X.Y.Z.

[All Pages of Index are Blank]

1.

Pneumatics

Treats of the [M]ature weight, pressure and spring of air
Is a transparent fluid Body
Its particles have no cohesion between
them

It differs from all other Fluids in this
particular that cannot be congealed
or fixed.

A wine quart of air weighs 16 Grains
– a quart of water 14621 Grains
Consequently Air is $\frac{14621}{16}$ = 914 times
in round numbers lighter than water –
near the Surface of the Earth.

The density of the Air is always

2.

as the force that compresses it.
D[r]. Coates has demonstrated, that if altitudes in the Air be taken in arithmetical proportion the rarity of the Air will be in geometrical progression.

	7	Miles	4	times
At	14		16	
	21	above	64	
t	28	the	256	thinner
h	35		1024	
e	42	s	4096	
	49	u	16384	&
	56	r	65536	
	63	f	262144	lighter
D	70	a	1048576	
i	77	c	4194304	than
s	84	e	16777216	
t	91		67108864	at
a	98	of	268435456	
n	105	the	1073741824	the
c	112	Earth	4294967296	
e	119		17179869184	Earths'
	126	the	68719476736	
of	133	Air	274877906944	Surface
	140	is	1099511627776	

[Bud-146]

3.

A cubic Inch of air, such as we breath would be so much rarefied at the altitude of 500 miles, that it would fill a hollow sphere equal in Diameter to the orbit of

The mean pressure of the atmosphere is equal to a Column of 29½ Inches of Quicksilver

A square Column of Quicksilver 29½ In. high and 1 in. thick weighs 15 lbs. which is equal to the pressure of the atmosphere on every square In. of the Earths Surface And 144 X 15 = 2160 lbs. is the pressure on every square foot

The middle size man whose Surface is about 14 square feet sustains a Pressure of 30,240 lbs. when the air is at it's mean gravity.

The Earths Surface contains in round numbers 200,000,000 square miles – each

4.

square miles 27,878,400 square feet there must be 5,575,680,000,000,000 square feet on the Earth's Surface, which X 2160 gives 12,043,468,800,000,000,000 lbs. the weight of the whole atmosphere.

The whole weight of the atmosphere is equal to the weight of a Col. of water 33 fa high. Consequently a Col. of quicksilver 29½ In.

5.

M[r]. Rouse's Table of the Force and Velocity of the Winds

Velocity in miles per Hour	Force on one Foot area in lbs. avoird:	General applications of the force of Winds
1	0.005	Hardly perceptable
2	0.020	Just perceptable
3	0.044	

high is equal to a Col. of water 33 f[t]. high.
In scerene calm weather the air has weight enough to support a Col. of quicksilver 31 In. high; but in tempestuous stormy weather not above 28 Inches.

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4	0.079	
5	0.123	Gentle pleasant Wind
10	0.492	
15	1.107	Pleasant Gale
20	1.968	
25	3.075	Very brisk
30	4.429	
35	6.027	High Winds
40	7.873	
45	9.963	Very high
50	12.300	A Storm or Tempest
60	12.715	A Great Storm
80	31.490	A Hurricane
100	49.200	A ditto that tears up Trees, carries away builds.

Winds are occasioned by the rarefaction of the air by the heat of the Sun at the Equator. The general direction of the Winds at the Equator, is from East to West

6.

– these are the Trade Winds
But the rarefaction of the Equator induces currents of Air both from the North and South Poles which being modified and biased by various Causes, produce all the different winds which we experience – Earthquakes, Volcanoes, Exhalations, great falls of Rain and high Mountains, may be considered as the principal Causes of varying the direction of the Wind.

The atmosphere is composed of 1 Part Oxygen, and 3 parts azotic or nitrogen Gas.

The constitution of Air in the superior Regions of the atmosphere is

9.

Freezing of Water – influence of Salt Water on the Temperature of the Globe – see Buchanan's Tretice on Fuel Pa. 34. and Count Rumford's 7[th]. Essay.

Thurmometers – invention of – see Buchanan on Fuel – Pa 5.

Table of specific Heat Buchannan Pa. 45

Buchanan on Fuel

Water appears to possess the greatest capacity for heat of any pure Liquid yet known – Pa. 48.

The Fuels commonly used may be considered under 5 Divisions – D[r]. Black[ing]

1. Fluid – Spirit of Wine & Oils
2. Peat or Turf
3. Charcoal of Wood.

similar to that at the Earths Surface
– ascertained by M. Guy Lusac

[Page 7 & 8 are Blank]

[Bud-146]

4. Pit Coal charred
5. Wood or Pit Coal in a crude State

10.

Pa.73 The light of a Gas Flame is to that
of an equal size flame of a Candle
or Lamp as 3 to 1. or in other words
one Gas Flame will give as much light
as 3 Candles burning with Flames of
equal size – Count Rumford

2 Pecks of Newcastle Coal weight 36 lbs
Produced
lbs oz
24.. 2 of Coke 3½ lbs. of oily Tar
about 4½ lbs of alkaline Liquor, and
nearly 4 lbs of Gas.

The heat produced in the combustion
of 1 lb of Pit Coal, will make 36.3 lbs of
ice-cold Water boil.

5 ¼ times as much heat as is sufficient
to heat any given quantity of Water – ice
cold – to the boiling point, is required to
reduce that same quantity of Water

[Bud-146]

11.

already boiling hot, to Steam.

