

Universitäts- und Landesbibliothek Tirol

Universitäts- und Landesbibliothek Tirol

A handbook of chemical manipulation

Williams, Charles Greville

London, 1857

Contents

urn:nbn:at:at-ubi:2-3808

CONTENTS.

SECTION I.

Experimental Laboratory page 1

SECTION II.

Furnaces.

Athanor						10
Brande's Table-fu	rna	ce				11
Furnace-rings .						11
Supports for furns	ace.	-ba	°S			12
Hood of furnace						12
Sand-pots						13
Combustion - furn	ace	fo	or	tu	be	
operations						14
Luhme's furnace						15
Sefström's blast-fu	rna	ice				16
Staffordshire coke						17
Platinum crucible	s p	rote	ecte	ed		18
Precautions with 1	olas	st-f	irn	ace		18
Wind-furnace for						
tions						19
tions Furnace-bars for v	vin	d-f	urr	ace	э.	19
Fused products, p	orec	aut	tion	ns :	in	
making						20
Chauffer (sheet-irc	m)					21
Cupelling furnace				÷	÷	$\overline{22}$
Muffle						23
Cupel mould			÷.	÷.	÷.	23
Cupel mould . Maximum heat, p	osi	tion	0 0	f. i	in.	
furnaces				-, ·		24
Large sand-bath	ŝ.		Ĩ	Ĵ.		24
					•	~1

SECTION III.

Lamps.

Argand gas-burner .		25
Mixed air and gas-lamp		26
Remington's burner .		27
Beale's burner		27

Gas-furnace				pe	ige	28
Gas sand-bath						29
Bunsen's burner						29
Oil- and spirit-la	m	ps				30
Circular spirit-la	m	s				31
Stoneware wick-h	olo	ler	s			31
Berzelius's lamp						32
Crucible jacket .						32
•						

SECTION IV.

Blowpipe Apparatus.

Black's blowpipe		33
Wollaston's ditto		34
Cronstedt's ditto		34
Blowpipe-lamp		34
Continuous blast kept up .		36
Oxidizing and reducing flame		36
Supports for substances befor	e	
the blowpipe		37
Platinum wire and spoons .		38
Handle for ditto		39
Removal of fused mass from wir		
and spoons		39
Platinum foil		40
Clay supports		40
Forceps		41
Self-acting blowpipes		41
Table blowpipes		43

SECTION V.

Baths.

Spirit-bath								45
Water- and	oil	-ba	ths					46
Table of boi	lin	g-n	oir	its	of	sat	11-	
rated solu	tion	nso	fv	ari	ous	sal	ts	49
Kemp's gas-	reg	ula	tor	• .				49

SECTION VI.

Heat Measurers.

Construction of thermometers pa	ge51
Examination of thermometers .	54
Thermometers graduated on stem	56
Varieties of thermometers	57
Leslie's differential thermometer	58
Melloni's thermo-electric multi-	
plier	58
Self-registering thermometers .	58
Daniell's pyrometer	59
Wedgwood's ditto	59
Regnault's air-thermometer	60

SECTION VII.

Operations preparatory to Weighing.

States	in	whie	ch	sub	osta	nce	s a	re	
to b	e w	eighe	ed						65
Crucib	les	cool	ed						66
Desicc	atir	ng m	edi	a.					66
Watch	-gla	asses							67
Ignitic	n	of pre	ecij	oita	tes				67
Appara	atu	s to c	on	tair	ı su	bsta	anc	es	
		eing							71
Counte	erp	oises							72

SECTION VIII.

The Balance.

Proofs of good ins	stru	me	nt			73
Robinson's balanc	e	•				75
Determination of	pla	tin	um	an	d	
silver in organic	c co	m	oou	nds	з.	75
Error caused by h	ook	-en	ds			76
Rider for balance						76
Oertling's balance	s.					77
Weights						78
Method of weight	\mathbf{ng}					78
Double weighing						79
Weighing of bulk	y aj	opa	rat	us		80
Weighing of deli	que	sce	\mathbf{nt}	su	b-	
stances						81
Crucibles, &c. o	cool	\mathbf{ed}	b	efo		
weighing						82
Substances which	emi	t c	orr	osi	ve	
vapours weighe	d					82
Weighing gases .						82

SECTION IX.

Specific Gravity.

