Analogy of gelatine and mucin.

313. *Albumen* (120): its composition: precipitation by heat, by alcohol, by acids and metallic salts: modes of its decomposition: its reaction by presence of iodine: decomposition by acids.

314. *Fibrin* (120): its preparation and properties: action of alcohol, of acids, of alkalies: its decomposition.

315. *Casein*: Effects of preparation on its chemical nature: albumen, fibrin, casein, of animal sources and artificial casein: water, albumen, casein, gelatin, gelatinized casein, and various matters: form of albumen: various constituents of milk: its uses in the animal economy. Preparation of French Milk.

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with indigestion. It differs
various fermentation, thus differs
from other animal substances
which ~~are~~ ~~distill~~ vegetables are
distinguished by this property

Goulard precipitates (from bile) all
a resin - leaving personal float
according to Pennard. Human
does not contain personal

cholesteric acid formed by
cholesterin in L
Freshly voided urine always acid in
presence of free G

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

D

Urea $H + O + C + 2H$ has a great portion of nitrogen from any other substance - diabetic urine. $O + C + H$

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-

... to purpurate of P - which
is expelled by heat.

The reappearance of uric acid test
of convalescence in diabetes.

Benzonic acid in urine of horse
in form of benzoate of P - seems
to replace the urate of P in the
urine of subject.

180. *Calculus of variations* - *the calculus of variations*
and the calculus of variations

181. *Calculus of variations* - *the calculus of variations*
and the calculus of variations
and the calculus of variations
and the calculus of variations

182. *Calculus of variations* - *the calculus of variations*
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183. *Calculus of variations* - *the calculus of variations*
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184. *Calculus of variations* - *the calculus of variations*
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186. *Calculus of variations* - *the calculus of variations*
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187. *Calculus of variations* - *the calculus of variations*
and the calculus of variations
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and the calculus of variations

1847

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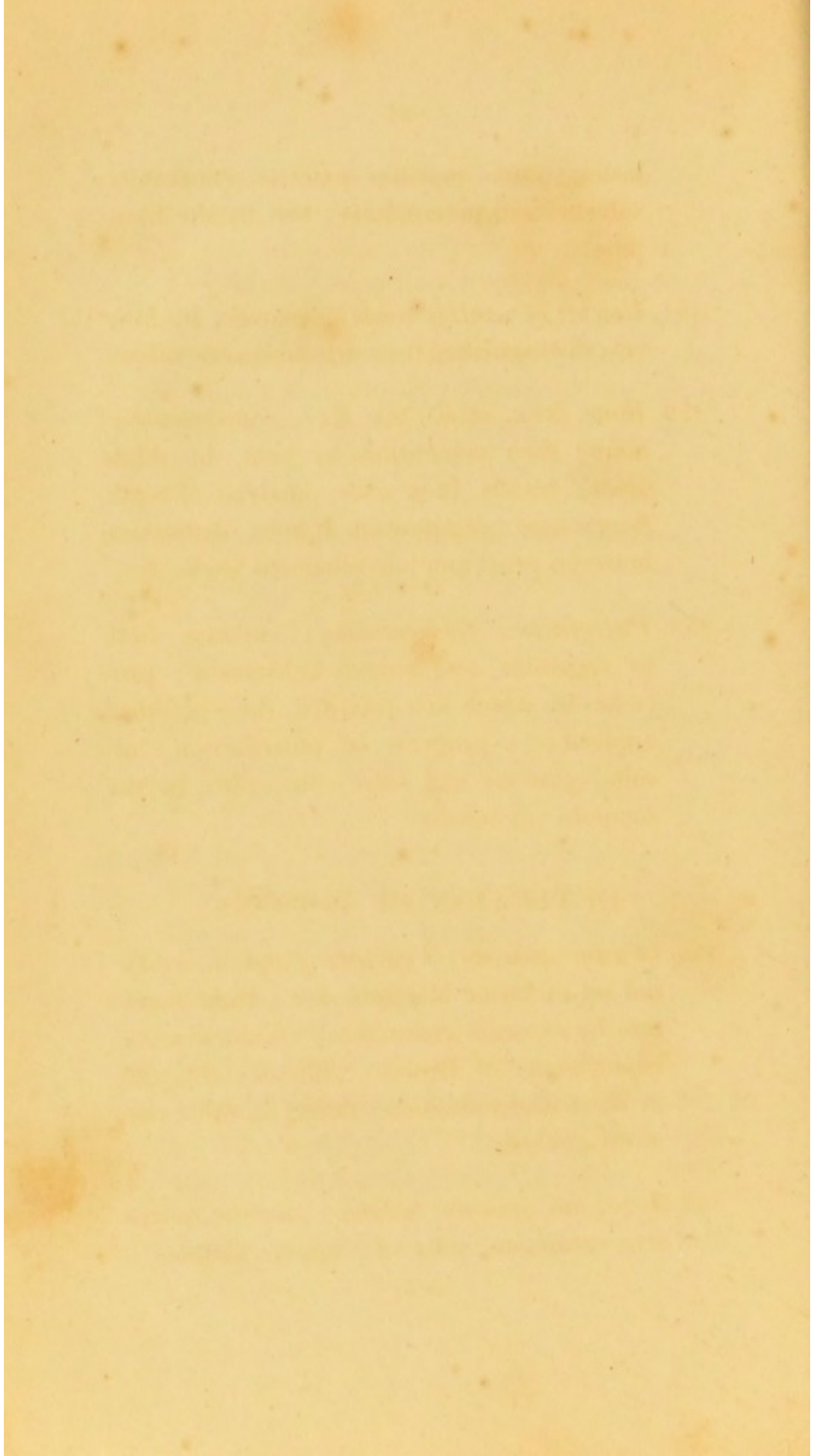
1849