The heat generated in the combustion
of 1 lbs of Coal, should be sufficient to
reduce very nearly 7 lbs of boiling hot Water
to Steam – Mr. Watt

Heat generated by Charcoal – see Pa. 80
The quantities of heat generated in the
combustion of charcoal and dry Oak, –
in equal [~~xxxxxxx~~]^<weights – are as 1089 to
600.

It requires 8 feet surface of Boiler
to be exposed to fire, to boil off one
cubic foot of water P. hour – 84 lbs.
Newcastle Coal so applied will boil off
from 8 to 12 cubic feet.

The heat required ^<~~expended~~> in boiling off a
cubic foot of Water, is about 6 times
as much as would bring it to a
boiling heat from the medium temperature

12.

(55) in this Climate.

Where wood is employed as the Fuel
for working Mr. Watt's Engines, he allows
3 times the weight of wood that he does
of Newcastle Coal.

A Bushel of Newcastle Coal which
weighs ¾ Cwt. is reconed to produce
as much heat as 1 Cwt. of Glasgow
Coals.

13.

Radiant Heat Pa. 93.

Measure of the quantity of heat thrown
into a Room, from different sorts of
Fuel ie. by the differential Thermometer.
Pa. 99.

Professor Leslies Experiments on the
radiation of Heat Pa. 100 to 104.

Vessels with polished metalic Surfaces
retain Heat best Pa. 106.

From trials made at Glasgow it
requires just double the quantity of Culm
or Small Coal that it does of Coal to
produce the same heat.
Effects of several kinds of Fuel pro-
ducing Heat Pa. 84.
On the motion of Heat Pa. 85
Conducting Powers of Metals Pa. 87.
Ditto – – – – – – – of Woods – Pa. 89.
Ditto – – – – – Liquid Bodies – Pa. 90.
Affinities – – – – – – – – – – – – – – 91.

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Powers of Metals – rejecting, absorbing
&c. heat Pa. 108.
Effects of encasing heated Bodies P. 115.
Experiment 116.
Measurement of the transmission of
Heat P. 124.
Refrigeration of Bodies in various
kinds of elastic Fluids P. 128

Section VI. Ebullition

Page 131.

Boiling Point of sundry Liquids
P. 132.
When a mass of water is heated
from the bottom ~~has~~ the temperature [~~xxxxxxx~~]^<deminishes>
in arithmetical progression, at the rate
of 1 Degree for every 10 Inches of water
Thus if the temperature is 212^{o}
on the Surface it will be at 10 In.
below, and at 214^{o} – 20 Inches below &c.
Strong Brine will not boil until it
is heated several degrees above the or-
dinary limit Pa. 138.
Gases are those elastic fluids which
cannot be reduced to a liquid state by
condensation, or pressure
A fluid is converted into vapour by
the absorption of Heat.
Steam is always of the same tem-
perature as the water from which it is
raised.

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It requires 6 times as long to boil off
a ^<small> quantity of water as it does to bring
it boil Pa. 143.
Whenever a body is hotter than 212^{o} comes
in contact with boiling water it increases
it's temperature; but when a body colder
than 212^{o} comes in contact with the water
the vapour is condensed
A gallon of ice cold water dashed
into a Steam cylinder will condence 3
hhd^{s}. of Steam, that is cylinder of 3
Hogsheads capacity
A cubic Inch of water forms a cubic
foot of Steam, when equal to the pressure
of the atmosphere at a temperature of
212^{o} – M^{r}. Watt's experiments
A gallon of water in the form of
steam contains as much heat as will
bring 51 gallons of ice cold water to a
boiling heat Black's lectures v.1 Pa 185
A Table of the force of Steam at dif-
ferent temperatures Pa. 147.

16.

Table of the expansion of air Pa. 148.
D°. – – – – – – – – – – – Liquids 149
D°. – – – – – – – – – – – water – 149

Section VII.

Ingition Pa. 150.

Ignition is an effect of the operation of caloric alone, it is wholly independent of the air.

All bodies seem to become ignited (red hot) at the same temperature (Pa 151) it appears to be about 800° of Fahrenheit. A white light is the highest state of ignition

The aeriform fluids are not made luminous by heat.

Heating apartments by Steam Part 2d. Section 1.

Size of Boiler 1 cubic foot of steam will heat 2000 cubic feet of space to a temperature of 70° to 80°

25 cubic feet of boiler is allowed to one horse's power – will heat 50,000 cubic feet of space in a close building.

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17.

According to Boulton & Watts calculation 14 lbs P. hour of good Newcastle Coal will be required for each horse's power of an engine. In this case the furnace &c. must be in perfect order.

One superficial foot of exterior surface of Steam pipe will warm from 200 to 400 cubic feet of space. The Steam in this case is of the same strength as is usually employed in Bolton & Watt's Steam engines viz.about 2½ lbs on the square inch Pa. 163.

Cast Iron pipes expand by the heat of steam about $^{1}/_{10}$th. of an inch in 10 feet length

Section V. Pa. 173 of the several methods of connecting Steam pipes

Iron Cement { 40 lbs of Iron filings
1 d°. – Salamoniac
½ d°. – Sulphur

18.

1 superficial foot of cast iron pipe heats 40 cubic feet of spare to a temperature of 90° – by Steam

N.B. In summer the temperature is sometimes 100° Pa. 210 – 217

The maximum heat to be produced by Steam, where the air is not confined, may be inferred to be 190° Pa. 228.

Heat produced from different proportions of Steam pipe Pa. 229.

Contrivance for measuring the quantity

19.

Mode of ascertaining the capacity of different liquids, or their specific attraction to heat Pa. 262.

Use of the Hygrometer recommended P. 263.