Specific gravity in general page	83
of solids	83
of substances in grains	84
tube apparatus for taking .	85
of solids lighter than water	86
of substances soluble in water	87
of liquids	87
bottle	88
at standard temperature .	89
Hydrometers	90
Urinometer	91
Twaddell's scale	91
Beaumé's, Cartier's, Gay-Lus-	
sac's and Tralles' hydrometers	91
Hydrometers for hot climates .	92
Nicholson's hydrometer	92
Specific gravity bottle dried	93
Perforated stoppers to be avoided	93
Vapour densities	94
as check on analytical results	95
Dumas' method of taking .	95
	96
balloons for, dried	96
balloons for, the point made	96
quantity of fluid to be used	96
fluid inserted in balloon .	97
fusible solids inserted	97
nature of bath for supports for balloon	97
supports for balloon	97
bath heated	98
balloon inserted in bath .	99
balloon sealed	99
volumeofvapourascertained	100
residual air ascertained.	100
formula for calculation of .	101
fusible metal baths for	101
Table of density of acetic acid at	
	101
Vapour densities under dimi-	
nished pressures 1	02
Gay-Lussac's method of de-	
termining	102
termining	
at various pressures .	104
Donsition of mean Romault's	
method of determining	105
method of determining . balloons weighed balloons balanced balloons exhausted barometric manometer Frankland & Kolbe's method	105
balloons balanced	106
balloons exhausted	107
barometric manometer	108
Frankland & Kolbe's method	110

SECTION X.

Solution.

Varieties of solvents page	112
Solvents selected	113
Apparatus for solution	116
Test-tubes, flasks, retorts	116
Capsules	117
Beakers	118
Infusion, decoction, percolation	119
Payen's apparatus for continuous	
distillation	120
Transference of fluids	
Pouring down a rod	
Transference of solids into flasks	122
Solubility modified by presence	
of organic matter	122
Separation of bodies by differ-	
ence of solubility in certain	
menstrua	123

SECTION XI.

Precipitation.

Precipitation induced by heat 124 by gases125 in analysis126	
in analysis	
influence of heat on 127	
special instances of 128	
of organic bodies 129	
electro-chemical 130	
incomplete, how remedied 130	
state of solution altered pre-	
vious to	
retarded by organic matter 131	
Action of certain reagents 130	
Lime as a precipitant 133	
Precipitation facilitated by heat 134	
of valuable substances 135	
fractional 135	
apparatus for 135	

SECTION XII.

Filtration and Washing of Precipitates.

Precipitates washed by decanta-

tion			137
Filtration in general			138
Filtering-paper			138

Filters, w	veigh	ıt	of				pag	je	138
shap	e of		•				•		139
shap	natic	m	of	ash				•	139
fold	ed								139
cut	•				•			•	141
weig	hed								141
supp	orte	d						•	141
Gmelin's	was.	hi	ng-	bot	tle				142
Berzelius	's di	tto).						142
Wash-wa	ter t	es	ted						143
Continuo	us w	as	hir	0 0	fi	ore	cipi	-	
tates . by in					. 1				143
by in	nvert	tec	1 fla	ask					143
by G	av-I	[m	ssa	e's	me	the	bd		144
by E	Berze	lii	18'8	me	the	bd			145
by d	oubl	A	sinl	hon					146
Double fi Quadrant	lter					:	÷	÷	147
Quadrant	ts of	ti	n fe	or e	ntt	ing	reir	_	
cular fi	ilters				- ce ce ce				148
Splashing	ravo	id	ed		•	•	•	•	148
Clearness	off		pot	·		·ve	d.	•	148
Non-mise									
filtratio	1010	m	uus	o sel	Jai	all	u o	y	148
Calias fl)II	•	•	•	•	•	•	•	140
Calico fil	ters	•	•	:	·	۰.	i	•	140
Filtration									
at hi	gh t	en	npe	rati	ire	s	•	•	150
of vo									
of sn	nall	qu	lan	titie	28		•	•	151
out	of co	nt	act	of	air			•	152

SECTION XIII.

Supports for Apparatus.

Supports for filtration			153
for pulverization			155
for thermometers.			155
Wire triangle			156
Supports for evaporation .			156
Table support			157
Support for reduction-tube			157
Sefström's holder			157
Wooden vice			158
Retort-stands			159
Test-tube holder			159
Tripod stand			159
Vertical support			160
Supports for burettes			161
Gahn's cylinder-holder .			161
Blocks			162
Supports for U-tubes			163
Support for thermometer	an	d	
vapour-flask			163

SECTION XIV. Disintegration.