1850

APPENDIX

1851

1852



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

read his book

351. *Calculi of xanthic oxide* ; discovery by Mar-
cet ; 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 ; pro-
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application ; progress of putrefaction ; re-
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economy of nature.

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354. *Organic poisons ; Vegetable* ; opium, essen-
tial oil of bitter almonds, &c. ; their detec-
tion by external characters ; chemical tests ;
experiments of Brodie ; *Animal* ; difficulty
in their discrimination ; defect in their che-
mical analysis.

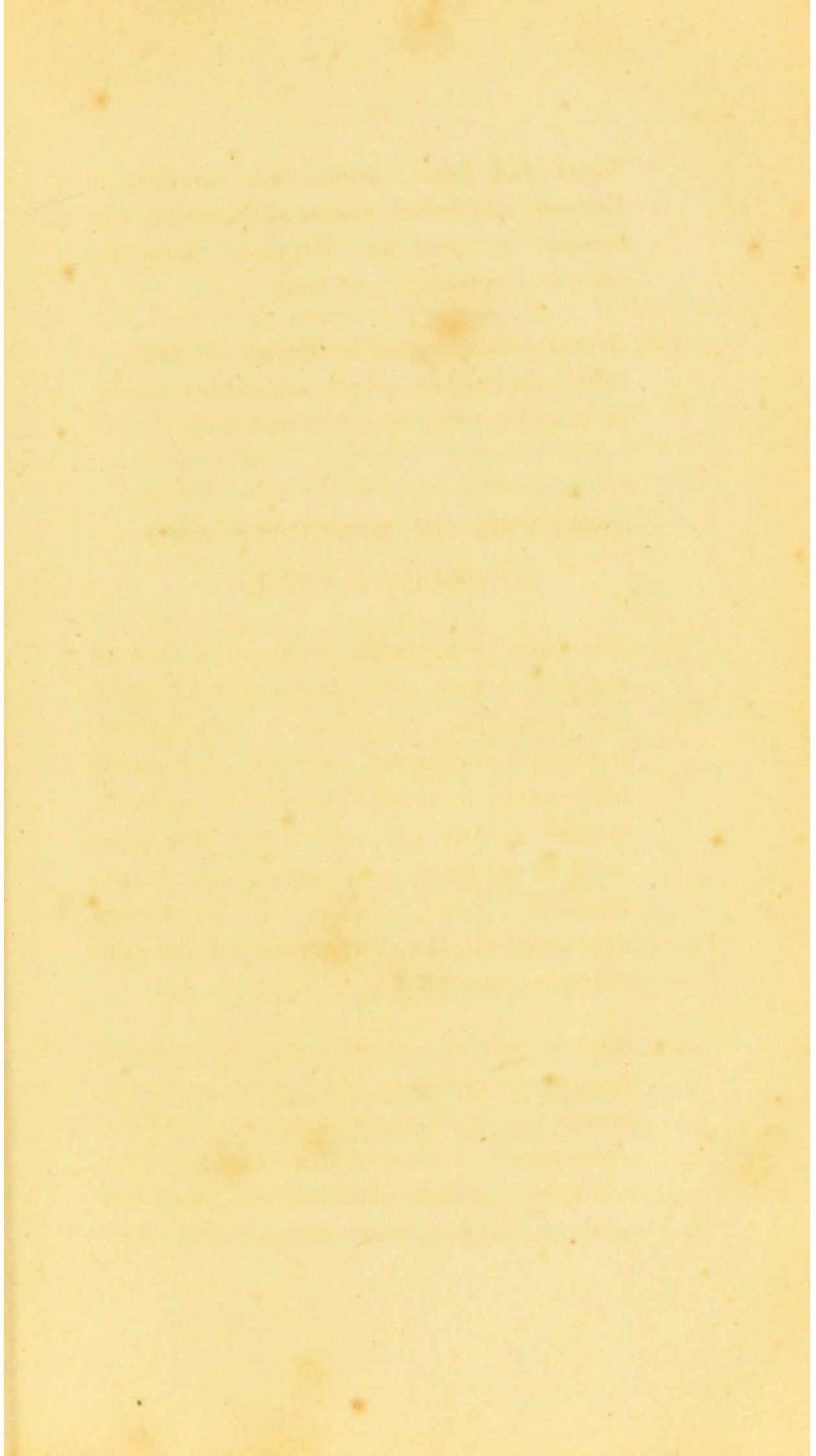
355. *Inorganic poisons ; soluble* ; arsenic, corro-
sive sublimate, salts of Copper, nitrates of