Grain &c. affected by moisture P. 264,

Remarks on evaporation P. 266.

Freezing of water by P. 267.

Specific heat of Gases compared with water P. 270.

Section II.

On heating of Mills &c. by Steam P. 275.

Observations on chimneys P. 277.

of heat produced by fuel. Pa. 234.
One Horses power requires 25 cubic feet of boiler Pa. 246.
One cubic foot of Boiler will warm 2000 cubic feet of space Pa. 247.
Altitudes at which perpetual congelation must commence
Under the Equator at – – – – 15207 feet
In the parallel of 45° – – – – – 7671
In the Latitude of London – – 5950
– – – – – – – – – Stockholm 3818
Towards the pole it comes to g[raze] along the surface.
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Furnaces for Boilers, 279, From &c. of Boilers. P. 282. Various modes of connecting steam pipes P. 284,
Observations on chimney Fire places P. 307.

20.

[Blank Page]

21.

Extracts from Humboldt's Personal Narrative

For the choise of the most proper Instruments to be employed in the distant journies, the degree of precision that can be obtained in the different kinds of observations, the peculiar motion of certain great Stars of the Southern hemisphere, and several methods, the use of which is not sufficiently common among navigators – see Astronomical Observations, two volumes in 4 to.
Equinoctial plants 2. Vol: folio
Monography of the Melastamas, rhexia r. 2. Vol: for
Essay on Geography of Plants.
Collection of observations on zoology, and comparative anatomy
Polilical essay on the Kingdom of new Spain, with physical & geographical atlas founded on astronomical observations, & trignometrical & barometrical measurements.
Views of the Cordilaras, and monuments of the indigenous nations of the new continent
Page 20. according to the traditions of Samothracians and other historical testimonies, according to which it is supposed, that the eruption of the waters thro' the Dardanells, augmenting the basin of the Mediterranean, rent and overflowed the southern part of Europe. The draining of the waters by the straights of Giberalter, brought the Mediterranean progressively to it's present

level, while lower Egypt emerged above its surface on the one Side, and the fertile plains of Tarragona, Valencia, and Murcia on the other

Between the Baltic and the Black Sea the ground is at present scarcely fifty toisis above the level of the ocean.

Page 45. The current which is felt between the Azores, the Southern coasts of Portugal, and the Canary Islands, is commonly attributed to that tendency towards the East, which the straits of Gibralter impress on the Waters of the Atlantic Ocean. M. de Fleurian, in notes to the voyage of Cap: Marchant, observes, that the Mediterranean losing by evaporation, more water than the rivers can supply, causes a movement in the neighbouring ocean, and that the influence of the Straits is felt at the distance of six hundred leagues.

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22.

Pa: 47. The equinoctial current is felt, though feebly, even beyond the tropics of Cancer, in the 26 & 28 degrees of latitude

More to the North under 28 & 35 degrees between the parallels of Teneriffe and C[euta] in 46 & 48 of Long: no constant motion is observed; there, a Zone of 140 degrees in breadth separates the equinoctial Current, the tendency of which is towards the West, from that great mass of water which is towards the East and is distinguished for its extraordinary high temperature. This mass of waters, called the Gulf-Stream, took the attention of Franklin & Blagden in 1776.

The equinoctial current drives the Waters of the Atlantic towards the coasts inhabited by the Mosquito Indians, & towards those of Honduras. The new Continent stretching from N. to South forms a sort of dyke to this current. The Waters are at first carried to the North West, & passing into the Gulf of Mexico through the Straight which is formed by false cape. And S[t]. Antanio, follows the bendings of the Mexican Coast, from Vera Cruz to the mouth of the Rio del Norte, and thence to the mouths of the Missesippi and the shoals to the West of the southern extremity of Florida

Having made this vast circuit to the West, the north, the East and the south, the current takes a new direction towards the North, and throws itself with impetuosity into the gulf of Florida

23.

The Waters of the gulf Stream preserve their warm temperature to such a point that at 40 & 41 deg: of l;at Humboldt found them at 22.5^{o} when out of the current, the heat of the ocean at it’s surface was scarcely 17.5^{o} Consequently in the parallel of New York & & aports the temperature of the Gulf Stream, is equal to that of the Seas of the Tropics in the 18th degree of latitude; as for instance in the parallel of Porto Rico, & Cape Verd Islands.

In the Lat: 41o.. 25’ and 67 Lon: the current is nearly 80 Leagues broad. From this point it turns suddenly to the East. and skirts the great bank of Newfoundland. The cold Waters of the Bank according to Humboldt are at the temp: of 8^{o}..7” to 10^{o} which present a Strong contrast with the Waters of the torrid Zone, driven to the N. by the Gulf Stream, the temp of which is 21^{o} to 22.5^{o} thus the waters of the Bank are 9.4^{o} colder than the neighbouring Sea; and this Sea is 3^{o} colder than the current. On the meridian of the isles of Corvo & Flores – the most Western of the Azores the breadth of the current is 160 leagues. At the 33^{d} degree of Lat: the equinortial Current of the tropics is in the near vicinity of the Gulf Stream. In this part of the ocean we may pass in a single day from water which flows towards the West to observed there in the month of May 1804 in the 26 & 27 degrees of latitude, a velocity of eight miles in twenty four hours, or five feet P. second. At the end of the gulf of Florida, the gulf Stream runs to the N.E. with the rapidity of a torrent, and is sometimes five miles an hour.