General remarks Pestles and morta				pa	ae	164
Pestles and morta	rs	of	va	riot	IS	
kinds						164
Reduction of subst	and	ces	to	pow	7-	
der						165
Pestle in one piece						166
Pestle in one piece Mortars tested and	pr	ese	rve	d		166
Refractory silicates	pu	ulve	eriz	ed		167
Agate mortar						168
Agate mortar exam						169
Agate mortar used						
operations .						169
Iron mortar						169
Pulverization of c						
chloride of amm						170
Metals obtained in	po	wd	er			170
Diamond mortar						170

SECTION XV.

Crucibles and Operations at High Temperatures.

Cornish crucibles 17	1
English crucibles 17	1
Skittle-pots	2
Hessian crucibles 17	3
Blue-pots	3
Porcelain crucibles 17	4
Platinum crucibles 17	5
Platinum capsules	6
Precautions in using platinum	
vessels	7
Gold crucibles 17	8
Silver crucibles	8
Iron crucibles 17	8
General remarks on crucible	
operations	8
Crucible tongs	9
Crucible tongs	
peratures	9
Crucibles heated	0
Crucible operations, special cases 18	2
Reductions in platinum and por-	
celain crucibles	5
Operations at high temperatures	
in tubes	5
Gun-barrels	6
Reductions in tubes 18	
Tubes luted	
Illustrations of processes in tubes 18	8

SECTION XVI.

Pressure-Tube Operations.

Pressure-tubes heated page	189
constructed	
labelled	190
Bath for pressure-tubes kept at	
constant level	191
Precautions in operations with	
pressure-tubes	
Pressure-tubes opened	192
Substitutes for pressure-tubes .	193

SECTION XVII.

Evaporation.

Evaporation over naked fire .	194
Bayeux and Meissen dishes	195
Necessity for stirring	196
Access of dust prevented	197
Evaporation over desiccating	
media	198
Precautions in drying substances	199

SECTION XVIII.

Distillation.

Alembic									202
Retorts.									203
Retorts. Substance	es a	dd	ed	du	rin	g d	listi	1-	
lation									204
Receivers						2	2		205
Substitute	es f	or	rete	orts	з.				206
Tube-reto	orts								207
Distillatio	on '	wit	h t	ube	e-re	tor	ts		209
Alembics	, tu	be	con	nde	ense	er,	con	n -	
mon st	ill								211
Distillatio	on '	wit	hс	om	mo	ns	still		213
Concussiv	re e	bu	lliti	ion					214
Worm cl	ean	ed							215
Precautio	ns	in	d	isti	llir	ng	wit	th	
retorts									216
Liebig's c	one	len	ser						217
Adapters									218
Adapters	use	ed a	is c	on	den	ser	s		219
Distillatio	on o	ofv	ery	VO.	lati	le f	lui	ls	220
Adapters	coo	olec	ι.						221
Fractiona	l d	isti	llat	ior	ı.				221
Special ca	ses	of	dis	still	lati	on			226
Distillatio	on (of s	ulp	ohu	ric	ac	id		227
Distillation of hy									$227 \\ 227$

Preparation of hydrochloric acid page Distillation of fluids which ex-	
acid page	229
Distillation of fluids which ex-	
plode at 212°	230
Distillation of mercury	230
Distillation in a current of hy-	0.01
drogen	231
Distillation of spontaneously in-	000
flammable fluids	232
Fluids requiring digestion pre-	233
vious to distillation Stoneware still	$235 \\ 234$
Chloride-of-celcium beth	$234 \\ 235$
Destructive distillation	235
Distillation of wood and coal .	236
Apparatus for destructive distil-	200
	237
Intion	238
Hot-air bath	239
	239
Distillation under diminished	
	240
Separation of bodies of different	
degrees of volatility by double-	0.35
headed still	241
Distillatory apparatus coated	212
headed still Distillatory apparatus coated with copper Small retorts for fractional di-	242
Small retorts for fractional di-	040
stillation	$243 \\ 243$
Apparetus for schebetion over	240
Apparatus for cohobation over sodium, &c.	244
soutum, ac	244
SECTION XIX.	
Sublimation.	
	015
Sublimation in platinum crucibles	$245 \\ 245$
in porcelain crucibles	245
in porcelain basins of iodine of naphthaline, &c	$245 \\ 245$
of paphthaline &c	240
of indigo	240
of biniodide of mercury .	247
Change of colour in substances	411
by sublimation	247
Sublimation in current of air .	248
in tubes	248
in crucibles	249
SECTION XX.	
Crystallization.	
Large crystals formed	251