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.

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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-



Section 1. The Board of Directors of the
Company shall have the right to elect or
re-elect any or all members of the
Board of Directors and to fill any
vacancies that may occur.

Section 2. The Board of Directors shall have the right to elect or re-elect any or all members of the Board of Directors and to fill any vacancies that may occur.

ARTICLE IV MINIMUM REQUIREMENTS

Section 1. The minimum number of directors shall be five (5) and no more than ten (10). The Board of Directors shall elect one or more of its members to serve as President, Vice President, Secretary and Treasurer of the Company. The Board of Directors may also elect one or more members to serve as Directors at Large. The Board of Directors shall determine the qualifications for the office of Director and shall have the right to elect or re-elect any or all members of the Board of Directors and to fill any vacancies that may occur.

Section 2. The minimum number of directors shall be five (5) and no more than ten (10). The Board of Directors shall elect one or more of its members to serve as President, Vice President, Secretary and Treasurer of the Company. The Board of Directors may also elect one or more members to serve as Directors at Large. The Board of Directors shall determine the qualifications for the office of Director and shall have the right to elect or re-elect any or all members of the Board of Directors and to fill any vacancies that may occur.

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ELECTRO-CHEMISTRY

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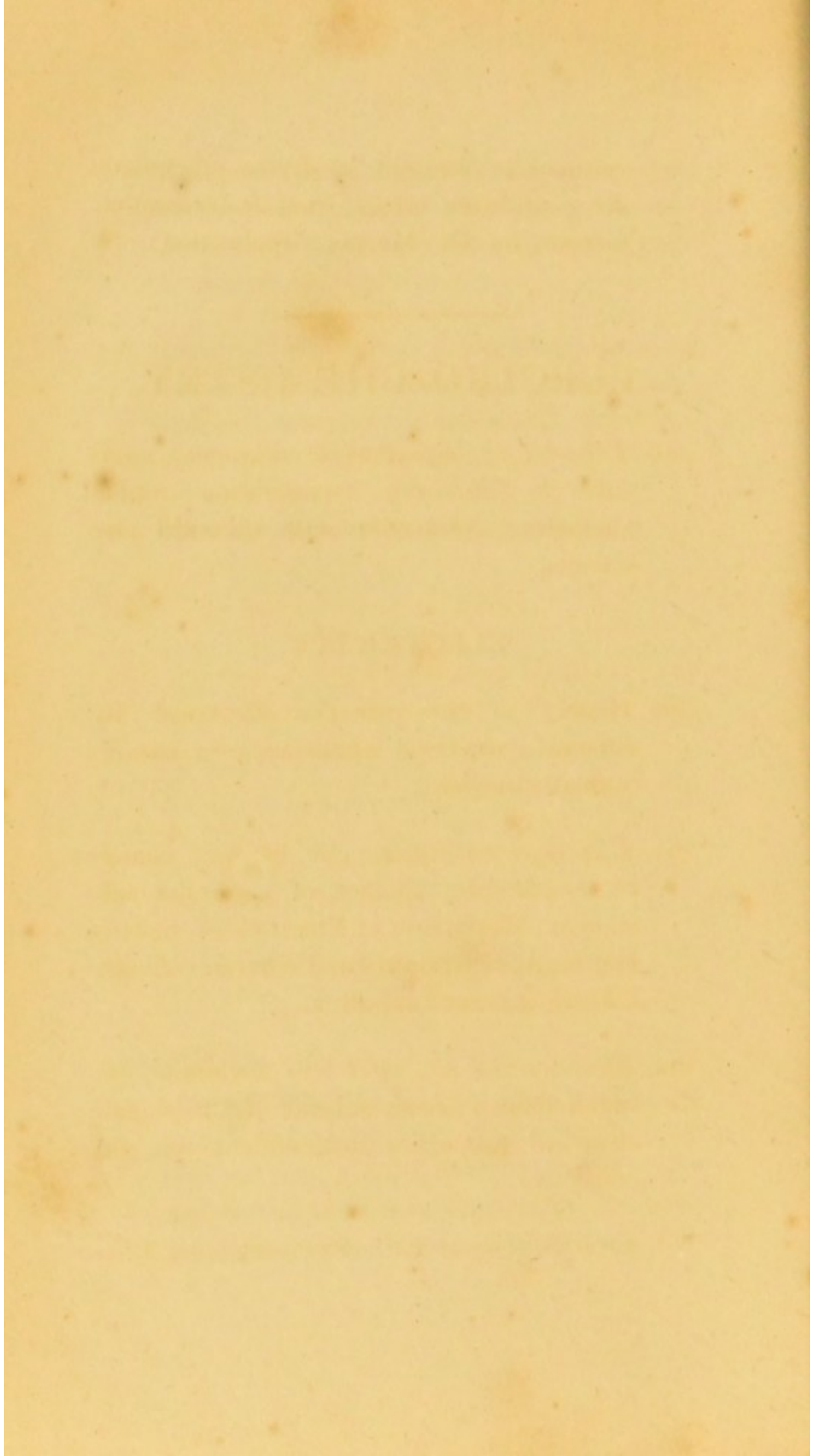
ELECTRICITY

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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.

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366. Supposed analogies between Electricity and Magnetism; experiments of Ritter and others; conjecture of Ørsted 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.

to render needle magnetic
by electricity. Poles must dip
in a direction transverse to
axis of needle +

unsymmetrical crystals of tourmaline
then heated exhibit electric
at dif. extremities -