The water of the gulf Stream is known by it's elevated temperature, it's strong saltiness, indigo blue colour the great quantity of Sea weed which cover the surface, and the heat of the surrounding atmosphere. It's rapidity diminishes towards the N. at the same time that it's breadth increases. Between Cayo Diseaio, & the bank of Bahama the breadth is only 15 leagues – in lat 28½^{o} it is 17 Leagues and in the parallel of Charlestown opposite Cape [Henlepen] it it is from 40 to 50 leagues. Where the Stream is narrowest the rapidity of the current is from 3 to 5 miles an hour, and is only one mile an hour as it advances towards the North.

[Bud-146]

those which run to the S^{o}. E. or E.S.E.

Pa. 86. Acording to the experiments of Bouguer, light is weakened after a passage of 180 feet, in the ratio of 1 to 1477.8

Pa. 92. Two kinds of sand cover the shores of the Island of G[raicosa] one is black basaltic, the other is white & quartzose – the temperature of the first was 51.0^{o} that of the latter 40^{o} the temperature of the air in the Shade was over the Sea 27.7^{o} or 7.5^{o} higher than that of the air over the Sea.

P. 99. According to observations of Gen^{l}. Roy the refractions in England vary from $^{1}/_{12}$th. to $^{1}/_{3}$. in the atmos:

Pa. 103. Micrometrical observations have proved that the limit of vision is but a minute only, when the dimensions of the objects are the same in every direction

Pa. 103. Without attending to the refraction, the Peak of Teneriffe (1004 toises) is visible at 1^{o}..57'..22" Mount Blanc (2440 toises) at 2^{o}..13 and Chimboraze (3350 toises)

24.

at 2..35'..30". the mean refraction supposed to be 0.08 augments this distance, as to Chimboraze, only fourteen miles.

Pa. 106. According to Bouguer, the intensity of the aerial colour which is reflected by the whole of the Atmosphere towards the horizon in a determinate direction is equal to 0.2575

Pa. 129. Limit of perpetual Snows. Snow sometimes falls as low as 37^{o} of Latitude

Pa. 158. Cirsious phenomenon the images of stars magnified by the Vapours of the Atmosphere.

Pa. 159 Rising of sun observed from the peak of Teneriff – curious.

Pa. 197. Enquiry as to the formation of Volcanic mountains

Pa. 202. Slender peaked mountains of a Conical form are are those which are still subject to violent eruptions, and at the nearest period to each other. Those with lengthened summits, and rugged with small stoney masses, are very old Volcanoes and near being extinguished. Those with rounded tops in the

25.

The peak of Teneriffe belongs to that group of Volcanoes, which like Etna, and A[ntisana], have had morecopious eruptions from their sides than from their Summits.

Pa. 217. Obsidian, Jade, & touchstone have been substituted for iron by Nations unacquainted with that metal – Obsidian vitrified Lava.

Pa. 261. In the island of Teneriffe five Zones of plants are at present exhibited. viz. the region of Vines – Laurels, Pines – Retama and Grasses.

	Feet In.
1 Toise =	6 .. 4.736
1 Foot (fie du roi)	12.789
1 Metre – – –	3 .. 3.371

Height of the Peak of Tenereffe taken by

Borda – Trigonometrically	– 1965 Toises
Lamanon Barometrically	– 1902
Cordier – – – – – – – – – – –	1920
	5727
Mean – – – – – –	1909

form of dorries, or bells, indicate those problematic Porphyries, which are supposed to have been heated in their primitive place, penitrated by Vapours, and forced up in a softened state, without having ever flawed as real lithoidal lavas.

Pa. 203. A mor exact idea may be formed of the structure of Volcanoes, by comparing the perpendicular height with the circumference of their bases. The circumference of the Peak of Teneriffe is 54000 toises – it's height is $^{1}/_{28}$th. of it's circumference.

The mean Slope or ascent of the Peak of Teyde is 12°..29' Vesuvius 12°..40' and Etna 10°..13'

Pa. 205. In France the High Roads must not exceed 4°..46' of slope – by Law. 15° Slope, extremely steep and cannot be descended in Carriages. 37° Slope almost inaccessible on foot. The body falls back when the libia makes a smaller angle than 53° 42° the steepest slope that can be climbed on foot, in a ground that is sandy or covered with Volcanic ashes.

[Bud-146]

From Mills's "Simple equation of Tithes" about the year 856 King Ethelwolf granted one tenth of the estimated produce of the lands in England to the Roman Catholic Clergy. Was transferred by Henry 8th. to to the protestant Clergy. – the Tithes were held Seven hundd. years by the Catholic clergy.

Tithes are divided into three classes viz. Personal, Predial, and mixed.

	Acres
According to the late trigonometrical Survey England & Wales, contains – – – – – – –	38,000,000
Deduct for uncultivated Lands, Wastes, Roads &c. as stated by Mr. Colqueum – – – – – – –	6,714,400
	31,285,600

26.

	Acres
According to Mr. A Young, there are in Corn cultivation – supposing on an average the four field System to be practiced	16,695,630
The titheable Corn Land is estimated at –	16,355,630
Ditto – – – – Grass do. – – – – – – – – – –	14,249,970
	30,605,600

It appears according to Dr. Beeke and others that it is necessary in these times for Farmers to make 5 Rents – to enable them to pay Rent, Taxes, Tithes & all out goings & to remunerate them for their trouble.