Large crystals formed .		251	1
Fractional crystallization		252	ł

Decomposition induced by ten-	
dency to crystallize . page	253
Water of crystallization	253
Water mechanically contained	
between layers of crystals	254
Crystallization from alcohol and	
mixtures of alcohol and water	254
Crystallization of substances	
equally soluble in hot and	
cold water	255
cold water	
crystallized	255
crystallized	~~~
stallization	255
Removal of resinous and oily	~~~
impurities from organic bodies	205
Variations in tendency to as-	
sume crystalline state with	
different members of homolo-	050
gous series	200
Special instances of crystalliza-	057
tion.	201
Crystallization at high tempe-	050
ratures . Coloured crystals bleached by	200
Coloured crystals bleached by	950
animal charcoal	200
Crystallization of substances	200
from a solution in benzole .	
nom a solution in belizoie .	400

SECTION XXI.

Volumetric Manipulation.

a					0.00
Gay-Lussac's burett	е.				262
Mohr's alkalimeter.					262
Binks' alkalimeter .					262
precautions in					264
part of curve of	ffin	id t	01	he	
					00-
read from .					265
French alkalimeter					265
Volumetric determ	inat	ion		of	
acids					266
Lime-syrup					
C	· ·	•		•	200
Compression-bottle	for	fi	Шır	ıg	
burettes					267
Strength of standard	l sol	uti	ons		268
Volumetric determin	anti		f .	1	
kalies					271
Volumetric methods	in .	gen	era	1	271
Volumetricestimatic	nof	bro	mi	ne	271
Volumetric estimati					
rine, uranium, ur	ea. s	ilve	er		272

Test-papers						pag	ye	273
Litmus-pape	rs				•			274
Turmeric dit	to							274
Lead ditto								274
Logwood .							•	275
Fir-wood .								275
Guaiacum								275
Experiments	sh	OW	ing	ac	ecu	rac	V	
of the met	hoc	ls g	ive	n		. '		275
Alkalimetry								
Estimation of	fsi	lvei	· by	7 st	and	lar	d	
solution of	co	mn	non	sa	lt			276
Estimation of								1000
oil of turp								277
Results of an								
bonates of								278
	T		_	-	-		~	

SECTION XXII.

Gas Manipulation.

Sulphuretted hydrogen	. 279
Preparation of sulphuretted hy-	-
drogen from sulphide of iron	1 280
Kemp's sulphuretted hydrogen	1
apparatus	. 281
apparatus . Uses of sulphuretted hydrogen	. 283
Carbonic acid	. 284
Sulphuretted hydrogen and car-	-
bonic acid prepared on large	,
scale	. 285
Hydrogen	. 286
Reductions in hydrogen	. 287
Other uses of hydrogen in re-	
search	. 288
Hydrogen lamp	. 289
Oxygen prepared	. 291
Chlorine prepared	. 292
Chlorine prepared in large	,
quantities	. 292
Sulphurous acid prepared	. 293
Sulphite and hyposulphite of	f
soda prepared	. 294
Cyanogen prepared	.294
Nitrous acid prepared	. 295
Muriatic acid gas prepared .	295
Collection and retention of	f
gases	295
Pneumatic trough	296
Bee-hive shelf	. 297
Manipulation with gas-jars .	298
Gas-jars required in experi-	
ments	. 299
Deflagrating jar	299

	2.1
Experiments with gas-jars page	300
Gases collected by displacement	302
Kerr's gas-tube	304
Solution of gases	305
Safety-tubes	307
Gasometer	300
Gasometer Glass gasometer Transference of gases at the	919
Thomas gasometer	919
Transference of gases at the	
pneumatic trough	314
pneumatic trough Manipulation with gases over	
mercurv	316
Mercurial troughs	317
Cooper's mercurial receiver	
Transference of gases	321
Transferring pipette	322
Millow's transforming minette	
Miller's transferring pipette .	323
Regnault's gas analysing appa-	
ratus	324
ratus Frankland and Ward's gas ana-	
lysing apparatus	332
	337
	338
Gay-Lussac's eudiometer	339
	339
	340
	342
Reading-off of volumes	
	343
Error of meniscus	$\frac{343}{343}$
Error of meniscus	
Error of meniscus . Estimation of carbonic acid in carbonates by weight	343
carbonates by weight	343 344
Error of meniscus . Estimation of carbonic acid in carbonates by weight . Parnell's method . Fresenius and Will's apparatus	343 344 344

SECTION XXIII.