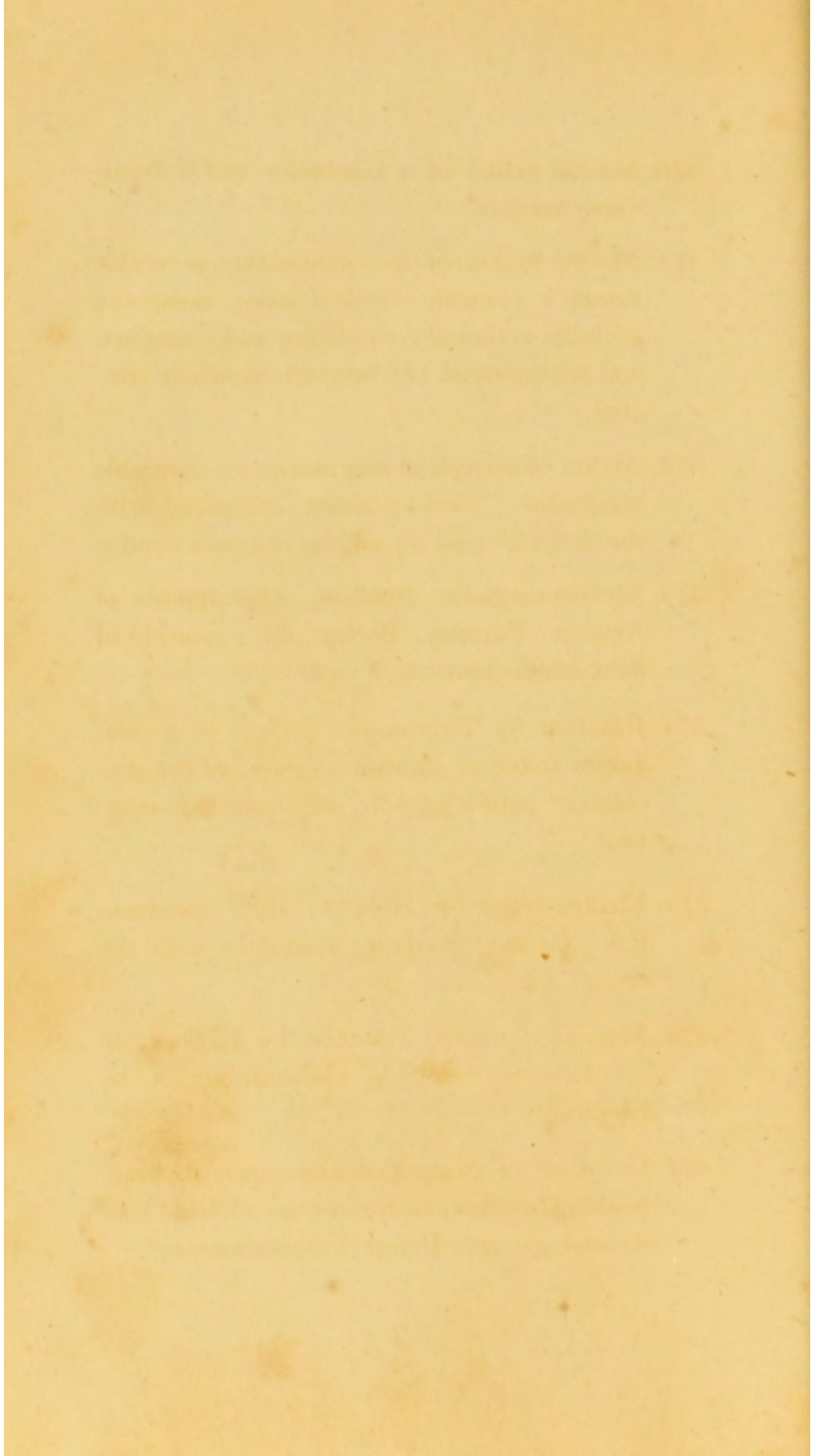
electricity excited by contact
if similar metals a fluid
interposed for one metal
res. greater affinity than the other

poles north & south according
to direction of transverse current
with one of needle points to
north -

currents of electricity after need-
les same effect as transverse
magnet. poles generated by

parallel currents attract each
other opposite repel

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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.

12. *Constitution of the United States, and the*
rights and obligations of the States.

13. *History of the United States, from the*
discovery to the present time.

14. *Theory of the Earth, and the history of*
the human race.