Mr. Buston of Essex, says a Farmer ought to make six Rents, on the 4 field husbandry

The Revd. Th. Rudge, in his view of the agrecu[lture] of Glocester – reckoned wheat at 8/- P. Bushel, that the Farmer should make on the

Three field Husbandry – – – 5 Rents
4 field do. – – – – – – – $5\,^{2}/_{5}$ –

27.

the population has increased to 10,000,000 inhabitants

	Quarters
Mr. Arthur Young estimates the yearly consumption of Wheat, in Engd. & Wales at	9,347,597
In 1801 the importation of Wheat and Flour, was – – – – – – – – – – – – – –	– 1,396,360

Equal to Weeks consumption

All the Corn which we have ever yet received from America in <u>one year</u>, does not equal twelve day's consumption

The Tax upon Seaborne Coal is **5/4** P. Ton

[Pages 28 to 31 are Blank]

9 field d^o. – – – – – – – 7 –
6 field d^o. Cotswold – 5½ –
A Dairy Farm – cheese at 63/- P. Cw^t. 4 Rents
Church Livings in England and Wales viz

Rectories – – – – –	5124	Royal Presentations	1083
Vicarages – – – – –	3636	Ecclesiastical d^o. –	2352
Existing Curacies –	1231	Universities – – – – –	701
	9991	Laymen – – – – – –	5855
			9991

In the year 636 when Bishop Honerius divided England and Wales into 9284 Parishes, the population was estimated at 2,000,000 inhabitants – the number of Priests have remained stationary; but

[Bud-146]

Specifications for an Iron Steamer by M^r. Coutts. – November 1841.

Description and Specification of an Iron Steamer, designed as a first Class Mail Packet of the most approved Proportions in her Dimensions, and admirably admirably adopted for the Conveyance of Passengers, and would, from the fineness of her lines, and the Great Power of her Engines be the fastest Vessel Afloat.

Dimensions

Length between Perpendiculars 215 Feet
Depth within Paddles. – – – – – 28 –
Depth of Hold – – – – – – – – – – – 12½
Draught of water with days Coal5 ft. 6 In. to 6 Feet.

Frames and Ribbs

The Iron Ribs to be 18 Inches apart, and formed of Angle Iron 3 Inches on the side, to one of the sides of which will be rivetted a piece of Boiler Plate $^5/_{16}$ In. thick and 9 In. broad at the Floors, and decreased to 6 Inches at the top sides, – to have a Flange 3 Inches broad turned on its inner edge – the Ribs to

around the Gunwale, and the reversed Boiler Plate Angle Iron bent inwards with a curve to meet the ends of the outer Angle Iron.

Beams.

To have Hold & Deck Beams 3 Feet apart from Centre to Centre, formed of two pieces of Angle Iron turned back to back, 2½ Inches on the side, and a piece of $^3/_8$ In: Boiler Plate Angle Iron 2½ In: by 7½ In: rivetted in between them, the upper end of the 7½ In: Flange of the Angle Iron to project 1½ In: above the tops of the enclosing pieces of Angle Iron, and let into the Deck Planking a like distance, the ends of the said Boiler plate and angle Iron to come down the Ship's side for at least 2 feet 6 Inches, and the webs of the 7½ & 6 Inches Angle Iron Rivetted together, as well as the enclosing Angle Iron of the Beams, and the outer Angle Iron of the Ribs – the 7½ & 6 In: Angle Iron Constituting strong vertical Knees, and the be bent inwards for at least 18 Inches all

[Bud-146]

outer Angle Iron of the Ribs & Stringers,
vert horizontal ones. The whole securely

[35]

fastened to the Ship's sides and to each other.
These said Beams to be bent to the Curve of
the Decks.

Stringers

To have 2 Iron Stringers running the
entire length of the Vessel, composed of $^5/_{16}$
In: Boiler plate in the Shape of angle Iron
1 Foot by 1½ In: rivetted to the top sides of Deck
and Hold Beams. The 1½ Inch Flange to be
turned upwards and let into the Deck-
Planking, and into a wooden Stringer at
the Hold Beam all their depth.

Paddle Beams

To have 2 Paddle Beams 12 X 15 Inches,
formed by 4 Bars of 2 Inch Angle Iron, and
the like number of pieces of $^3/_8$ In: Boiler-
Plates securely rivetted together.

Hold-Stancheons

To have Hold-Stancheons formed of
4 Inch Circular Malleable Iron Tube $^3/_8$
Inch thick – to have Angle Iron bent round
the tops and bottoms of the Stancheons 3½ X 2 In:
for securing the Stancheons at Top & Bottom

Water-yight Bulk Heads

To have 5 Water tight divisions in the
length of the vessel, going right athwart-ships
formed of 3½ by 2½ In: Angle Iron standing
in a Diagonal Direction, or at an Angle of

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[36]

45^o to the water lines of the Vessel. These
Angle Iron Bars to stand at right angles
to each other, viz: the one half inclining
towards the Starboard, and the other
towards the larboard sides, to be turned
Back to Backs, and Boiler Plate ¼ In:
thick to be securely rivetted in between
them. These Angle Iron Bars to be about
3 ½ Feet apart, securely rivetted to the
Beams, Ribs, and Floors of the Vessel,
and the platings to have proper Weltings
&c. at the Joints. One of these Divisions
to be made, between the Engines and the
Boilers.

Keel

To have a hollow Keel 9 In: by 6 formed Keel
of $^5/_8$ Inch Boiler Plate.

Stem and Stern Posts

To have a Sterm & Stern Post formed of
the same thickness of Metal, the Stern-
post to be bent in a Hollow form to
embrace the Rudder Post. The Stem, or
Iron Cut Water to go up as high as the
level of the Decks at the Bow of the Boat,
and formed so as to receive a proper
Figure Head.