Manipulation connected with Organic Analysis.

Analysis with chromate of lead	349
	350
	351
	352
	353
	354
Corks prepared for combustions	355
	356
Combustion-tubes made	
Reduced copper turnings	358
Caoutchouc-tubes	
Combustion-furnace	359
Operations previous to all ana-	
lyses	360
Analysis of substances free from	
nitrogen	361

Analysis of substances contain-
ing nitrogen mage 367
Analysis of liquida 360
ing nitrogen page 367 Analysis of liquids 369 Combustion of fluids easily de-
composable by heat
composable by heat
Modified process for burning
fluids
Analysis of fusible solids 373
Glass trays made
Analysis of substances difficultly
combustible
Laurent's mode of burning in a
current of oxygen 375
current of oxygen 375 Potash-tube with extra tube at-
tached
Combustion of very volatile li-
quids
quids
taining carbon
Estimation of nitrogen 380
Estimation of nitrogen by Will
and Varrentrap's method
Kemp's nitrogen-tube
Kemp's nitrogen-tube 381 Nitrogen determinations made
in gun-barrel
in gun-barrel
big's qualitative method
big's qualitative method 383 Determination of nitrogen by
Bunsen's method 384
Bunsen's method
Absolute method of determining
nitrogen
Gas-furnaces for organic analy-
sis
Beale's furnace 390
Hofmann's furnace 390
sis
tions
O VYTY

SECTION XXIV.

Glass-working.

Tubes bent .						400
Herapath's jet						401
Cutting glass						402
Spring-coals or	p	astil	les			403
Piercing holes i	n	glas	s			404
Siphons made	•	•				406
Tubes closed.						408
Pipettes made						409
Bulbs blown .						410
Gas-funnel .					÷	411
U-tubes made			•		•	413

Safety-tubes made . . . page 414 Retort and receiver in one piece 415

SECTION XXV.

Electrical and Galvanic Manipulation.

Electrophorus const	ructe	d			417
Smee's battery					418
Silver platinized .					419
Smee's battery made	е.				420
Large binding-screw	7.				422
A					422
Binding-screw for	Grove	's	bat	-	
tery					423
Daniell's battery .					424
Bunsen's battery con	nstru	etee	F		
Miscellaneous galva	nic m	ani	ipu	-	
lation					426
Binding-screws and	conn	exi	ons	5	426
Apparatus for electr	olysis	3			427
Apparatus for prepa					
gas					428
Apparatus for ob	tainir	1g	ga	s	
from either electr					429
Electrotype					
Glass flasks covered	with	cor	ne	r	431
Copper flasks made	by th	ie e	lec	-	
trotype	~ j u				432
	- C	-	-	•	

SECTION XXVI.

Miscellaneous Operations.

List of tools	434
Wooden screws made	435
Metallic screws made	436
Caoutchouc-tubes	437
Corks and cork-borers	439
	440
Stopcocks . Exhausted globes filled with gas	445
Exhausted globes filled with gas	447
Knots	448
The barometer	450
The goniometer	451
	452
	453
The air-pump	457
	459
Precautions in drying in vacuo	460
	461
Silver salts dried in vacuo in	
darkness	462

SECTION XXVII.

Processes and Reactions employed in some researches.

projou in boino roboniono.
Non-metallic bodies page 465
Processes of oxidation 466
Atomic weight of non-metallic
element determined 468
Determination of vapour volume 469
Processes and reactions con-
nected with metals 469
nected with metals
mium 471
mium
new metal by Bergman 412
Subphosphate of yttria mis-
taken for new metal 472
Thorina mistaken for new me-
tal, and called donarium 472
Physical properties of metals . 473
tal, and called donarium 472 Physical properties of metals
Tenacity of metals 475
Tenacity of metals 475 Chemical properties of metals . 475
Metallic oxides 4/1
Ilmenium a mixture of sesqui-
oxide and binoxide of niobium 477
Pelopium a mixture of tantalic
acid with niobate of niobous
acid
Solubility of metals in acids . 478
Reduction of oxides to lower state of oxidation 479
state of oxidation
Peculiarities of various oxides . 481
Action of the non-metallic ele-
ments on metallic oxides 484
Action of chlorine on metallic
oxides
weights
weights
elements
Metallic groups
elements
organic researches 493
organic researches 493 Volatile acids examined 495
Fixed vegetable acids examined 496
Acids derived from the animal
kingdom 498
Acids produced by treating or-
ganic substances with oxidi-
zing agents 500
0.0