APPENDIX

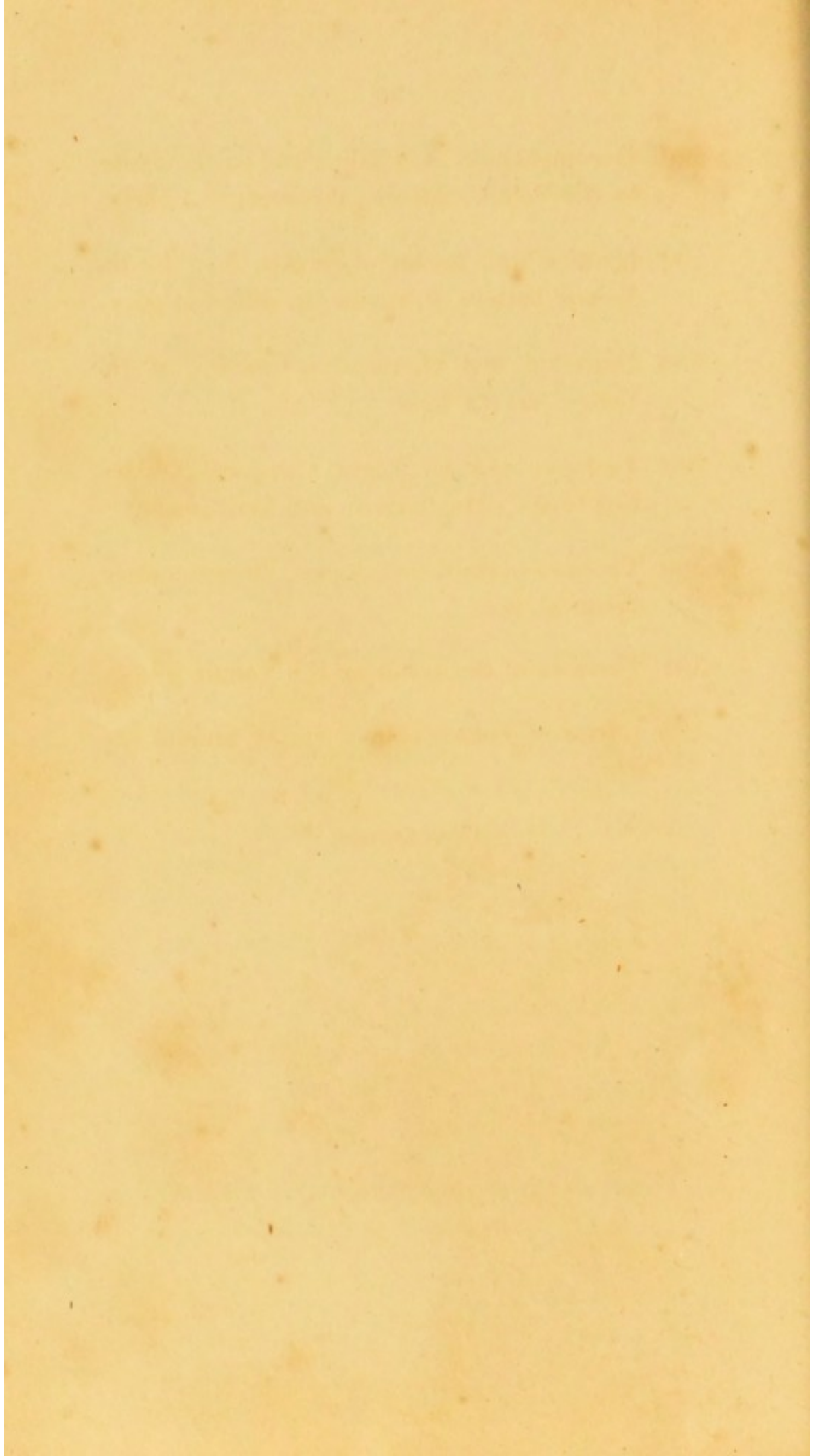
15. *Account of the various nations, and of*
their manners and customs.

16. *Political History of the United States,*
from 1776 to the present time.

17. *History of the various States of the Union,*
from their first settlement to the present
time, and of the different
constitutions of each of their respective
governments, and of the
rights and obligations of the
States.

18. *History of the various Colonies, and of*
the different manners and customs of
each of them, and of the
rights and obligations of the
Colonies.

19. *History of the various Territories,*
and of the different manners and
customs of each of them, and of the
rights and obligations of the
Territories.



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.



to influence therefore course
the course will prevent influence
July 18th hyd. 2000 - 905 - 50
very fine wire -

Fact, leading to descent of vapour
and dread of returning flamm
carb. hyd - latter prevents
tube of water in fine line
if length of tube be diminished
diameter must be $\frac{1}{2}$ - same as
length -

Carbonated hyd. when mixed with
atmospheric air not near so ex-
posed as pure hyd.

Flint will used formerly in carb.
carb. hyd. requiring white heat to
explode -

... of ...
bituminous
... acetic acid
... carburated hydro
... does not contain
... bitumen -

analysis of coal - driving
bitumen - coke remaining
Carburated hydro - paper thro
ed lime - on shelves in chamber
to free from moisture air - & ...
sulphurated hydro - presence of
led by paper moistened by acet
of lead - next sulphurous a
- C^{oxide} - all of it are removed
by lime -

gases obtained best at temp. of
red heat - paper over into water
for another retaining, then - the
residual contains lime - then in
open air -
besides tar & ligures - a great
quantity of ...