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Outside plating

The Floors of the Vessel to be plated with $^3/_8$
Inch – the bends with $^7/_{16}$, and the top ^<sides> with
$^5/_{16}$ Inch Boiler Plate. The whole to be [jump]
or flush-jointed with Weltings 4 In: broad,
and of a thickness equal to the respective
plates to which they are attached.

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Hold Bracings

To have Diagonal Hold Bracings formed of
T Iron of the same section as that employed
for the Decking Bindings, the upper part of
the **T** securely rivetted to the Angle Iron
Ribs, and the vertical let into the
Wooden Ceiling in the same manner as

The Horizontal Weltings to run in length not under 15 Feet, and the Vertical Weltings to be properly scarfed under them – to have proper Iron fillating between the Ribs & Plates in the interstices between the Horizontal Weltings, – the whole of the Plates where Counter-sunk holes on the outside, for the reception of <u>flush</u> Rivet Heads.

Diagonal Bracings.

To have Diagonal Deck Bracings formed of **T** Iron 1½ In: each Web by $^{3}/_{8}$^{ths}. In: – the top of the **T** to be turned downwards and securely fastened to the underside of the Deck Planks by means of Screw Bolts, and the vertical leg of the **T** to be let into the Deck Plankings all its length. These Diagonal to be securely fitted Rivetted, or Bolted to the Deck Beams and Ribs of the Vessel.

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proposed for the Deck Bracings. these Hold Diagonals to stand at an angle of 45^{o} with the line of the Keel, and are to be about 5 Feet apart, and are likewise to change their line of direction at certain lengths of the Vessel – viz: say for 20 Feet these may run from right to left, and then from left to right for other 20 Feet, and so on alternately, properly secured so as to form an Arch, or Couple, where they change their line of direction.

Bulwark <u>Stancheons</u>

To have hollow Iron Bulwark Stancheons securely rivetted to the Dock Stringer Ribs, and Dock Beams – to these Iron Stancheons, wooden ones are to be attached and to them the wooden wash-Board Bulwarks and Rails are to be fixed.

<u>Waterways</u>

The Wooden Water-Ways to be 6 In: thick projecting 2 to 3 Inches over the Outside of Iron Work, and securely fastened to the Deck Stringer, Beams, and Ribs – the 1½ In: Flange of the Deck Stringer is to be let into the Water Way, all its length.

<u>Decks</u>

The Decks to be laid with 4 In: Yellow Pine Deals, and not to exceed 4 Inches in breadth, to have an Iron Slip-Feather or Hoop 2 Inches Broad, & $^{1}/_{8}$ In: thick let in betwixt the Joints, halfway into each adjoining Deck Deal, and the Grooves filled, with liquid Tar prior to the insertion of the Slip Feather, and fixing the Deck-Deals, in their proper places. The Deck Deals to be securely fastened to the Iron Beams, and Diagonal Bracings by proper

<u>Saloon</u>.

This vessel can admit of a Saloon 40 Feet long finished with pannelling Rosewood, Oak, or Mahogany work, French-polished and fitted round with hand-some Sofas covered with Crimson velvet with proper carpeting and Ornamental Cabinet, and Upholstery work in Keeping.

Ladies' <u>Cabin</u>

Also a Ladies' Cabin 20 feet long & 14 Feet wide, fitted up in the same manner as the Saloon, with Dormitories or Sleeping Berths for 10 Passengers.

Gentlemens' <u>Dormitories</u> <u>State Rooms</u>

The Gentlemens' Dormitary or Cabin may contain 12 Berths with 10 State Rooms with Berths in each. all fitted up with Sofas & Marble wash-hand Basins.

Bath Room <u>&c &c</u>

May have 3 water closets for Cabin Passengers, fitted up with Patent Water Apparatus, with Bath Room, Steward's

Screw Bolts from the underside.

Rail and Bulwarks

To have a neat Moulded Rail of American Elm and Pannelled Bulwarks on ~~each~~ ^<both> sides, and painted on the Inner-side to represent Grained wood works.

Gilded Stripe

To have a hollow Gilded Stripe moulded along the Centre of projecting waterway, 4 In: broad.

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Glass & Spirit Rooms, &c &c &c.

Fore Cabin

The Fore Cabin may be 45 Feet long, richly pannelled and painted to represent Rosewood or Oak, and proper sleeping Berths for 20 Passengers, and 9 private Berths for Female Passengers.

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Fore-castle

The Fore-castle may be 19 Feet long, and fitted up with Berths for the Seamen, Firemen, & Stokers. To have 10 Deck Houses for the accommodation of Officer Engines &c.

Cook Houses

To have proper Larders & Cooking Houses on the most approved principles the whole fitted up and finished in the first rate style of Workmanship and Design.

(Engines.)

To have 2 Engines of 130 Horse Power each.

Diameter of Cylinder – – – –	63 Inches
Length of Stroke – – – – – – –	6 Feet
Diameter of Air Pump – – –	39 Inches
Length of Stroke – – – – – – –	4 Feet
Diameter of Paddle Wheels	25 –
Length of Float Board – – –	10 –
Breadth of Float Board – – –	2 –

The Engines to be of the Kind called Tower or Steeple Engines, with Metallic Packed Pistons, Brass-Lined Air-Pumps & Rods, with Brass Brackets, Valves, &c. To have wro^{t}. Iron Shafts, Cranks, Cross-heads, Eccentree-Rods &c. – the whole of these Shafts, Cranks,

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<With Cylinder & Air pump Covers & Stuffing Boxes covers and Malleable Iron Connectors –>

Eccentric Rods, Cross-heads, Valve Pearing &c ^ to be bright polished work, and finished in all respects in the most efficient & Superior Style of workmanship, and fitted with expansion Valves and Connecting Gearing

Boilers.