	Formation of acids by treat-
	Formation of acids by treat- ment of organic substances
	with nitric acid page 501 Treatment with peroxides 503 Production of acids by ferment-
	Treatment with peroxides 503
	Production of acids by ferment-
	ation
	Treatment of organic bodies
	with acids to form conjugate
	acids 504
	acids
	Production of acids by destruc-
	Brue acida 506
	tive distillation
	acida 507
	acids 507 Gerhardt's anhydrous acids
	Decomposition of anhydrous
	acids by metals 509
	Decomposition of anhydrous acids by metals 509 Organic alkaloids 510 Alkaloids obtained from the ve-
	Alkaloids obtained from the ve-
	getable kingdom 510 Bases derived from the animal
	Bases derived from the animal
	kingdom 513
	kingdom
	tion of alkalies on the cyanic
	and cyanuric ethers 515 Production of bases by the ac-
	Production of bases by the ac-
	tion of ammonia on the hy- driodic ethers
	driodic ethers
•	the nitro compounds of con
	tain hydrocarbons 519
	the nitro-compounds of cer- tain hydrocarbons
	the nitro-compounds of oxi-
	dized bodies
	Formation of alkaloids by de-
	structive distillation
	General remarks on organic
	alkaloids
	Some processes and reactions
	connected with neutral bodies 524
	Alcohols
l	Aldehydes
۱	Ethers
	Nature of aldehydes
	Aldehydes produced by destruc-
	tive distillation 530
	Aldehydes found in plants 530
	Isomeric aldehydes
	Thialdine
	tive distillation
	complex mixtures 531

				pa	ge	531
						531
ben	zol	е				533
ls						
hor	nol	ogo	ous	wit	th	
						534
of	hal	log	en	con	n-	
odi	um					535
					•	536
	ben ls hor of	benzol ls homol of hal odium	benzole ls . homologo of halog odium .	benzole ls homologous of halogen odium	benzole ls homologous wit of halogen con odium	benzole

Appendix.

Lamp for the production of high	
	537
Forge for high temperatures .	539
	540
Determination of vapour-densi-	~ 10
ties at varying pressures	542
Lines divided into equal parts . Stills for destructive distilla-	544
	~ . ~
tion, &c	545
	546
	547
	547
Small press for squeezing fluids	E10
out of preparations Cement for glass and metal for	548
Cement for glass and metal for	510
temperatures up to 212° Apparatus for obtaining the elec-	548
tric spark in damp rooms .	548
Plan of laboratory, and descrip-	010
tion	549
	010
TABLES	552
I. For conversion of de-	001
grees Centigrade into	
degrees Fahrenheit	
	552
II. Elastic force of aque-	552
II. Elastic force of aque- ous vapour in inches	552
II. Elastic force of aque- ous vapour in inches	552
II. Elastic force of aque- ous vapour in inches of mercury for Fahr- enheit's thermometer.	
 II. Elastic force of aque- ous vapour in inches of mercury for Fahr- enheit's thermometer . III. Elastic force of aque- 	
 II. Elastic force of aque- ous vapour in inches of mercury for Fahr- enheit's thermometer . III. Elastic force of aque- 	
II. Elastic force of aque- ous vapour in inches of mercury for Fahr- enheit's thermometer.	
 II. Elastic force of aque- ous vapour in inches of mercury for Fahr- enheit's thermometer . III. Elastic force of aque- ous vapour in milli- 	
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer. IV. Comparison of the de- 	554
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	554
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	554
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer IV. Comparison of the degrees of the mercurial with those of the airthermometer according 	554 555
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer IV. Comparison of the degrees of the mercurial with those of the airthermometer according 	554
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	554 555 555
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	554 555
 II. Elastic force of aqueous vapour in inches of mercury for Fahrenheit's thermometer. III. Elastic force of aqueous vapour in millimetres of mercury for Centigrade thermometer	554 555 555 554

- VII. Correction to be applied to barometers with brass scales extending from the cistern to the top of the mercurial column, to reduce the observation to 32° Fahrenheit . . page 556
- VIII. Correction to be applied to barometers the scales of which are engraved on glass, to reduce the observations to 32°
- X.&XI. Conversion of the gramme and its subdivisions into grains . 562
 - XII. Conversion of millimetres into inches, and inches into millimetres 563
 - XIII. Weights and measures. 563
 - XIV. Boiling-points of water at different pressures . 563
- XVIII. Specific gravity and absolute weight of certain