To have 3 Boilers 25 Feet long and measuring Athwart-Ship 25 feet 4 Inches. – To have 12 Furnaces 1 F^{t}. 9 In.: wide & 7 F^{t}. 6 In: long of Fire Bar. The Centre Boiler to measure, across, 8½ Feet, and the side or Wing Boilers to measure 8 Feet 4 Inches each. The Outside Shell of the side or Wing-Boilers to be of a Curvalinear form except where the joining to the Centre Boiler takes place, at the Smoke and Water Joints, where they will be a Straight Surface, and 8 Feet 6 In: High. – the Centre Boiler to be Flat on the sides to the height of the Wing Boilers, or 8 F^{t}. 6 In: And there to rise 3 feet 6 In: with a Semi-elliptical Curve.

Furnaces

The Furnaces and Flues to the first turning to be $^{3}/_{8}$ Low Moor Boiler Plate.

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Flues & Shell.	The rest of the Flues, Take-ups, Shell. Steam-Chest &c. to be of $^{3}/_{8}$ In: best Crown Plate, except the bottoms and for 2 Feet up the sides of Shell, which will be of $^{7}/_{16}$ In: Crown Plate, and the said $^{7}/_{16}$ In: Plate to be double rivetted. The whole of the Flat sides of the Flues to be properly stayed and fastened together, and to have 6 Stays of 1½ In: Round Iron Across the Boilers from one side to the other, about 6 Inches above the tops of the Furnaces.
Mountings	To have proper Water & Mercury Gauges and Glass to each Boiler. To have Safety and Stop-Valve to each Boiler – these Valves so connected, with the Steam Chest, that either of the Boilers may be detached, while the other are working, at pleasure. To have a proper Smoke Funnel and Copper Waste, Steam, and Feed Pipes, and the whole fitted up in an efficient and working order.
Coal-Bunkers	To have Coal-Bunkers fitted to the tops and sides of each Wing Boiler, composed of N^{o}. 15 Wire-Gauge Plate, and 1½ In: Angle Iron with proper intake and discharge Doors, and Capable of stowing 160 Tons of Coals.

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Water Tanks	and should that quantity be insufficient for the length of the Passage, a Coal store to be constructed in front of the Boiler for say other 300 Tons, making in all 460 Tons – sufficient store foe a Voyage of 8000 Miles without renewal.
	To have Iron Water Tanks fitted into the Bow and Stern of the Vessel, having a number of small Divisions in each, Connecting with a HeadPump – One of those Divisions to be completed before another is broached, in order to prevent a Shake in the vessel when in motion. Thes two Tanks to be Capable of containing 10 Tons of Water.
Rudder	To Have an Iron compensation Rudder formed of three plates of Metal, one to slide, in between the other two, and to be formed so as to admit the Centre one to be extended beyond the Outer line of the General Rudder of the load Water line, and by that means offer a greater surface of the Rudder to the Action of the water, at pleasure.

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Wheel	The Rudder to be fitted with a Steering Apparatus and Wheel, in the most approved and efficient manner.
Compasses	The Vessel to be provided with two Binnacle Compasses, corrected for the vessel agreeable to the directions laid down by Professor Airey Astronomer Royal, Greenwick.
Windlass Chains &	To have a Patent Windlass, Capstan, and Winch, with Anchors and Chains agreeably

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	fastened to the Bracings and Ribs of the vessel by proper Screw Bolts.
Sponsons	The vessel to have proper Iron Sponsons 6 X 12 Inches, formed by 4 Pieces of 2½ In: Angle Iron, and a like number of Plates of $^{3}/_{8}$ In: Iron, securely rivetted together, and to the Paddle Beams, and sides of the vessel.
Paddle Boxes	To have proper Paddle Boxes formed

Anchors to Loyd's regulations for a twelve Dears Ship of equal Tonnage.

Guns. To Carry a long 32 [ld] Swivel forward, and a 24 [ld] Carronade Aft – both Guns to move on proper horizontal Iron Carriages.

Breast Hooks To have 2 Horizontal Breast Hooks, formed of 2½ Inch, Angle Iron and $^3/_8$ In: Boiler Plate, extending backwards from the Bow of the vessel about 3 Feet.

Ceiling The whole of the Hold (except such part as may be Occupied by the Boilers to be ceiled with 2½ Inch American ^<Elm> Planking – the vertical leg of the Diagonal Bracing to be let into the ceiling Planks, its entire depth – and the whole ceiling to be securely

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of Baltic Red Pine, and fitted up in a sufficient and workmanlike manner.

Kelsons To have 5 Pitch Pine Kelsons 15 X 9 Inches – One running the entire length of the Vessel, and the other 4, all the length of the Engine and Boiler Rooms, securely fastened down to the Iron work of the vessels Keel and Floors.

Rigging To have 2 Masts, with Mizzen, Out-rigger, Bowsprit, Jib-boom &c. with Spars and Rigging as a Schooner in the usual manner.

Cost

The Hull of the Vessel before Specified, with masts, Spars, Rigging, Chains &c. – and without Saloon, Cabins, Dormitories, or any of the Fittings connected there with will Cost – – – – – – – – – – – – – – – £11080

Engines & Boilers in complete Working order – – – – 9800

Coal Bunkers – – – – – – – – – – – – – 100

In short the vessel Completely fitted out for Sea, without the Cabins, or work connected therewith (as that can be executed much cheaper in France than in England) for the Sum of £20980.

Should the Government seriously intend going into a Contract for such a Vessel, general and detailed Drawings of the vessel and Engines will be furnished, but as the getting up of these is attended with considerable Expence the Government

But in the event of an order being given no charge will be made for Drawings, Models &c. Any explanation of the foregoing Specification that may be wanted, will be readily given by referring to the particular Paragraph which may not be quite intelligible.

Such a Vessel as have before specified would be Capable of proceeding to any part of the World, and would possess numerous advantages over Wooden Vessels. Some of these advantages consist of

1. The Iron are cheaper as to the original Cost.
2. They are Kept up & worked at less Expence.
3. They are more safe or less Hazardous.
4. They Sail much faster.
5. They will last for a much longer period.
6. They Carry a larger Cargo at a less draught of Water.

must pay a Certain Sum for the Drawings
which will then become their own Property.

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In reference to Cheapness of Original Cost, A Steam Vessel of 840 Tons, constructed of wood the Hull, exclusive of Machinery, would Cost on the lowest Calculation £19 P. Ton = £15960

Coppering and Copper – – – – –	1050
	£17010

Whereas the Hull of an Iron Vessel of the above Tonnage, and as per Specification may be built for £12 Per Ton, Amounting to the Sum of £10,080 – difference £6930

A wood Steamer of the above size from it's great draught of Water & displacement on Account of the weight & dimensions of the Hull, which on the Average is 40 Per Cent more than Iron, will require at least and additional power of 60 Horses, which at £40 Per Horse Power would make a Sum of – – – – – – 2400

Leaving a Balance in favour of Iron, on the original Cost of the Hull of – – – – – – – – – – – – – – } £9330.

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In reference to the Cheapness of working Charges 1st. Diminution of the Power of the Engines in favour of Iron say 600 Horse Power, making a saving on the Article of Fuel alone of £1350 Per Ann: supposing the vessel to run 200 days during the Year. This Item is made as follows viz: 7 lb. of Coal per Horse power 7 X 60 X 24 = 11,080 ÷ 112 ÷ 20 = 4½ Tons And 4½ Tons X 200 = 900 Tons @ 30/- P. Ton = £1350 Per Annum.

Supposing According to Calculation of expence in Coppering say £1050 – lasting 3 Years, will make a difference of in favour of Iron of £300 P. Annum. allowing £150 for old Copper, and the expence of replacing it with new.

Interest on Original Cost.

Say wooden Steamer – – –	£17000 -	£850
Intt. on difference in Machinery	2400 -	120
– differ Coal £1350 at 2½ P. Cent – –		34
Intt. on Copper – – – – – – – – – – – – –		15
		1019
Interest on Original Cost of Iron Steamer £10,080 – –		500
		£519

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Annual saving in Fuel – – –	£1350
– ditto Interest of Money –	519
	£1869

More Safe less hazardous. This Iron Steamer is safer than any wooden Vessel.

In the first place she is Fire Proof, and

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Water equal to the buoyancy of that division only, the other divisions remaining buoyant as before, thereby enabling her to proceed on her Voyage without delay.

Sailing much faster. In the first place they displace and draw less Water –

when properly Constructed and arranged, according to the foregoing Specification, is a Perfect Life Boat. Should a vessel so constructed Strike upon a Rock or other substance the damage must be local – that is limited to that part of the vessel which comes, in contact with the opposing body, Consequently is easily repaired, whereas a wooden Vessel under similar Circum-stances, would not only receive the local damage, but would open her Seams from Stem to Stern.

Suppose the Iron Vessel constructed with 5 Water-tight Divisions – should she strike upon a Sharp pointed Rock, or other substance capable of penetrating her bottom, she would sink in the

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can be constructed much finer in the entrance and the run, from the strength of the Materials requiring only $^{1}/_{10}$th. of the Dimensions necessary for wooden vessels. Second, the flexibility and Elasticity of Iron compared with wood must shew the superiority of the former over the latter as a building materials, it having been well ascertained that the slight and flexible wooden Ships are the fastest Sailers, and vice versa – whereas Iron Vessels possess greater strength than a Stiff wooden Ship, and greater flexibility than a slight one.

Can[y] a larger Cargo at less Draught

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of Water. The difference between the thickness of the Floors and planking of an Iron and wooden Vessel of the size referred to, will be 20 Inches, and throughout the vessel in the same proportion, giving her much more Capacity for stowage.

Difference in Draught of Water between the Iron Steamer, and one of the same Tonnage, of wood, would be at least 3 Feet.

In reference to Durability. Not as yet having heard of any Iron Steamer being worn out, we cannot directly state how long they will last – but, from the examina-tion of Examples now afloat, and which have been for Sears in the Water, and scarcely any symptoms of any Decay being visible – And from the Experiments lately made, and at present in the course of Investigation, by the

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It may be necessary, in addition to the fore-going Remarks, to state how advantageous Iron Steamers may be used as Vessels of War, And we have only to refer to the various actions in which they have been engaged – more particularly ^<to> the Nemesis, which will be seen by the Annexed Extract from the Public Prints, has shewn a decided superi-ority over the Wooden Steamers sent out to the Chinese Sea – having been in all the Engagements – often Grounded, while all the wooden Steamers have been sent to Calcutta or Bombay for Repair, the Nemesis continues afloat, and as fit for service as the first day she entered

British Government, as to the Durability of Iron vessels compared with Wooden Ones, we may reasonably infer that they will last three times as long as wooden ones.

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the Chinese waters.

Should the French Government deem it proper, a Specification for a War Steamer could be furnished of any Dimensions required. –